Plant Community Classification and Mapping Project: John Muir National Historic Site (Mt. Wanda)

September 2004

Prepared by:
Susan O'Neil, SFAN I & M Natural Resource Specialist
&
Stefanie Egan, Biological Science Technician - GIS

Table of Contents

SUMMARY **3**

1. BACKGROUND **4**

1.1 INTRODUCTION 4
1.2 STUDY AREA 5

2. METHODS **8**

2.1 AERIAL PHOTO ACQUISITION 8
2.2 AERIAL PHOTO INTERPRETATION AND POLYGON DELINEATION 8
2.3 RAPID ASSESSMENT AND VEGETATION CLASSIFICATION 9

3. RESULTS AND DISCUSSION **10**

3.1 VEGETATION MAP 10
3.2 CLASSIFICATION 11
3.3 INVASIVE SPECIES 12
3.4 RECOMMENDATIONS FOR FUTURE WORK 12

4. LITERATURE CITED **14**

5. KEY TO PLANT COMMUNITIES **16**

DIVISION A- HERBACEOUS VEGETATION 16
DIVISION B- SHRUB VEGETATION 17
DIVISION C- TREE VEGETATION 18

6. VEGETATION COMMUNITY DESCRIPTIONS **20**

A. HERBACEOUS PLANT COMMUNITIES 20
B. SHRUB DOMINATED PLANT COMMUNITIES 23
C. TREE DOMINATED PLANT COMMUNITIES 26

Appendices

CNPS Rapid Assessment Field Form 36
FDGC Metadata 38

Maps

Figure 1 45
Figure 2 46
Figure 3 47
Figure 4 48
Figure 5 49
Figure 6 50

Summary

This report describes the work conducted at the John Muir National Historic Site in 2004. The John Muir National Historic Site (JOMU) is located in Martinez, Contra Costa County, California. Data on the vegetation of Mt. Wanda was gathered using the rapid assessment field method as developed by the California Native Plant Society (CNPS). . A formal site-specific classification using ordination was not performed and the plant communities are not fully described. Vegetation communities were delineated for the Mt. Wanda sub-unit of the John Muir National Historic Site in the summer of 2004. A total of 13 alliances and 18 associations were identified in the study area. These 13 alliances represent 7 formation types and 4 classes: forest, woodland, shrubland and herbaceous vegetation. CNPS, California Fish and Game, and NatureServe will use these data in conjunction with other agencies and vegetation mapping projects in the San Francisco Bay area to more fully develop plant community classifications specific to the area. The vegetation map resulting from this project will be used by the National Park Service (NPS) to assist with park and Network management activities and research.

Acknowledgements:

This project is the first attempt to classify and map the vegetation communities at the Mt. Wanda unit of the John Muir NHS (JOMU) at a fine scale. The San Francisco Bay Area Network (SFAN) Inventory and Monitoring Program provided the funding and staff to implement this project. The Network Natural Resource Specialist, Susan O'Neil, provided project management and collected the field data with the help of biologists from Point Reyes National Seashore. Stefanie Egan compiled and analyzed all GIS data from the first delineation to the final vegetation maps. She also managed the database and provided assistance in the field as needed. Dave Schirokauer, GIS Biologist at Point Reyes National Seashore, provided guidance on methodology, data structure and GIS analysis. He and Sarah Allen, NPS Science Advisor, reviewed the final report and maps.

1. Background

1.1 Introduction

The United States Geologic Survey (USGS) and the National Park Service (NPS) formed a partnership in 1994 to map and classify the vegetation of the United States' National Parks using the National Vegetation Classification, the standard adopted for reporting vegetation information among federal agencies (Grossman *et al.* 1998). Goals of the project include providing reference 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 generally follows a standardized field sampling and data analysis regime to document the parks' plant communities. This report describes the work conducted at the John Muir National Historic Site in 2004. The small size of the Mt. Wanda area is such that several steps were skipped or done slightly differently than outlined in the USGS-NPS vegetation mapping program (USGS 1994).

Data on the vegetation of Mt. Wanda was gathered using the rapid assessment field method as developed by the California Native Plant Society (CNPS). Due to the small size of the study area and few plant communities, the releve method was not used. Two digital aerial photographs were used to delineate vegetation polygons: one color photograph taken in March of 2003 at 1:24,000 and one black and white photograph taken in May of 2000 at 1:20,000. The rapid assessment data helped to refine the polygon boundaries as the project progressed. The rapid assessment data were also used to develop a coarse plant community key. A formal site specific classification using ordination was not performed and the plant communities were not fully described. CNPS will use the data in conjunction with other agencies and vegetation mapping projects in the San Francisco Bay area to more fully develop plant community classifications specific to the area.

The final products consist of digital and hardcopy vegetation maps at two different levels in the National Vegetation Classification Standards, a draft field key with some descriptions of the plant communities, a final report, and metadata. A formal accuracy assessment was not performed, as all polygons were confirmed using the rapid assessment field method and/or mapped using GPS in the field.

The U.S. National Vegetation Classification (USNVC), developed by The Nature Conservancy (now NatureServe) and the Association for Biodiversity Information, in partnership with the network of Natural Heritage Programs, was used to classify the vegetation in the JOMU study area. A first edition of the classification has been released that provides a thorough introduction to the classification, its structure, and the list of vegetation units known from the United States, as of April 1997 (Grossman *et al.* 1998). The classification is a hierarchical system with physiognomic features at the highest levels of the hierarchy and floristic features at the lower levels determining group membership. The physiognomic units have a broad geographic perspective while the floristic units have local and site-specific perspective (Grossman *et al*. 1998).

The physiognomic-floristic classification includes all upland terrestrial vegetation and all wetland vegetation with rooted vascular plants. The USNVC hierarchy has seven levels, with five physiognomic levels and two floristic levels (Table 1). The basic unit of the physiognomic portion of the classification is the "formation," a type defined by dominance of a given growth form in the uppermost stratum and characteristics of the environment (e.g., cold-deciduous alluvial forests). The physiognomic portion of the classification is based upon the UNESCO world physiognomic classification of vegetation (1973).

The floristic levels include alliances and associations. The alliance is a physiognomically uniform group of plant associations that share dominant or diagnostic species, usually found in the uppermost strata of the vegetation. For forested types, the alliance is roughly equivalent to the "cover type" of the Society of American Foresters. Alliances also include non-forested types.

The association is the lowest level in the national classification. The association is defined as "a plant community of definite floristic composition, uniform habitat conditions, and uniform physiognomy" (see Flahault and Schroter 1910 in Moravec 1993).

Table 1. The USNVC's Physiognomic-floristic Hierarchy for Terrestrial Vegetation (from Grossman et al. 1998)

Level	**Primary Basis For Classification**	**Example**
Class	Growth form and structure of vegetation	Woodland
Subclass	Growth form characteristics, e.g., leaf phenology	Evergreen Woodland
Group	Leaf types, corresponding to climate	Winter-rain Evergreen Sclerophyllous Forest and Woodland
Subgroup	Relative human impact (natural/semi-natural or cultural)	Winter-rain Evergreen Sclerophyllous Forest and Woodland
Formation	Additional physiognomic and environmental factors, including hydrology	Lowland or Submontane Winter-rain Evergreen Sclerophyllous Forest
Alliance	Dominant/diagnostic species of uppermost or dominant stratum	*California Bay*
Association	Additional dominant/diagnostic species from any strata	*Umbellularia californica / Quercus agrifolia / Toxicodendron diversilobum*

1.2 Study Area

The John Muir National Historic Site (JOMU) is located in Martinez, Contra Costa County, California (Figure 1). It is approximately 20 miles northeast of San Francisco. The original 1964 enabling legislation preserved the 8.8 acre area containing the residence of John Muir. The remainder of the property is managed to provide a historically appropriate setting for the house; vineyards and orchards typical of those during the Muir lifetime are found here. In 1988, an additional 326 acres incorporated

Mount Wanda, an undeveloped area of grassland and woodland (Public Law 100-563). Muir and his daughters used to go for evening walks there. The Mt. Wanda land is maintained to represent a pastoral setting. The area surrounding it is now primarily residential in character. Mt. Wanda is the primary natural area at the John Muir National Historic Site and the study area for this project.

The NPS Inventory and Monitoring Program through the SFAN provides a majority of the natural resource work at the site. The species inventories completed on Mt. Wanda along with the current vegetation map provide the park with the necessary tools to assist with future management decisions by park staff. The data also serve as a baseline for future change detection studies, including changes to plant communities throughout the Network of parks.

1.2.1 Adjacent areas

Mt. Wanda is bordered on the north and east by roads: Franklin Canyon Road, Alhambra Avenue and Alhambra Valley Road. The land extending beyond the roads is fairly high-density neighborhoods with negligible vegetation, and incorporates the Muir House and gravesite parcels of the National Historic Site. The "Almond property" west of Mt. Wanda is currently privately held open space with extensive grazing composed of habitats similar to Mt. Wanda. Depending on future ownership, this property is the only potential for undeveloped open space conservation adjacent to Mt. Wanda. The hills to the southwest of Mt. Wanda are high-end housing developments with large lots at the top of the watershed. Although the housing is low density, it has the potential to drastically change the character of the vegetation, and in many cases already has. Through development of the upper watershed, erosion and gullying continue to be exacerbated and the ornamental landscaping in the area provides a vector for suites of invasive species to establish in the adjacent wildlands.

Because most of the land is developed and privately held, we did not include areas outside of park boundaries for the current plant community map. Limited funding in 2004 also influenced the scope of the project.

1.2.2 Geologic resources

Elevation in the watershed ranges from 200 ft (61 meters) to 660 ft (201 meters). Slopes are fairly steep and deeply dissected, with the steepest occurring on the low elevation flanks of Mt. Wanda and in the narrow drainages. Soils are moderately well developed, brown in color, with a slight acidity. The weathering front is probably deep below the soil surface, as few rocks outcrops are exposed at the surface. Soil maps show Mt. Wanda to be predominantly Los Gatos series loam. These rich, well-drained loam to clay-loams are prone to small slope failures when abused and to rapid runoff when bare. This soil type is found under oak woodlands and on north facing slopes. Permeability is moderate as is shrink-swell potential (Welch 1977).

Los Osos series soils are found on the grassy summits and ridges of Mt. Wanda and adjacent terrain. Generated from the finer grained sands and shales of the Great Valley Sequence rocks, these soils have a higher clay content, and are classified as clays or clay-

loams. They are slightly deeper than the Los Gatos soils, grayish brown in color, with medium acidity. Permeability is low, and the clays readily shrink or expand as moisture conditions change. Locally, these two soil types may grade into one another. A third soil type, Botella clay-loam is found in the lowermost reaches of Strentzel Canyon and on the Alhambra Creek floodplains (Welch 1977).

Mass movement of soils and rock are a significant geomorphic agent in the watershed. Soil creep is evident throughout the watershed, particularly near channels where trees show a characteristic bending at the lower trunk. This is caused by repeated swelling and settling of soil particles in the upper layers, and is driven by either wetting/drying or freezing/thawing. Numerous small slumps, identified by their arced scarp at the top and bulging mound at the bottom, occur in both the upper and lower watershed. Upon the Los Osos soils, they are associated with advancing headcuts into colluvium, oversteepened hillslides, or sub-surface piping. In canyon bottoms they frequently fringe gullies and stream channels. Other mass movement processes include small earthflows and small landslides (Moore 2004).

John Muir NHS incorporates two watersheds, the Alhambra Creek watershed to the southeast and the Franklin to the northwest. The watershed basins have subparallel ridges, deeply entrenched canyons, and small valleys that trend northwestward. This regional trend is caused by geologic structure. All of the streams are classified as intermittent. The stream channels have sinuous alignments, and the relatively steep channel slopes cause rapid rises in flood flows. Flood peaks occur near the mouth of the drainage in about 3-hours after critical rainfall (Moore 2004).

Several faults traverse the area, generally from a southeasterly to northwesterly direction. The faults have had activity in historic time (Moore 2004).

1.2.3 Vegetation

Mt. Wanda is within the Central California Coast (Section 261A) as described by Miles and Goudy (1997). This section is comprised of hills and valleys in the southern Coast Ranges of California. The climate is influenced by the Pacific Ocean creating mild winters with most rain falling at that time. The summers are typically very hot and dry. The growing season in this section ranges from 200 to 300 days. Mt. Wanda is within the East Bay Hills – Mount Diablo subsection (261Ac) consisting of the Diablo Range and steep hills west of Mt. Diablo. In this subsection the marine influence is moderate. The hills trend northwest with rounded ridges, steep sides and narrow canyons. The vegetation for this subsection is described as Coast live oak series in the East Bay Hills, Coast live oak series and Blue oak series on Mt. Diablo and Valley oak on alluvial plains. The chamise series is found on shallow soils with sagebrush present on south-facing slopes (Miles and Goudy 1997). The specifics of Mt. Wanda vegetation generally follow this description but with some degree of variation, such as Valley oaks occurring in the uplands. Miles and Goudy (1997) describe the climate for this subsection as 15 to 25 inches of mean annual precipitation and mean annual temperatures between 54° to 60° F.

In 1992, at least 253 species of vascular plants were documented on Mt. Wanda (Hunter *et al.* 1993). Species with coastal distributions and a number of species at their northern range limits are also found. Annual grassland and blue oak woodland dominate the vegetation of the Mt. Wanda area although mixed evergreen forest and chaparral communities can also be found. In 2002, the vascular plant inventory was completed through a contract with Point Reyes Bird Observatory (Jepsen and Murdock 2002). In 2003, voucher specimens were collected, pressed and accessioned for over 80% of all vascular plant species on Mt. Wanda. One set of specimens is housed at the park and the other is at the Jepson and University Herbaria at the University of California Berkeley. This vegetation mapping project used information from both the plant inventory and the herbarium specimens. All data on vascular plants that occur within the boundaries of JOMU are stored in the national NPSpecies database.

1.2.4 Grazing

The effects of grazing by domestic livestock remain to be determined. The high density of livestock grazing is thought to have subjected California's vegetation to a different grazing pressure than that of herds of the indigenous deer, antelope and elk. Along with livestock came exotic weeds. The Martinez family grazed cattle, horses, sheep and goats on Mt. Wanda. Following the drought of 1860-1, cattle and sheep essentially denuded large areas and most livestock perished. Large areas of land were then brought into cultivation and by 1870, agriculture had replaced ranching on the most fertile bottomlands. Uplands continued to be grazed and grasslands were also cut for hay. The increased population of Martinez created a demand for fuel wood. Grazing continued from 1920 until 1996, but was intermittent and moderate in intensity.

2. Methods

2.1 Aerial photo acquisition

We obtained both black and white and color digital aerial photos of the area from the Contra Costa County Department of Public Works. The black and white aerials were taken in May of 2000 and are 1:20,000. The color aerial photograph (1:24,000) was purchased from Aerials Express, Tucson, AZ in winter of 2004 and dates from March of 2003. Trees, shrubs and herbaceous species, including grasses, are all fully leafed out in March. Slightly different colors allow for differentiation of plant communities during the spring, but a more stark contrast could be provided in the winter or summer. By May, some grasses may begin to senesce depending on the year. In 2003, the grasses were still mostly green in May due to late, heavy rains.

2.2 Aerial photo interpretation and polygon delineation

To begin our work, we interpreted the aerial photos to obtain a coarse sense of the different vegetation formation classes present on Mount Wanda. This included the examination of the color aerial photo for subtle color differences among the wooded areas to help broadly differentiate the various types of oaks present. The vegetation classes were hand-drawn onto a paper copy of the aerial photo. Based on these initial coarse polygons, fieldwork was done to refine and correct the initial broad vegetation categories (see below).

GPS points were obtained using a Trimble GeoExplorer III unit. The points were differentially corrected through the use of Pathfinder Office software; once corrected they were downloaded into ESRI ArcView 8.3. The GPS points and the attribute information collected in the field enabled us to create polygons that accurately reflected the vegetation observed in the field. The majority of polygons were created directly on the computer via heads-up digitizing (at an average scale of 1:500) using the aerial photographs as a background layer and GPS points and field notes as guides. Several of the polygons were obtained by walking the perimeter of the vegetation stand with a GPS unit. These include *Baccharis pilularis, Crypsis schoenoides, Leymus triticoides, Lolium multiflorum, and Olea europaea* stands.

Once the fieldwork was completed and all of the vegetation formation classes had been confirmed, the attribute information was checked manually and the polygons were edited by hand to ensure that no slivers remained. Heads-up digitizing was done using map scales between 1:800 and 1:500 and edited at an average map scale of 1:20.

A pre-existing shapefile delineating the boundary of Mt. Wanda was used as a guideline. The vegetation polygons were drawn only within and up to the Mt. Wanda digitally delineated border except at the most northern extent of the property. Here the polygons were extended beyond this boundary as it is recognized that the boundary of this area is not entirely accurate and that, for management purposes, it would be prudent to show the entire extent and composition of the vegetation of this area.

2.3 Rapid assessment and vegetation classification

Due to the size of the study area and vegetation stands, we chose not to perform releve plots as is typically the first step of most plant community mapping projects. Although these provide more detailed data on the plant communities, they are very time consuming and not necessary for accurately assigning alliances and associations to stands of vegetation. All of the data used for vegetation classification and field checking assigned types were collected using the California Native Plant Society (CNPS) rapid assessment protocol. These plots were performed throughout the duration of the project primarily to determine plant community types and secondarily to act as an accuracy assessment as the polygons were created in GIS. The aerial photograph interpretation was used primarily to delineate boundaries of vegetation stands, and not to distinguish vegetation types on a fine scale. Broad analysis, such as woodland versus forest delineation, was done early on in the project when choosing locations for the first series of rapid assessment plots. Other plots were chosen to capture variables such as aspect, slope and other environmental differences that might be present within a vegetation stand.

Each rapid assessment plot has two associated digital photographs taken with a Nikon Coolpix 4500. The digital photographs are stored on the I& M Network shared drive (X:\Inventories\Vegmap\JOMU|JOMU_Veg_map_plot_photos) and included in the CD accompanying each hardcopy of the report. Each plot also has a GPS point taken using a Geoexplorer III. A Silva compass was used in determining all slope exposure and photograph directional data. A clinometer was used to estimate steepness. Geology data

is the "sedimentary" category in the database. Only the first few plots had the soil texture analyzed on site using the key provided by CNPS. All other plots were assigned soil texture based on a USDA soil map due to the fact that the small study area does not have much soil diversity (2-3 types) (Welch 1977). A fine scale soil analysis is scheduled for future work on Mt. Wanda as recommended by the Watershed Management Plan (Moore 2004). Visual cues and knowledge of past land were used to estimate type and level of disturbance. The species lists included species of interest, but not just those that were dominant or relatively abundant. Often species with less than 2% cover were included in the list in order to better describe the stand (and as a supplement to the data since releves were not performed). Unusual species were listed for those 1.) that occur in very low numbers throughout the study area, 2.) are considered rare by state and/or local lists or 3.) are not typically found in the community type being assessed. Unknown species in relatively great abundance were pressed and brought back for identification. Plant species identification and nomenclature followed The Jepson Manual (Hickman 1993).

Data from the rapid assessment plots were used to assign alliances and associations to each polygon. The GIS polygons were refined several times to reflect the vegetation on the ground as data became available. All rapid assessment field data was entered into an Access database developed by CNPS. The database is compliant with I & M and other vegetation database standards. The database is stored on the I& M Network shared drive (X:\Inventories\Vegmap\JOMU\Rapid_Assessment_database) and included in the CD accompanying each hardcopy of the report.

A formal accuracy assessment was not completed on the map because plant community type was determined in the field for all polygons. All polygons were visited at least once with rapid assessment plots performed in over 80% of them. Due to the size and accessibility of the study site, we are very confident with polygon delineation and classification of the vegetation down to the alliance level.

3. Results and Discussion

3.1 Vegetation map

Vegetation communities were delineated for the Mt. Wanda sub-unit of the John Muir National Historic Site in the summer of 2004. A total of 13 alliances and 18 associations were identified in the study area (Figure 2). These 13 alliances represent 7 formation types and 4 classes: forest, woodland, shrubland and herbaceous vegetation (Figure 3). The locations of the rapid assessment plots are shown in Figure 4. The plot locations encompass every vegetation type and include every aspect and elevation of Mt. Wanda. Included in the report are an alliance level map (Figure 5) and a class level map (Figure 6)using the black and white aerial photograph of 2000.

There are eight polygons that were classified to the alliance level and were visited, but do not have an association assignment because a rapid assessment plot was not done within the polygon. There are two polygons called "facilities" which have some vegetation cover but consist mostly of buildings or horse corrals. In future mapping efforts, these polygons should be included in vegetation analysis since they may have structures

removed and/or restoration projects associated with them. The horse corrals are particularly important for management of invasive species since some are a source for specific invasive species not found in other locations on Mt. Wanda, such as purple starthistle (*Centaurea calcitrapa*) and perennial pepperweed (*Lepidium latifolium*) (Bossard *et al*. 2000).

3.2 Classification

Many of the polygons have enough data to determine the association of the stand. None of the associations have been officially described and are not used in the final vegetation map (Grossman *et al.* 1998). The finest level of detail the vegetation map provides is at the alliance level. Almost all alliances had previously been described and were available on the NatureServe website (see section 6). For those communities without a described alliance, a determination was made based on both field data and data from similar alliances to populate the classification descriptions and attribute tables.

Some polygons do not have rapid assessment plots within them while others have up to five (see Figure 4). The small polygons without any rapid assessment plots were visited to check the accuracy of the alliance assignment but no data were taken. In some instances, guide points were collected using the GeoExplorer III to assist in determining where community boundaries should be placed on the map. In some stands, several rapid assessment plots were conducted throughout the community in order to determine if it should be classified as one or many alliances and to confirm the initial classification. In a few cases, when there were two common species there were discrepancies between rapid assessment plots as to which species was dominant. In these instances the aerial photos were reviewed, either the polygon was split to reflect different alliances or the polygon stayed as is due to the fact that it was encompassing a fairly homogenous stand. In the case of a homogenous stand, the polygon was classified by the species reflected as dominant in the most number of rapid assessment plots (over 50%). This occurred most often in the *Umbellularia californica* and *Quercus agrifolia* forests because they are so similar and often the two species had equal percent coverage.

Table 2: Summary of area and polygons by formation class and alliance.

Formation Class:	**Acres covered**	**Percent of Area***	**Number of Rapid Assessment Plots**	**Number of Polygons**
Forest	115.92	35.56	17	12
Herbaceous (grassland)	94.90	29.11	11	12
Shrubland	5.91	1.81	4	4
Woodland	122.74	37.65	13	8
Alliance name:				
Blue oak woodland	86.34	26.48	7	3
Buckeye woodland	9.26	2.84	5	3
California laurel (bay) forest	44.02	13.50	10	3
Chamise shrubland (chaparral)	3.74	1.15	2	2
Coast live oak forest	66.35	20.35	5	7
Coyote brush shrubland	2.17	0.67	2	2

Crypsis grassland	0.04	0.01	1	1
Leymus grassland	1.49	0.46	1	1
Oak forest	0.68	0.21	1	1
Olive forest	4.87	1.49	1	1
Ryegrass grassland	2.15	0.66	3	6
Valley oak woodland	27.13	8.32	1	2
Wild oats grassland	91.22	27.98	6	4

* Total area includes facilities that are represented as two polygons on the maps.~~4~~

The key in section 5 includes a general key to the vegetation communities on Mt. Wanda. The field-determined associations are listed in the key below each alliance, but are not further described because an official description is lacking and more work is needed. There is no case where more than one association was found for each alliance based on the level of botanical detail available during the study. The relatively small size of the study site reflects a lack of significant diversity within stands. Each field-determined association is simply the alliance with the next most dominant species determined by the rapid assessment plot data. These may be true associations or may simply reflect the characteristics of the stand in the area where the data were collected. More data will have to be collected in similar habitats outside of the Mt. Wanda study area before associations can be officially described for this area.

3.3 Invasive species

Invasive species are of particular concern in the study area. Individual populations and/or occurrences of species have been mapped on Mt. Wanda as part of on-going vegetation management. Most populations were too small to include in the vegetation map, occur as understory (i.e. *Avena fatua*), or are not dominant enough to justify the creation of a polygon. The current invasive species occurrence maps can be overlaid with this plant community map for future management and habitat assessments. With very few exceptions, every polygon from grassland to wetland to forest had some amount of Italian thistle (*Carduus pycnocephalus*) present, making it the most established invasion on Mt. Wanda. Tree of heaven (*Ailanthus altissima*) is found along the northern and eastern boundaries of Mt. Wanda as it moves in from residential areas. Due to removal efforts over the past few years, it was never in great enough abundance to dominate a stand of vegetation. Due to the urban interface and current levels of invasion by invasive species it is very likely that without active management, a future vegetation map may have more polygons dominated by a variety of invasive species from trees to herbaceous species. Currently the olive forests and grasslands are the major communities dominated by exotic species. The shapefiles for the invasive species occurrences reside on the natural resource computer at JOMU (C:\Geodata\JOMU\shapefiles).

3.4 Recommendations for future work

In the future we hope to include vegetation data beyond the immediate borders of Mt. Wanda. This could assist in future vegetation management and monitoring in cooperation with other agencies and stewards, such as the Muir Heritage Land Trust, the Alhambra Watershed Action Group, East Bay Regional Park District and Contra Costa County.

The creation of a more accurate digital boundary line for the Mt. Wanda property will enable the vegetation map to more concisely represent the composition and extent of the vegetation around the peripheral areas. Given that the map and database system is designed to facilitate management decisions, it is optimal for the fringe areas of the property to be characterized as precisely as possible.

Future aerial photographs should try to capture different phenologies of the trees and herbs. A photograph in the winter would provide a stark comparison between deciduous woodland and evergreen forest. A summer photograph would provide clear contrast between the annual grasses and native grasses and herbs that senesce later into the year.

The most important future work concerns the collection of more vegetation and GIS data throughout the East Bay hillls in order to classify and describe further the local alliances and associations. By increasing the sample size and spreading out the location of vegetation plots, the classification will have meaning beyond the boundaries of Mt. Wanda. We hope that the data collected for this project will be a starting point for more work on vegetation in the area.

Once more areas are sampled, the goal is to formally describe many of the alliances and associations that are currently without a formal description on vegetation communities in the San Francisco Bay Area. With an area as small as Mt. Wanda, it is not possible to describe vegetation alliances and associations based on what is found there. More areas need to be sampled to determine if these are repeating patterns within the landscape and qualify for formal descriptions. The data gathered by the National Park Service will hopefully assist NatureServe and the California Native Plant Society in future descriptions of these plant communities.

The data gathered during this project can be used to assist with management efforts by determining fuel loads, wildlife habitat relationships and combined with future studies, like soil models, to assist with restoration planning.

4. Literature Cited

Allen-Diaz, B. and Jackson, R.D. 2000. Grazing effects on spring ecosystem vegetation of California's hardwood rangelands. *Journal of Range Management* 53: 215-220.

Bossard, C.C., J.M. Randall and M.C. Hoshovsky. 2000. *Invasive plants of California's wildlands*. University of California Press, Berkeley, CA.

Grossman, D. H., D. Faber-Langendoen, A.S. Weakley, M. Anderson, P. Bourgeron, R. Crawford, K. Goodin, S. Landaal, K. Metzler, K. Patterson, M. Pyne, M. Reid, and L. Sneddon. 1998. International classification of ecological communities: terrestrial vegetation of the United States. Volume I. The National Vegetation Classification System: development, status and applications. The Nature Conservancy, Arlington, Virginia, USA.

Hickman, J.C. 1993. The Jepson Manual. University of California Press, Berkeley, CA.

Hunter, J.C., S.D Veirs and P. Reeburg. 1993. The flora, vegetation and human use of Mt.Wanda, John Muir National Historic Site, Martinez, California. National Park Service. Technical Report.

Jepsen, E.P.B. and A.G. Murdock. 2002. Inventory of native and non-native vegetation on John Muir National Historic Site, Eugene O'Neill National Historic Site and Port Chicago National Monument. PRBO Conservation Science.

List of California Terrestrial Natural Communities Recognized by the California Natural Diversity Database. September 2003 Edition. Department of Fish and Game, Wildlife and Habitat Analysis Branch.

Miles, S. R. and C.B. Goudy. 1997. Ecological subregions of California: Section and subsection descriptions. USDA Forest Service Pacific Southwest Region San Francisco, CA.

Moore, C. 2004. Watershed Management Plan, John Muir National Historic Site, Martinez, CA (draft). National Park Service. Technical Report.

Moravec, J. 1992. Is the Zurich-Montpellier approach still unknown in vegetation science of the English-speaking countries? Journal of Vegetation Science 3:277 278.

NatureServe. 2004. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.0. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: August 23, 2004).

Sawyer, J.O. and T. Keeler-Wolf. 1995. A Manual of California Vegetation. California Native Pant Society, Sacramento, CA.

United Nations Educational, Scientific and Cultural Organization (UNESCO). 1973. International Classification and Mapping of Vegetation, Series 6, Ecology and Conservation. Paris, France: United Nations Educational, Scientific, and Cultural Organization. 93 pp.

US Geologic Survey. 1994. National Vegetation Classification. (complete document available at following website: http://biology.usgs.gov/npsveg/nvcs.html)

Welch, L.E. 1977. Soil Survey of Contra Costa County, California. USDA Soil Conservation Service.

5. Key to Plant Communities

I. Vegetation dominated by non-herbaceous species including grasses, grass-like plants, and broad-leaved herbaceous species. Shrub species, if present, are of lower absolute cover than herbs and grasses (less than 15 percent cover). Sub-shrubs, if present, may form up to 25 percent cover but are never taller than dominant herbaceous vegetation. Trees, if present, may compose less than 15 percent cover.
Division A- Herbaceous Vegetation

II. Vegetation dominated by shrubs or sub-shrubs. Trees, if present, may compose up to 15 percent cover in stand, herbaceous species may total higher cover than shrubs, but are shorter in stature. Shrubs are always greater than 15 percent cover and are distributed relatively evenly over the stand
Division B- Shrub Vegetation

III. Vegetation dominated by trees (at least 5 m tall). Tree canopy is greater than 15 percent cover over denser sub-canopies of shrub and herbaceous species and is distributed relatively evenly over the stand. * Unless Adenostoma fasciculatum represents a significant understory, in which case it is classified as shrub vegetation.
Division C- Tree Vegetation

Division A- Herbaceous Vegetation

IA. Vegetation dominated by grasses or grass-like species, lacking a significant overstory of trees or shrubs, may have low shrubs or sub-shrubs present in significant amounts, but these are overtopped by the dominant grasses……..**Native and non-native grasslands**.

1. Non-native annual grasslands- Grasslands dominated by non-native annual grass species with no more than 15 percent relative cover of native perennial species. Dominant species include wildoat (*Avena fatua*), slender wildoat (*Avena barbata*), brome (*Bromus sp.*), foxtail (*Hordeum murinum*), Mediterranean barley (*Hordeum marinum*) and often Italian ryegrass (*Lolium multiflorum*) mixed with other species. ……**Short temperate annual grassland**.

   A. *Avena fatua* is the dominant grass. The most common co-dominant or co-occurring grass species is *Bromus diandrus*. Large patches dominated by *Carduus pycnocephala* are common in this alliance ……**Wild oats** (*Avena fatua*) **alliance**.
   1. *Avena fatua* - *Bromus diandrus* - *Carduus pycnocephalus* association.

2. Mesic (wet) and/or perennial grasslands- Grasslands with greater than 15 percent relative cover of facultative wetland species and/or native perennial grass species. Dominant species include swamp grass (*Crypsis schoenoides*), creeping wild rye (*Leymus triticoides*), and monocultures of Italian ryegrass (*Lolium multiflorum*) in drainages. No associations are defined ……**Temporarily flooded temperate or subpolar grassland**.

   A. *Leymus triticoides* is the dominant grass. This species stays green well into summer and is easy to distinguish from surrounding grasslands. Often

comprised of significant, but not dominant, cover of annual non-native grasses……**Leymus** (*Leymus triticoides*) **alliance**.
1. *Leymus triticoides* - *Carduus pycnocephalus* - *Geranium dissectum* association

B. *Lolium multiflorum* is the dominant grass. This grass is a facultative wetland species and only dominates in drainages and near seeps where it stays green well into summer. Co-occurring species often include *Polypogon monspessulana* and *Leymus triticoides*. This species occurs throughout the area as a component of the California annual grassland vegetation type when it does not form monocultures and dies earlier in season ……..……**Ryegrass** (*Lolium multiflorum*) **alliance**.
1. *Lolium multiflorum* - *Leymus triticoides* association.
2. *Lolium multiflorum* - *Bromus hordeaceus* association.

C. *Crypsis schoenoides* is the dominant grass. This alliance only occurs in the remaining dammed cattle pond that acts like a vernal pool with rings of *Hordeum marinum* and *Polypogon monspessulana* ……..……**Crypsis** (*Crypsis schoenoides*) **alliance**.

IB. Vegetation dominated by annual or perennial native or non-native forbs. **Non-existent.**

All areas dominated by forbs fall within a grass, shrub or tree dominated vegetation type due to the minimum mapping units. Most of the forbs that dominate are invasive species such as yellow starthistle (*Centaurea solstitialis*), perennial pepperweed (*Lepidium latifolium*) and milk thistle (*Silybum marianum*) are represented in various weed maps of Mt. Wanda. Italian thistle (*Carduus pycnocephalus*) is present in most polygons, most patches of Italian thistle fall below the minimum mapping unit and should be classified as **Native and non-native grasslands**.

Division B- Shrub Vegetation

IIA. Vegetation dominated by microphyllous (small-leaved) or broad-leaved evergreen species. Includes coyote brush, chamise, toyon, California broom (*Lotus scoparius*).

A.. Chamise chaparral (*Adenostoma fasciculatum*) dominates the stand, often associated with toyon (*Heteromales arbutifolia*), sticky monkey-flower (*Mimulus aurantiacus*) and California broom (*Lotus scoparius*). …… ……**Chamise** (Adenostoma fasciculatum) **alliance**.
1. *Adenostoma fasciculatum – Mimulus aurantiacus* association.
2. *Adenostoma fasciculatum – Mimulus aurantiacus / Avena fatua* association.

B. Coyote brush (*Baccharis pilularis*) dominates stand. This vegetation type only occurs on the north-facing slope of Mt. Wanda and is found in small patches. Co-occurring species include poison oak (*Toxicodendron diversilobum*), California broom (*Lotus scoparius*) and toyon (*Heteromales arbutifolia*)……**Coyote brush** (*Baccharis pilularis*) **alliance.**
1. *Baccharis pilularis – Lotus scoparius* association
2. *Baccharis pilularis – Toxicodendron diversilobum*/*Avena fatua* association

Division C- Tree Vegetation

IIIA. Evergreen broad-leaved forests and woodlands dominated by one or more of several species including California bay (*Umbellularia californica*), coast live oak (*Quercus agrifolia*), eucalyptus (*Eucalyptus globulus*), and buckeye (*Aesculus californica*). California bay and coast live oaks are by far the most abundant, comprising roughly half of these forests, these two species often associating with each other ……**Winter-rain Evergreen Sclerophyllous Forests and Woodlands**.

A. Forest/woodlands are dominated by bay (*Umbellularia californica*) with extensive coverage of coast lie oak (*Quercus agrifolia*). Stands occur primarily in riparian zones, and otherwise mesic habitats relative to other communities. Co-occurring species often include buckeye (*Aesculus californica*), hop tree (*Ptelea crenulata*), poison oak (*Toxicodendron diversilobum*). The understory is typically rather sparse with more forbs or shrubs than grasses ……**California laurel** (*Umbellularia californica*) **alliance**.

1. *Umbellularia californica – Quercus agrifolia* association

B. Forest/woodlands are dominated by coast live oak (*Quercus agrifolia*) with extensive coverage of bay (*Umbellularia californica*). Stands occur primarily in drainages, north-facing slopes and otherwise mesic (wet) habitats relative to other communities. Co-occurring species often include black oak (*Quercus kelloggii*) particularly on north-facing slopes, buckeye (*Aesculus californica*), poison oak (*Toxicodendron diversilobum*). The understory is typically rather sparse with more forbs or shrubs than grasses and a high cover of litter ……...**Coast live oak** (*Quercus agrifolia*) **alliance**.

1. *Quercus agrifolia – Umbellularia californica*/*Toxicodendron diversilobum* association

C. Forest/woodland is dominated by olives (*Olea europaea*). Due to a remnant orchard that persisted, the olives have expanded and continue to dominate. This vegetation type dominates on a hilltop that has some similar stand characteristics to the other winter-rain evergreen alliances, such as a sparse understory. Coast live oak (*Quercus agrifolia*) is common in this alliance……...……**Olive** (*Olea europaea*) **alliance**.

. 1. *Olea europaea – Quercus agrifolia* association

IIIB. Mixed broad-leaved evergreen-cold-deciduous forest. These forests do not have just one oak species that dominates and the co-dominants are often of two types of oak (cold-deciduous and evergreen)……**Mixed broad-leaved evergreen-cold-deciduous forest**.

A. Coast live oak (*Quercus agrifolia*) and blue oak (*Quercus douglasii*) dominate the stand evenly with other tree species having a high percent cover. Associated species include black oak (*Quercus kelloggii*) with the shrubs *Mimulus aurantiacus* and *Toxicodendron diversilobum* present in the understory……**Oak** (*Quercus*) **forest alliance**.

1. *Quercus agrifolia – Quercus douglasii* association.

IIIC. Cold-deciduous broad-leaved woodlands or savannas dominated by one of several species including blue oak (*Quercus douglasii*), valley oak (*Quercus lobata*), black oak (*Quercus kelloggii*) and buckeye (*Aesculus californica*). Blue oak is by far the most abundant, normally associating with other oak species listed here as well as some evergreen species. Some evergreen sclerophyllous species are associated such as coast live oak (*Quercus agrifolia*) and California bay (*Umbellularia californica*). The canopies are not as dense as winter-rain evergreen forests and woodlands, and range from barely touching to large gaps between individual trees ……...…….……**Cold-deciduous Woodlands**.

A. Blue oak woodland. Dominated by *Quercus douglasii* with some valley oaks (*Quercus lobata*) and Coast live oak (*Quercus agrifolia*). This vegetation type occurs on ridgelines and slopes below the California annual grasslands and in areas that are not wet enough to support Oak/Bay forests. The understory is composed of the same species of exotic annual grasses that dominate the grasslands, as well as some native herbaceous species such as soap plant (*Chlorogalum pomeridium*), and yampah (*Perideridia kelloggii*). *Quercus douglasii* is the most abundant tree species on Mt. Wanda……**Blue oak (*Quercus douglasii*) alliance.**
1. *Quercus douglasii – Avena fatua* association.

B. Valley oak woodland. Dominated by *Quercus lobata* with some Coast live oak (Quercus agrifolia) and few buckeyes (*Aesculus californica*) and blue oaks (*Quercus douglasii*). Dominates exclusively on the west- and southwest-facing slopes near top of watershed. ……..……...……**Valley oak (*Quercus lobata*) alliance**.
1. *Quercus lobata – Quercus agrifolia/Avena fatua* association (71.040.06).

C. Buckeye (Aesculus californica) dominates the stand with a relatively low canopy compared to surrounding oak/bay forest. Often associated with hop tree (*Ptelea crenulata*)……**Buckeye (*Aesculus californica*) alliance**.
1. *Aesculus californica – Ptelea crenulata* association.
2. *Aesculus californica – Quercus agrifolia* association.

6. Vegetation Community Descriptions

The following descriptions include communities at the alliance level only. Several associations were determined in the field and included in the attribute table of the final vegetation map, but are not found in Natureserve and do not currently have enough data to support a formal description. The following alliances occur often enough to support authoring a new alliance and/or already have representation in Natureserve. All descriptions, excluding the subsection specific to John Muir NHS (JOMU), are taken from Natureserve or are adapted to fit categories based on similar alliances.

A. Herbaceous Plant Communities

1.) Wild oats (*Avena fatua*) grassland alliance: 42.040.00
No alliance authored.

The following is based on a similar vegetation type, Bromus grassland alliance from Natureserve:
System: Terrestrial
Class: Herbaceous vegetation
Subclass: Annual graminoid or forb vegetation
Group: Temperate or subpolar annual grasslands or forb vegetation
Subgroup: Natural/Semi-natural temperate or subpolar annual grasslands or forb vegetation
Formation: Short temperate annual grassland

Alliance description: Not available
Nation: United States
United States Distribution: CA
Distribution Outside Canada and the United States: Mexico
Global Range: Stands of this widespread alliance occur throughout California and Baja California.
Vegetation Summary: The composition of this widespread western annual grassland alliance varies widely. Many alien and native annual species may be present, including *Bromus diandrus, Bromus hordeaceus, Bromus madritensis, Cynosurus echinatus, Aira caryophylla*, and species of *Erodium, Lasthenia, Lupinus, Brassica, Avena, Castilleja, Lolium*, and *Centaurea*.
Physiognomy: This short, temperate, annual grassland forms an herbaceous canopy less than 1 m in height. Emergent shrubs and trees may be present.
Wetland Indicator: No
Environmental Summary: This broadly defined annual grassland alliance is composed of many native and exotic annual grasses. Composition varies among stands. Fall precipitation and temperatures are the major factors determining grassland composition, along with light intensity, litter and microtopography.
Dynamics: The composition of this alliance is largely determined by fall temperatures and precipitation, light intensity, litter thickness and microtopography. Disturbance history is often directly related to the percentage of exotic alien species, with heavy disturbance correlating with heavy exotic invasion. Annual grasses are supremely

adapted to the Mediterranean climate of California; many species evolved under similar conditions in southern Europe and northern Africa. Plants germinate during winter rains, and complete their life cycles by the beginning of the summer drought. Seeds often remain viable for many years.

JOMU: On Mt. Wanda, the *Avena fatua* dominated grasslands are found primarily on hilltops in association with a clay dominated soil type. This community experienced heavy grazing until 1996 when the land was turned over the National Park Service. The grasslands are comprised of the suites of European grass species typical of the coast and foothills of California including *Bromus diandrus*, *Lolium multiflorum*, *Hordeum murinum*, *Avena barbata*, and *Bromus hordeaceus*. Overall, *Avena fatua* dominates the stands, but in many locations much smaller than our minimum mapping unit, other grasses dominate, particularly *Bromus diandrus*. On Mt. Wanda, *Carduus pycnocephalus* is the major non-graminoid, non-native forb that co-occurs in the grasslands along with *Centaurea solstitialis* and *Silybum marinum.* Native species that co-occur in small patches include *Perideridia kelloggii*, *Chlorogalum pomeridianum* var. *pomeridianum* and *Asclepias fascicularis*. Some native grasses such as *Nassella lepida* and *Melica californica* are present but in much smaller numbers than the exotic species. This same vegetation type continues into the understory of the blue (*Quercus douglasii*) and valley (*Quercus lobata*) oak woodlands.

2.) *Leymus triticoides* Temporarily Flooded Herbaceous alliance: 41.080.00
System: Terrestrial
Class: Herbaceous vegetation
Subclass: Perennial graminoid vegetation
Group: Temperate or subpolar grassland
Subgroup: Natural/semi-natural temperate or subpolar grassland
Formation: Temporarily flooded temperate or subpolar grassland

Alliance description: This alliance is described from the Warner Valley of southeastern Oregon and the Cow Creek Basin in northwestern Nevada. Elevations range from 1250-1600 m. The climate is arid with mostly winter precipitation ranging from 10-25 cm annually. Stands occur in valleys in drainage bottoms, poorly drained floodplains, and historic lake basins. Sites are typically flat, but include moderate slopes (to 18%). Stands are found on the less xeric northeastern and eastern aspects in Nevada. Soils are typically poorly drained, alkaline, with sandy loam to clay loam texture. The water table is shallow and causes mottles in the soil. Stands have a moderate herbaceous layer (50-80% cover) codominated by the perennial graminoids *Leymus triticoides (= Elymus triticoides)* with *Poa secunda* or *Carex* spp. Other frequent graminoid species include *Distichlis spicata, Hordeum brachyantherum ssp. californicum (= Hordeum californicum), Hordeum jubatum, Juncus balticus*, and forbs, such as *Achillea millefolium, Agoseris glauca, Iris missouriensis, Scirpus* spp., *Triglochin maritima*, and *Nitrophila occidentalis*, in the saline/alkaline playas. Adjacent communities are shrublands dominated by *Artemisia tridentata*.
Nation: United States
United States Distribution: CA, NV, OR

Global Range: This grassland alliance occurs in northwestern Nevada and southeastern Oregon.
Vegetation Summary: This vegetation occurs in bottomlands and lake basins. Stands have a moderate herbaceous layer (50-80% cover) codominated by the perennial graminoids *Leymus triticoides (= Elymus triticoides)* with *Poa secunda* or *Carex* spp. Other frequent graminoid species include *Distichlis spicata, Hordeum brachyantherum ssp. californicum (= Hordeum californicum), Hordeum jubatum, Juncus balticus*, and forbs such as *Achillea millefolium, Agoseris glauca, Iris missouriensis, Scirpus* and/or *Schoenoplectus* spp., *Triglochin maritima*, and *Nitrophila occidentalis* in the saline/alkaline playas.
Physiognomy: Vegetation included in this alliance has a moderately dense herbaceous layer (50-80% cover) of medium-tall and short perennial grasses. Perennial forb cover is sparse to moderate. Annuals are seasonally present with variable cover.
Wetland Indicator: Yes
Environmental Summary: This alliance is described from the Warner Valley of southeastern Oregon and the Cow Creek Basin of northwestern Nevada. Elevations range from 1250-1600 m. Climate is arid with the mostly winter precipitation ranging from 10-25 cm annually. Stands occur in valleys in drainage bottoms, poorly drained floodplains, and historic lake basins. Sites are typically nearly flat, but include moderate slopes (to 18%). It is found on the less xeric northeastern and eastern aspects in Nevada. Soils are typically poorly drained, alkaline, with sandy loam to clay loam texture. The water table is shallow and causes mottles in the soil. Adjacent communities are shrublands dominated by *Artemisia tridentata*.
Dynamics: Exotic species, such as *Descurainia sophia* and *Taraxacum officinale*, are common in some stands.

JOMU: On Mt. Wanda, small patches of *Leymus triticoides* are located at the tops of drainages and intermittently amongst other grassland communities in moist locations. Only one stand was large enough to map and had *Leymus triticoides* as the dominant species. *Leymus triticoides* is also found in other "wetland" communities associated with the top of drainages where it occurs but does not dominate the stand and as very small, scattered patches in moist locations on the north-facing aspect of Mt. Wanda.

3.) <u>Ryegrass (*Lolium multiflorum*) grassland alliance</u>: 42.040.00
No alliance authored.

The following is based on existing categories and combines portions of annual grassland classes and groups with temporarily flooded herbaceous subgroups and formations due to the wetland qualities exhibited by the stands.

System: Terrestrial
Class: Herbaceous vegetation
Subclass: Annual graminoid or forb vegetation
Group: Temperate or subpolar annual grassland or forb vegetation
Subgroup: Natural/semi-natural temporarily flooded temperate or subpolar grassland
Formation: Temporarily flooded temperate or subpolar grassland

JOMU: Stands dominated by *Lolium multiflorum* occur toward the top of Mt. Wanda in the bowls at the top of drainages. In most cases seeps are probably present. These stands stay green much further into the year than the adjacent *Avena fatua* grasslands. The communities are similar to that described as "spring ecosystem vegetation" by Allen-Diaz and Jackson (2000). Other wetland indicator species found in these stands are *Leymus triticoides*, *Hordeum marinum*, and *Polypogon monspessulana*. *Lolium multiflorum* occurs amongst other European grasses in the *Avena fatua* stands, but does not dominate, often comprising less than 5% cover. In *Lolium multiflorum* dominant stands, percent cover ranges from 55 % to 85%. Some stands have few other species besides *Lolium* while others are quite diverse, particularly the stand upstream from the breached cattle pond.

4.) Crypsis (*Crypsis schoenoides*) grassland alliance: 42.040.00
No alliance authored.

The following is based on existing categories and combines portions of annual grassland classes and groups with temporarily flooded herbaceous subgroups and formations due to the wetland qualities exhibited by the stands.
System: Terrestrial
Class: Herbaceous vegetation
Subclass: Annual graminoid or forb vegetation
Group: Temperate or subpolar annual grassland or forb vegetation
Subgroup: Natural/semi-natural temporarily flooded temperate or subpolar grassland
Formation: Temporarily flooded temperate or subpolar grassland

JOMU: There is only one location on Mt. Wanda where *Crypsis schoenoides* is found. It is the bed of the dammed cattle pond at the top of an east-facing slope. This stand acts similar to a vernal pool with species blooming in concentric rings as water is lost from evaporation during the spring and summer. Other major species that make up this stand are *Hordeum marinum* and *Polypogon monspessulana*, which are found in other locations on Mt. Wanda, unlike *Crypsis schoenoides*. This stand is well below the minimum mapping unit but was included as part of the vegetation map because of its rarity on the landscape and management implications that may exist via dam removal/restoration. According to *The Jepson Manual* (Hickman 1993), *Crypsis schoenoides* is native to Europe and used for wildfowl and livestock forage.

B. Shrub Dominated Plant Communities

1.) Chamise (*Adenostoma fascicularis*) shrubland alliance: 37.101.00
System: Terrestrial
Class: Shrubland
Subclass: Evergreen shrubland
Group: Temperate broad-leaved evergreen shrubland
Subgroup: Natural/semi-natural temperate broad-leaved evergreen shrubland
Formation: Sclerophyllous temperate broad-leaved evergreen shrubland

Alliance description: This widespread chaparral alliance of dry slopes and ridges of interior California is found between 10 and 1800 m elevation. It can occur on all slopes and usually occurs on xeric sites. Stands of this alliance usually occur on shallow, mafic-derived soils. This sclerophyllous, broad-leaved evergreen shrubland is dominated by *Adenostoma fasciculatum*. Mature stands are densely interwoven thickets of *Adenostoma fasciculatum*, with other species contributing very little to overall cover. Emergent trees of *Quercus wislizeni* may be present. Shrubs may include *Arctostaphylos glauca, Salvia mellifera, Heteromales arbutifolia, Eriogonum fasciculatum, Artemisia californica, Toxicodendron diversilobum, Yucca whipplei*, and various *Ceanothus* spp. There is very little understory or herbaceous litter. This alliance intergrades with other chaparral types, coastal scrubs, and grasslands.
Nation: United States
United States Distribution: CA
Distribution Outside Canada and the United States: Mexico
Global Range: This widespread alliance occurs in the inner northern coast of California, along the foothills surrounding the margins of the great Central Valley, throughout southern California, and into Baja California, Mexico, and the Mojave Desert. It is relatively infrequent in the northern part of its range compared to its abundance in southern California.
Vegetation Summary: This sclerophyllous broad-leaved evergreen shrubland of interior California is dominated by *Adenostoma fasciculatum*. Mature stands are densely interwoven thickets of *Adenostoma fasciculatum*, with other species contributing very little to overall cover. Emergent trees of *Quercus wislizeni* may be present. Shrubs may include *Arctostaphylos glauca, Salvia mellifera, Heteromeles arbutifolia, Eriogonum fasciculatum, Artemisia californica, Toxicodendron diversilobum, Yucca whipplei*, and various *Ceanothus* spp. There is very little understory or herbaceous litter.
Physiognomy: This broad-leaved evergreen shrubland is dominated by a continuous canopy of shrubs less than 3 m in height. The herbaceous layer is sparse, and some small to medium emergent trees (15-20 m tall) may be present.
Wetland Indicator: No
Environmental Summary: This widespread chaparral alliance of dry slopes and ridges of interior California is found between 10 and 1800 m elevation. It can occur on all slopes and usually occurs on xeric sites. Stands of this alliance usually occur on shallow, mafic-derived soils. This alliance intergrades with other chaparral types, coastal scrubs, and grasslands.
Dynamics: This alliance has adapted to cycles of drought and fire. The needle-like leaves of the dominant species are most active during the cool, moist winters, and become dormant (though still alive) during the intensely hot, dry summers. By fall these shrublands are very susceptible to fire. When plants of the nominal species burn, they crown-sprout to re-generate, though growth is slow because of the poor growing conditions. For several years after a fire a fairly dense herbaceous layer may exist.

JOMU: There are two stands of chaparral dominated by *Adenostoma fascicularis* on Mt. Wanda. Both are relatively small and contain species that are non-existent or rare in other communities on Mt. Wanda. The stand on the west side of Mt. Wanda is south-facing on a steep slope with over half of the vegetation cover comprised of *Adenostoma*

fascicularis. Other species of interest in the stand are *Mimulus aurantiacus*, *Artemisia californica*, *Lotus scoparius* and *Salvia mellifera*, which is at the northernmost extent of its range. The stand on the north side of Mt. Wanda is slightly more open, grades into a *Baccharis pilularis* dominated shrubland and contains *Helianthella castanea*, a species of special concern. This northern stand also becomes the understory for a portion of the surrounding *Quercus douglasii* woodland. Contrary to suggested protocols, the area was mapped as shrubland up to the point where the shrubs stopped in the understory of the woodland (never more than 3 meters) due to the potential management importance of this community type. It is unknown whether the shrubs are encroaching into oak woodland or if the oaks are invading the chaparral community.

2.) Coyote brush (*Baccharis pilularis*) shrubland alliance: 32.060.00

System: Terrestrial
Class: Shrubland
Subclass: Evergreen shrubland
Group: Microphyllous evergreen shrubland
Subgroup: Natural/semi-natural microphyllous evergreen shrubland
Formation: Lowland microphyllous evergreen shrubland

Alliance description: Not available.
Nation: United States
United States Distribution: CA, OR
Global Range: This alliance has been described from southern Oregon to northern California along the Pacific Coast. It also occurs farther south in California, but further inventory and classification work are required to develop its concept in this region.
Vegetation Summary: *Baccharis pilularis* shrublands are an important component of dune, bluff, and coastal mountain vegetation along much of the central Pacific Coast. Across this broad geographic range, associated species vary widely. In dune shrublands of the northern California and Oregon coasts, *Scrophularia californica, Solidago simplex var. spathulata (= Solidago spathulata)*, and *Anaphalis margaritacea* are common forb associates. In older dune stands, tree species relatively tolerant of salt and wind, such as *Alnus rubra* and *Pinus contorta*, may become established. In *Deschampsia - Danthonia* northern coastal prairies, *Baccharis pilularis* is the primary shrub colonizer and often forms dense, pure stands.
The following information is from Sawyer and Keeler-Wolf (1995) and Barbour and Major (1977) for *Baccharis pilularis* shrublands elsewhere in California. Away from the immediate coast, *Baccharis pilularis* forms shrublands with several other shrub species. *Toxicodendron diversilobum, Eriodictyon californicum, Ceanothus thyrsiflorus, Lupinus* spp., *Gaultheria shallon, Artemisia pycnocephala, Eriophyllum stoechadifolium*, and *Rubus ursinus* are all common associates. Common herbaceous associates include *Polystichum munitum, Castilleja latifolia*, and *Heracleum maximum (= Heracleum lanatum)*. South of San Francisco Bay, the coastal scrub is similar in structure, but different in species composition. Associated shrub species include *Artemisia californica, Diplacus aurantiacus (= Mimulus aurantiacus), Eriogonum fasciculatum, Salvia* spp., and *Eriophyllum confertiflorum*. Herbaceous species decrease in abundance and non-

native annual grasses, such as *Bromus* spp., *Avena* spp., and *Lolium* spp., increase in cover.
Physiognomy: The vegetation in this alliance is characterized by the dominance of an evergreen sclerophyllous shrub, but is somewhat variable in species composition and community structure. In coastal sand dunes, the shrublands are somewhat open (40-70% cover) with abundant forb and graminoid associates. Older stands may also have a sparse emergent layer of needle-leaved evergreen or cold-deciduous trees.
Wetland Indicator: No
Environmental Summary: The vegetation in this alliance occurs along the Pacific Coast in low-elevation (0-500 m) habitats which are under the influence of maritime air for much or all of the year. Precipitation is highly variable, ranging from 25-200 cm annually, with a pronounced dry period in summer. The shrublands are scattered on inner dune habitats from San Francisco Bay north to Oregon, where they form the outer fringe of woody vegetation. Salt spray and sand abrasion are typical stresses in these habitats. Away from the immediate coast, the shrublands are seral communities which follow fire, logging, or other disturbance in low-elevation forests.
Dynamics: *Baccharis pilularis* is a vigorous, short-lived pioneer species which can form dense even-aged stands. It may serve as a nurse plant for native grasses as well as coastal live oak, (*Quercus agrifolia*). When a *Baccharis pilularis* individual dies, live oak seedlings are released from competitive suppression. Ruderal stands may form on disturbed sites such as roadsides, levies, and sites of recent landslides.

JOMU: Stands of *Baccharis pilularis* are found exclusively on the north-facing slope of Mt. Wanda. One small stand is two-thirds of the way up Mt. Wanda. This small stand is well below the minimum mapping unit, and occurs in a relatively open area adjacent to *Quercus douglasii* woodland. The larger stand is adjacent to chamise chaparral at the toe of Mt. Wanda. The primary co-occurring species are *Heteromales arbutifolia*, *Lotus scoparius* and some *Adenostoma fascicularis* moving in from the chaparral. Compared to coyote brush shrublands on the coast, this stand is relatively open (40% vegetation cover). It also has very small *Quercus agrifolia* trees that seem to be stunted adults rather than encroaching saplings.

C. Tree Dominated Plant Communities

1.) California laurel (*Umbellularia californica)* forest: 74.100.00
System: Terrestrial
Class: Forest
Subclass: Evergreen forest
Group: Winter-rain broad-leaved evergreen sclerophyllous forest
Subgroup: Natural/semi-natural winter-rain broad-leaved evergreen sclerophyllous forest.
Formation: Lowland or submontane winter-rain evergreen sclerophyllous forest

Alliance description: Stands of this alliance are found in coastal California on intermittently flooded sites between sea level and 500 m elevation. Soils are primarily derived from sandstone or schist. Precipitation falls mostly between the months of November and May, averaging approximately 150 cm/year. Summers are dry, but

temperatures are mild due to the coastal influence. Winters are mild and wet. This alliance is dominated by *Umbellularia californica*, which is the sole or dominant tree in the canopy. Other trees present may include *Quercus chrysolepis, Quercus agrifolia, Quercus wislizeni, Arbutus menziesii, Sequoia sempervirens*, and *Lithocarpus densiflorus*. *Garrya elliptica* is a common shrub associate in coastal stands. The herbaceous layer is sparse or absent.
Nation: United States
United States Distribution: CA
Global Range: Stands of this alliance are found along the outer northern and central Coast Ranges.
Vegetation Summary: This alliance is dominated by *Umbellularia californica* which is the sole or dominant tree in the canopy. Other trees present may include *Quercus chrysolepis, Quercus agrifolia, Quercus wislizeni, Arbutus menziesii, Sequoia sempervirens*, and *Lithocarpus densiflorus*. *Garrya elliptica* is a common shrub associate in coastal stands. The herbaceous layer is sparse or absent.
Physiognomy: This lowland or submontane, winter-rain, evergreen sclerophyllous forest forms a continuous canopy less than 25 m in height. Shrubs are infrequent. The herbaceous layer is sparse or absent.
Wetland Indicator: N
Environmental Summary: Stands of this alliance are found in coastal California on intermittently flooded sites between sea level and 500 m elevation. Soils are primarily derived from sandstone or schist. Precipitation falls mostly between the months of November and May, averaging approximately 150 cm/year. Summers are dry, but temperatures are mild due to the coastal influence. Winters are mild and wet.
Dynamics: Periodic inundation with fresh water is needed to establish and maintain stands of this alliance.

JOMU: On Mt. Wanda *Umbellularia californica* forests are primarily along the riparian zones. The two primary drainages, Strentzel Creek and the one following the secondary nature trail are composed of Oak-Bay forest which tend toward a slight dominance by *Umbellularia californica*. *Quercus agrifolia* is always a co-occurring species in these stands, which have high litter cover and relatively low understory cover. The primary species found in the understory are *Toxicodendron diversilobum*, *Dryopteris arguta*, *Stachys rigida* and *Melica californica*. Other tree species that occur depending on adjacent community types are *Aesculus californica*, *Ptelea crenulata*, *Quercus kelloggii* and *Quercus lobata*. The stands that are dominated by *Umbellularia californica* rather than *Quercus agrifolia* tend to be slightly more mesic with a more dense canopy and directly within riparian zones compared to those dominated by coast live oak.

2.) <u>Coast live oak forest alliance</u>: 71.060.00
The following classification is the same as the *Umbellularia californica* forest rather than the one provided in Natureserve for *Quercus agrifolia* woodland. No *Quercus agrifolia* forest alliance is described, but the stands on Mt. Wanda are much denser than the surrounding woodlands, which is represented in the associated vegetation map.
System: Terrestrial
Class: Forest

Subclass: Evergreen forest
Group: Winter-rain broad-leaved evergreen sclerophyllous forest
Subgroup: Natural/semi-natural winter-rain broad-leaved evergreen sclerophyllous forest.
Formation: Lowland or submontane winter-rain evergreen sclerophyllous forest

The description below follows the Coast live oak woodland alliance description from Natureserve. All information provided in the woodland alliance description is relevant to the forest alliance that occurs on Mt. Wanda except that it has a continuous canopy and a less dense understory than that of a woodland (see "physiognomy").

Alliance description: This woodland alliance occurs between sea level and 1200 m on the flanks of the coastal mountains of California and Baja California, Mexico. Stands are usually found on slopes, often steep, and along raised streambanks and terraces. The precipitation regime in the range of this alliance is strongly Mediterranean, with most precipitation falling between November and April as rain. Summers are warm and dry, though the coastal influence moderates temperatures. Annual precipitation totals range from 20-50 cm. Stands of this woodland alliance contain *Quercus agrifolia* as an important or dominant species in the tree canopy. Other trees may include *Acer macrophyllum, Acer negundo, Quercus kelloggii, Quercus douglasii, Quercus engelmannii, Quercus dumosa, Umbellularia californica, Corylus cornuta, Arbutus menziesii*, and *Heteromeles arbutifolia*. The shrub layer may contain *Salvia mellifera, Rubus* spp., *Pteridium aquilinum, Rhamnus ilicifolia (= Rhamnus crocea ssp. ilicifolia), Artemisia californica, Adenostoma fasciculatum, Ceanothus oliganthus, Malosma laurina, Holodiscus discolor*, and *Toxicodendron diversilobum*. The herbaceous layer is grassy or absent, though *Symphoricarpos mollis* may be present.
Nation: United States
United States Distribution: CA
Distribution Outside Canada and the United States: Mexico
Global Range: This woodland alliance occurs in the coastal mountains of California and Baja California, Mexico. Stands are found in the northern, central, and southern Coast Ranges, the montane Peninsular and Transverse ranges, and the Baja Peninsula.
Vegetation Summary: Stands of this woodland alliance of coastal California and Baja California contain *Quercus agrifolia* as an important or dominant species in the tree canopy. Other trees may include *Acer macrophyllum, Acer negundo, Quercus kelloggii, Quercus douglasii, Quercus engelmannii, Quercus dumosa, Umbellularia californica, Corylus cornuta, Arbutus menziesii*, and *Heteromeles arbutifolia*. The shrub layer may contain *Salvia mellifera, Rubus* spp., *Pteridium aquilinum, Rhamnus ilicifolia (= Rhamnus crocea ssp. ilicifolia), Artemisia californica, Adenostoma fasciculatum, Ceanothus oliganthus, Malosma laurina, Holodiscus discolor*, and *Toxicodendron diversilobum*. The herbaceous layer is grassy or absent, though *Symphoricarpos mollis* may be present.
Physiognomy: This lowland or submontane, winter-rain, evergreen sclerophyllous forest forms a continuous canopy less than 30 m in height. Shrubs are occasional or common, and the herbaceous layer is grassy or absent. (This has been modified to fit the new *Quercus agrifolia* forest alliance).

Wetland Indicator: No
Environmental Summary: This woodland alliance occurs between sea level and 1200 m on the flanks of the coastal mountains of California and Baja California, Mexico. Stands are usually found on slopes, often steep, and along raised streambanks and terraces. The precipitation regime in the range of this alliance is strongly Mediterranean, with most precipitation falling between November and April as rain. Summers are warm and dry, though the coastal influence moderates temperatures. Annual precipitation totals range from 20 to 50 cm.
Dynamics: Stands of *Quercus agrifolia* seem to be dependant on permanent soil moisture at depth.

JOMU: The stands of vegetation dominated by *Quercus agrifolia* on Mt. Wanda are adjacent to and extremely similar to *Umbellularia californica* forests. They both occur in riparian zones and along drainages. *Quercus agrifolia* stands dominate in other areas as well such as north- and west-facing slopes. *Quercus agrifolia* is often within 5-10 % of *Umbellularia californica* cover. With few exceptions the understory and co-dominant species are similar for both alliances. In a few areas which tend to be relatively open and slightly drier, *Aesculus californica* takes over as the second most dominant tree species. *Ailanthus altissima* is a non-native tree that is commonly found in this forest type, often establishing from populations outside of the park boundary or from resprouts of established root systems.

3.) Olive woodland (*Olea europaea*) alliance:
No alliance authored.

The classification used follows *Umbellularia californica* and *Quercus agrifolia* forests, due to the ecology and physiology similarities.
System: Terrestrial
Class: Forest
Subclass: Evergreen forest
Group: Winter-rain broad-leaved evergreen sclerophyllous forest
Subgroup: Natural/semi-natural winter-rain broad-leaved evergreen sclerophyllous forest.
Formation: Lowland or submontane winter-rain evergreen sclerophyllous forest

JOMU: The *Olea europaea* trees present on Mt. Wanda are a relict of past land-use by the Strentzel and Muir families. The forest has become established and is adjacent to a Bay-Oak forest where the olive trees continue to encroach. *Olea europaea* are indigenous to a Mediterranean climate and are able to thrive in the coastal mountains of California. This forest community exists in only one location on Mt. Wanda on a relatively dry east-facing slope south of Strentzel creek. There is a continuous canopy, high litter cover in the center of the stand with a significant understory of grasses along the outer edge of stand. The understory is made up of primarily exotic annual grasses such as *Bromus diandrus, Bromus hordeaceus* and *Avena fatua* with some *Centaurea solstitialis* encroaching from adjacent populations in the grasslands.

4.) Oak (*Quercus*) forest alliance: 71.100.00
System: Terrestrial
Class: Forest
Subclass: Mixed evergreen-deciduous forest
Group: Mixed broad-leaved evergreen – cold-deciduous forest
Subgroup: Natural/semi-natural mixed broad-leaved evergreen – cold-deciduous forest
Formation: Mixed broad-leaved evergreen – cold-deciduous forest

Alliance description: Stands of this California forest alliance are found on moderately deep soils in gently sloping valleys. Soils are seasonally to permanently saturated at depth. The precipitation regime where this alliance occurs is strongly Mediterranean, with most precipitation falling as rain between November and April. Summers are quite warm and dry. Winters are cool, but frosts are rare. This alliance is characterized by the presence of several oak species, none of which achieve dominance. Characteristic oaks include *Quercus kelloggii, Quercus douglasii, Quercus agrifolia*, and *Quercus lobata*. Other trees in the canopy or subcanopy may include *Umbellularia californica, Aesculus californica, Pseudotsuga menziesii, Pinus sabiniana, Pinus ponderosa, Arbutus menziesii*, and *Heteromeles arbutifolia*. Shrubs may include *Frangula californica (= Rhamnus californica), Baccharis pilularis*, and *Toxicodendron diversilobum*.
Nation: United States
United States Distribution: CA
Global Range: Stands of this alliance are found in valleys in California's outer and inner northern Coast Ranges, the outer and inner central Coast Ranges, and the Sierra Nevada foothills.
Vegetation Summary: This alliance is characterized by the presence of several oak species, none of which achieve dominance. Characteristic oaks include *Quercus kelloggii, Quercus douglasii, Quercus agrifolia*, and *Quercus lobata*. Other trees in the canopy or subcanopy may include *Umbellularia californica, Aesculus californica, Pseudotsuga menziesii, Pinus sabiniana, Pinus ponderosa, Arbutus menziesii*, and *Heteromeles arbutifolia*. Shrubs may include *Frangula californica (= Rhamnus californica), Baccharis pilularis*, and *Toxicodendron diversilobum*.
Physiognomy: This mixed broad-leaved, evergreen, cold-deciduous forest forms a continuous canopy less than 30 m in height. A subcanopy may be present. Shrubs are infrequent to common, and the herbaceous layer is sparse to abundant and often grassy.
Wetland Indicator: No
Environmental Summary: Stands of this California forest alliance are found on moderately deep soils in gently sloping valleys. Soils are seasonally to permanently saturated at depth. The precipitation regime where this alliance occurs is strongly Mediterranean, with most precipitation falling as rain between November and April. Summers are quite warm and dry. Winters are cool, but frosts are rare.
Dynamics: This alliance is subject to periodic fires. Burns favor oaks over pines.

JOMU: There is only one *Quercus* forest alliance polygon on the vegetation map of Mt. Wanda. In this particular stand, there was no *Quercus* species that dominated the overstory. The area is essentially an ecotone where blue oak woodland meets with Coast live oak and semi-riparian forest on a west-facing slope. There are definitely other small

areas of Mt. Wanda where no one *Quercus* species dominates, but they are typically ecotones where distinct stands come together and are often not large enough to distinguish or capture with our methodology. The two dominant species are *Quercus douglasii* and *Quercus agrifolia* with significant cover of *Quercus kelloggii*. *Mimulus aurantiacus* is present in the understory, probably due to the proximity of a chaparral stand, along with *Toxicodendron diversilobum* and *Avena fatua*.

5.) Valley oak woodland alliance: 71.040.00
System: Terrestrial
Class: Woodland
Subclass: Deciduous woodland
Group: Cold-deciduous woodland
Subgroup: Natural/semi-natural cold-deciduous woodland
Formation: Cold-deciduous woodland

Alliance description: This California woodland alliance of valley bottoms and gentle slopes requires intermittently flooded, seasonally saturated soils. The soils are deep and alluvial or residual, and the water must be fresh. Elevations range from sea level to 775 m. The climate regime throughout the range of this alliance is strongly Mediterranean, with cool, moist winters and warm, dry summers. Most precipitation falls as rain between November and April. Yearly rainfall totals average approximately 60 cm. Stands of this woodland are dominated by *Quercus lobata*. Other trees in the canopy may include *Quercus kelloggii, Quercus douglasii, Quercus agrifolia, Platanus racemosa*, and *Fraxinus latifolia*. Occasional shrubs may include *Frangula californica ssp. californica*, and *Toxicodendron diversilobum*. Lianas, such as *Vitis californica*, are common. Annual grasses dominate the ground layer.
Nation: United States
United States Distribution: CA
Global Range: Stands of this alliance are found in California's Coast Ranges, the Great Central Valley, the foothills of the Sierra Nevada, the Cascades and the Klamath Range.
Vegetation Summary: Stands of this California woodland alliance are dominated by *Quercus lobata*. Other trees in the canopy may include *Quercus kelloggii, Quercus douglasii, Quercus agrifolia, Platanus racemosa*, and *Fraxinus latifolia*. Occasional shrubs may include *Frangula californica ssp. californica*, and *Toxicodendron diversilobum*. Lianas like *Vitis californica* are common. Annual grasses dominate the ground layer.
Physiognomy: This sclerophyllous, extremely xeromorphic evergreen woodland forms an open to continuous tree canopy less than 30 m in height. Shrubs are occasional and lianas are common. The herbaceous layer is dominated by graminoids.
Wetland Indicator: No
Environmental Summary: This woodland alliance of valley bottoms and gentle slopes requires intermittently flooded, seasonally saturated soils. The soils are deep and alluvial or residual, and the water must be fresh. Elevations range from sea level to 775 m. The climate regime throughout the range of this alliance is strongly Mediterranean, with cool, moist winters and warm, dry summers. Most precipitation falls as rain between November and April. Yearly rainfall totals average approximately 60 cm.

Dynamics: Periodic, low intensity floods help maintain this alliance. Stands are usually found outside the immediate zone of high energy flood waters, in the lower-energy margins of the floodplain.

JOMU: *Quercus lobata* is a common species represented in relatively low numbers in more diverse areas of *Quercus douglasii* woodlands and *Quercus agrifolia* forests. The only location of Mt. Wanda where *Quercus douglasii* dominates the canopy is the mid to upper portions of the south- and southwest-facing slope. The woodland is bordered at the top of Mt. Wanda by grassland and at the toe of Mt. Wanda by riparian forest along Strentzel Creek. The woodland is fairly open with tree cover estimated at only 25%. The understory is composed of the same grasses and forbs that make up the adjacent *Avena fatua* grasslands. *Quercus agrifolia* is present in low numbers throughout the stand with a slight increase in *Quercus douglasii* cover in the northern portion of the stand. Unlike the description above, on Mt. Wanda this vegetation type occurs on extremely steep slopes. There are several small drainages within this stand that are dominated by *Quercus agrifolia*; one drainage has a small seep that still had running water in July.

6.) Blue oak (*Quercus douglasii*) woodland alliance: 71.020.00
System: Terrestrial
Class: Woodland
Subclass: Deciduous woodland
Group: Cold-deciduous woodland
Subgroup: Natural/semi-natural cold-deciduous woodland
Formation: Cold-deciduous woodland

Alliance description: This woodland alliance of northern and central California occurs in savannas and foothills between 30 and 1700 m of elevation. Stands grow on shallow, infertile soils that are moderately to excessively drained. Many rock fragments are in the soil, and the soil surface is often covered with stones and rock outcrops. The climatic regime where this alliance grows is strongly Mediterranean with warm, dry summers, and cool, moist winters. Most precipitation falls as rain between November and April. Yearly rainfall totals average about 100 cm. This is one of the most floristically diverse of the oak woodlands. Many associations have been defined within the alliance. Also, stands dominated by *Quercus X alvordiana* are included. Typical stands contain *Quercus douglasii* as an important or dominant species in the tree canopy. The canopy may be two-tiered. Other trees that may be present include *Quercus agrifolia, Quercus wislizeni, Juniperus occidentalis var. occidentalis*, and *Pinus sabiniana*. Shrubs are infrequent to common, and composition of the shrub layer is highly variable. Shrubs present may include *Lupinus concinnus, Cercocarpus montanus var. glaber, Delphinium parryi, Collinsia sparsiflora, Bowlesia incana, Phacelia imbricata, Plantago erecta, Lotus wrangelianus, Amsinckia menziesii var. intermedia (= Amsinckia intermedia), Pentagramma triangularis, Ribes californicum, Ericameria linearifolia, Viola pedunculata, Lithophragma cymbalaria, Galium andrewsii, Rigiopappus leptocladus, Plagiobothrys nothofulvus, Trifolium ciliolatum, Eriogonum elongatum, Euphorbia spathulata, Ceanothus cuneatus, Arctostaphylos viscida, Erodium moschatum*, and *Lithophragma affine*. The ground is covered with graminoids and can include *Hordeum*

murinum ssp. leporinum (= Hordeum leporinum), Achnatherum lemmonii (= Stipa lemmonii), Nassella pulchra (= Stipa pulchra), and *Bromus diandrus*.
Nation: United States
United States Distribution: CA
Global Range: This alliance occurs in valleys of California's northern, central, and southern Coast Ranges, the Klamath Range, the foothills of the Cascades and Sierra Nevada, and the western Modoc Plateau.
Vegetation Summary: This is one of the most floristically diverse of the oak woodlands. Many associations have been defined within the alliance. Also, stands dominated by *Quercus X alvordiana* are included. Typical stands contain *Quercus douglasii* as an important or dominant species in the tree canopy. The canopy may be two-tiered. Other trees which may be present include *Quercus agrifolia, Quercus wislizeni, Juniperus occidentalis var. occidentalis*, and *Pinus sabiniana*. Shrubs are infrequent to common, and composition of the shrub layer is highly variable. Shrubs present may include *Lupinus concinnus, Cercocarpus montanus var. glaber, Delphinium parryi, Collinsia sparsiflora, Bowlesia incana, Phacelia imbricata, Plantago erecta, Lotus wrangelianus, Amsinckia menziesii var. intermedia (= Amsinckia intermedia), Pentagramma triangularis, Ribes californicum, Ericameria linearifolia, Viola pedunculata, Lithophragma cymbalaria, Galium andrewsii, Rigiopappus leptocladus, Plagiobothrys nothofulvus, Trifolium ciliolatum, Eriogonum elongatum, Euphorbia spathulata, Ceanothus cuneatus, Arctostaphylos viscida, Erodium moschatum*, and *Lithophragma affine*. The ground is covered with graminoids and can include *Hordeum murinum ssp. leporinum (= Hordeum leporinum), Achnatherum lemmonii (= Stipa lemmonii), Nassella pulchra (= Stipa pulchra)*, and *Bromus diandrus*.
Physiognomy: This cold-deciduous woodland of California's foothill valleys and slopes forms a one- or two-tiered canopy less than 18 m in height. Tree cover may be continuous, intermittent, or savanna-like. Shrubs are infrequent to common, and annual graminoids blanket the ground.
Wetland Indicator: No
Environmental Summary: This woodland alliance of northern and central California occurs in savannas and foothills between 30 and 1700 m elevation. Stands grow on shallow, infertile soils that are moderately to excessively drained. Many rock fragments are in the soil, and the soil surface is often covered with stones and rock outcrops. The climatic regime where this alliance grows is strongly Mediterranean with warm, dry summers, and cool, moist winters. Most precipitation falls as rain between November and April. Yearly rainfall totals average about 100 cm.
Dynamics: Stands that have had frequent fires favor *Quercus douglasii* over *Pinus sabiniana*.

JOMU: *Quercus douglasii* woodland is the most common tree dominated vegetation community on Mt. Wanda. This woodland occurs on the more xeric mid-slope areas of Mt. Wanda which are west-, north- and east-facing. The even drier south-facing aspects are dominated by *Quercus lobata*, which is a common species in many of the *Quercus douglasii* woodland stands. The understory of *Quercus douglasii* woodlands is basically composed of the same species as the *Avena fatua* grasslands. Some areas of *Quercus douglasii* have remarkable patches of native forbs and grasses that are often not in great

enough abundance to include in percent cover estimations. These species include *Chlorogalum pomeridianum* var. *pomeridianum*, *Claytonia perfoliata*, *Melica torreyana*, *Elymus glaucus*, and *Wyethia helenoides* and many others.

7.) Buckeye (*Aesculus californica*) woodland alliance: 75.000.00

System: Terrestrial
Class: Woodland
Subclass: Deciduous woodland
Group: Cold (drought*)-deciduous woodland
Subgroup: Natural/semi-natural cold (drought*)-deciduous woodland
Formation: Cold (drought*)-deciduous woodland
*Drought-deciduous was added to reflect the actual ecology of the species.

Alliance description: This woodland alliance of cismontane California requires shallow, excessively drained soils on steep, north-facing slopes. Elevations range from 100-1500 m. *Aesculus californica* is the dominant or important species in the tree layer and can attain tree size due to the low fire frequency. Other trees present may include *Umbellularia californica, Fraxinus dipetala, Pinus sabiniana, Prunus ilicifolia, Quercus wislizeni*, and *Heteromeles arbutifolia*. Shrubs are infrequent, and the herbaceous layer is sparse.
Nation: United States
United States Distribution: CA
Global Range: This alliance occurs throughout California's inner Coast Ranges, the Sierra Nevada foothills, and the montane Transverse Range.
Vegetation Summary: This woodland alliance of cismontane California contains *Aesculus californica* as a dominant or important species in the tree layer. Other trees present may include *Umbellularia californica, Fraxinus dipetala, Pinus sabiniana, Prunus ilicifolia, Quercus wislizeni*, and *Heteromeles arbutifolia*. Shrubs are infrequent, and the herbaceous layer is sparse.
Physiognomy: This deciduous woodland has a continuous to intermittent tree canopy less than 10 m in height. The tree canopy may be two-tiered. Shrubs are infrequent, and the herbaceous layer is sparse.
Wetland Indicator: No
Environmental Summary: This woodland alliance of cismontane California requires shallow, excessively drained soils on steep, north-facing slopes. Elevations range from 100-1500 m. *Aesculus californica* attains tree size in stands of this alliance due to the low fire frequency.
Dynamics: This alliance thrives in areas with low fire frequency. Stands grow on steep, north-facing slopes which tend to be cooler and moister than the surrounding terrain. These conditions provide some protection from fire, allowing *Aesculus californica* to attain tree stature.

JOMU: As described above, the stands dominated by *Aesculus californica* on Mt. Wanda are in relatively cool and moist areas. These tend to be the tops of drainages above where the canopy closes and *Quercus agrifolia* and/or *Umbellularia californica* take over. The understory is composed of the adjacent *Avena fatua* dominated grasslands

with a varying degree of shrub and small tree species including *Sambucus mexicanus*, *Toxicodendron diversilobum, Ptelea crenulata*, *Heteromales arbutifolia*, and *Ribes californica*. Common species in the canopy include *Quercus agrifolia*, *Umbellularia californica*, and *Quercus douglasii*. These stands dominated by *Aesculus californica* are similar to *Quercus* forest stands in that they are somewhat of an intermediary between vegetation types. *Aesculus californica* is a common species in many vegetation types on Mt. Wanda in relatively low abundance.

All of the data in "Plant Community Descriptions" not related specifically to the John Muir National Historic Site is from: NatureServe. 2004. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.0. NatureServe, Arlington, Virginia. Available http://www.natureserve.org/explorer. (Accessed: August 23, 2004).

Alliance codes are from the list of California terrestrial communities recognized by the California Natural Diversity Database (2003).

Appendix A
Vegetation Rapid Assessment Field Form

CALIFORNIA NATIVE PLANT SOCIETY - VEGETATION RAPID ASSESSMENT FIELD FORM

(Revised February 5, 2003)

For Office Use: Final database #: Final vegetation type name:
Alliance_____
Association_____

LOCATIONAL/ENVIRONMENTAL DESCRIPTION

Polygon/Stand #: Air photo #: Date: Name(s) of surveyors:
_____ _____ _____ _____
GPS waypoint #: _____ **GPS name:** _____ **GPS datum: (NAD 27)** _____ **Is GPS within stand? Yes / No**
If No cite distance (note ft/m), bearing and view from point to stand center: _____ **Error:** ±_____ **ft/m**
UTM field reading: UTME __ _ _ __ _ _ __ _ __ _ _ _ **UTMN** __ _ _ __ _ _ __ _ _ __ _ _ _ _ _ **UTM zone:** _____
Elevation: _____ **ft/m Photograph #'s**: _____
Topography: flat____ **concave**____ **convex**____ **undulating**____ **| bottom**____ **lower**____ **mid**____ **upper**____ **top**____
Geology: _____ **Soil Texture:** _____ **% Large Rock**_____ **% Small Rock**_____ **% Bare/Fines**_____
Slope exposure (circle one and/or enter actual º): **NE**_____ **SE**_____ **SW**_____ **NW**_____ **Flat**__ **Variable**__
Slope steepness (circle one and enter actual º): **0º**__ **1-5º** _____ **5-25º**_____ **> 25º**_____ **Upland** or **Wetland/Riparian** (circle one)
Site history, stand age, and comments: _____
_____
_____
Type / level of disturbance (use codes): _____

VEGETATION DESCRIPTION

Field-assessed vegetation alliance name: _____
Field-assessed association name (optional): _____
Size of stand: <1 acre___ **1-5 acres**___ **>5 acres**___ **Adjacent alliances:** _____ _____
_____ _____ _____ _____
Tree: T1 (<1" dbh), T2 (1-6" dbh), T3 (6-11" dbh), T4 (11-24" dbh), T5 (>24" dbh), T6 multi-layered (T3 or T4 layer under T5, >60% cover)
If Tree, list 1-3 dominant overstory spp.: _____
Shrub: S1 seedling (<3 yr. old), S2 young (<1% dead), S3 mature (1-25% dead), S4 decadent (>25% dead)
Herbaceous: H1 (<12" plant ht.), H2 (>12" ht.) **Desert Palm/Joshua Tree:** 1 (<1.5" base diameter), 2 (1.5-6" diam.), 3 (>6" diam.)
Desert Riparian Tree/Shrub: 1 (<2ft. stem ht.), 2 (2-10ft. ht.), 3 (10-20ft. ht.), 4 (>20ft. ht.)
% Overstory Conifer/Hardwood Tree cover: _____/_____ **Shrub cover:** _____ **Herbaceous cover:** _____ **Total Veg cover:**_____
Modal Conifer/Hardwood height: _____/_____ **Tall Shrub/Low Shrub height:** _____/_____ **Herbaceous height:** _____
Species (List up to 12 major species), Stratum, and Approximate % cover: (Jepson Manual nomenclature please)
Strata categories: T=tall, M=medium, L=low; **% cover** intervals for reference**: <1%, 1-5%, >5-15%, >15-25%, >25-50%, >50-75%, >75%**
Strata Species % cover Strata Species % cover
Major non-native species (with % cover): _____
Unusual species: _____

PROBLEMS WITH INTERPRETATION

Confidence in identification: (L, M, H) _____ **Explain** _____
Other identification problems (describe): _____
Polygon is more than one type: (Yes, No) _____ (Note: type with greatest coverage in polygon should be entered in above section)
Other types: _____ _____ _____
Has the vegetation changed since air photo taken? (Yes, No) _____ **If Yes, how? What has changed** (write N/A if so)**?** _____
_____

Appendix B
FDGC Metadata

John Muir Vegetation Mapping Project Metadata

Federal Geographic Data Committee (FGDC) Metadata for the associated GIS data:

Identification_Information:

Citation:
Citation_Information:
Originator: **Inventory and Monitoring Program, National Park Service**
Publication_Date: Unpublished Material
Title:
Vegetation Map- Mt. Wanda, John Muir National Historic Site - 2004
Geospatial_Data_Presentation_Form: vector digital data
Online_Linkage: **GOGA Network X:\Inventories\VegMap\JOMU**
Description:
Abstract:
The National Park Service (NPS), in conjunction with the Biological Resources Division (BRD) of the U.S. Geological Survey (USGS), has implemented a program to develop a uniform hierarchical vegetation mapping methodology and classification at a national level and apply it to National Parks. The purpose of the data is to document the state of vegetation on Mt. Wanda at the John Muir National Historic Site during 2004, thereby providing a snapshot of conditions to assist in future monitoring and management. The vegetation units of this map were determined through visual interpretation of aerial photographs supported by field sampling. The vegetation boundaries were identified on the photographs and the vegetation type was confirmed for each polygon by performing field surveys as outlined by the California Native Plant Society. The mapped vegetation reflects conditions present on Mt. Wanda during the months of May through August of 2004. Several sets of aerial photography were utilized for this project: 1.) color aerial photograph of Contra Costa County, March 2003, 1:24,000 provided by Contra Costa County 2.) black and white aerial photograph

There is an inherent margin of error in the use of aerial photography for vegetation delineation and classification.

Purpose:
These data provide a tool for use in the effective management and monitoring of the vegetation of Mt. Wanda. The John Muir National Historic Site, of which Mt. Wanda is part, was established in 1992. Mt. Wanda encompasses 325 acres of varied habitat, including deciduous and non-deciduous woodlands and forests, shrubland, and grasslands.
Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: Summer 2004
Currentness_Reference:
ground condition
Status:
Progress: Complete
Maintenance_and_Update_Frequency: None planned
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -122.139887
East_Bounding_Coordinate: -122.124889
North_Bounding_Coordinate: 37.990015
South_Bounding_Coordinate: 37.975108
Keywords:

Theme:

Theme_Keyword_Thesaurus: Natural Resources
Theme_Keyword: Inventory
Theme_Keyword: Plant Communities
Theme_Keyword: **Aerial Photo Interpretation**
Theme_Keyword: Vegetation
Theme_Keyword: Land Cover
Place:

Place_Keyword: John Muir National Historic Site
Place_Keyword: Mt. Wanda
Place_Keyword: National Park Service
Place_Keyword: Contra Costa County
Place_Keyword: Martinez
Access_Constraints: None
Use_Constraints:
Any person using the information presented here should fully understand the data collection and compilation procedures, as described in these metadata, before beginning analysis. The burden for determining fitness for use lies entirely with the user. For purposes of publication or dissemination, citations should be given to the National Park Service.
Point_of_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: **Inventory and Monitoring Program, National Park Service**
Contact_Address:

Address_Type: mailing and physical address
Address:

Fort Mason Building 201
City: San Francisco
State_or_Province: CA
Postal_Code: 94123
Country: USA
Contact_Voice_Telephone: 415-331-3679
Data_Set_Credit:

NPS
Security_Information:
Security_Classification_System: na
Native_Data_Set_Environment:
Microsoft Windows 2000 Version 5.1 (Build 2600) Service Pack 1; ESRI ArcCatalog 8.3.0.800
Data_Quality_Information:

Attribute_Accuracy:
Attribute_Accuracy_Report:
All attribute data was verified by hand. Polygons were reviewed to ensure they correctly reflected the field data collected. Any errors were checked against the vegetation field notes and corrections were input into the database.
Lineage:
Source_Information:
Source_Citation:
Citation_Information:
Publication_Date: Unpublished Material
Title:
Vegetation Map - Mt. Wanda, John Muir National Historic Site-2004

Source_Contribution:
All information from the Final Report associated with this project.
Spatial_Data_Organization_Information:

Direct_Spatial_Reference_Method: Vector
Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: G-polygon
Point_and_Vector_Object_Count: 38
Spatial_Reference_Information:

Horizontal_Coordinate_System_Definition:
Planar:
Grid_Coordinate_System:
Grid_Coordinate_System_Name: Universal Transverse Mercator
Universal_Transverse_Mercator:
UTM_Zone_Number: 10
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999600
Longitude_of_Central_Meridian: -123.000000
Latitude_of_Projection_Origin: 0.000000
False_Easting: 500000.000000
False_Northing: 0.000000
Planar_Coordinate_Information:
Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 0.000001
Ordinate_Resolution: 0.000001
Planar_Distance_Units: meters
Geodetic_Model:
Horizontal_Datum_Name: **North American Datum of 1983**
Ellipsoid_Name: **Geodetic Reference System 80**
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222
Entity_and_Attribute_Information:

Detailed_Description:
Entity_Type:
Entity_Type_Label: **Vegetation map-Mt. Wanda, John Muir National Historic Site-2004**
Attribute:
Attribute_Label: FID
Attribute_Definition:
Internal feature number.
Attribute_Definition_Source:
ESRI
Attribute_Domain_Values:
Unrepresentable_Domain:
Sequential unique whole numbers that are automatically generated.
Attribute:
Attribute_Label: Shape
Attribute_Definition:
Feature geometry.
Attribute_Definition_Source:
ESRI

Attribute_Domain_Values:
Unrepresentable_Domain:
Coordinates defining the features.
Attribute:
Attribute_Label: OBJECTID
Attribute:
Attribute_Label: Area
Attribute:
Attribute_Label: SHAPE_Leng
Attribute:
Attribute_Label: SHAPE_Area
Attribute_Definition:
Area of feature in internal units squared.
Attribute_Definition_Source:
ESRI
Attribute_Domain_Values:
Unrepresentable_Domain:
Positive real numbers that are automatically generated.
Attribute:
Attribute_Label: Alliance
Attribute_Definition:
A grouping of associations with a characteristic physiognomy and habitat and which share one or more diagnostic species typically found in the upper most or dominant stratum of the vegetation. Synonymous with series. Part of the national vegetation classification system.
Attribute_Definition_Source:
Proposed Standards for Association and Alliances of the U.S. National Vegetation Classification
Attribute:
Attribute_Label: Comment
Attribute:
Attribute_Label: Rcvr_Type
Attribute:
Attribute_Label: GPS_Date
Attribute:
Attribute_Label: GPS_Area
Attribute:
Attribute_Label: ID
Attribute:
Attribute_Label: Northing
Attribute:
Attribute_Label: Easting
Attribute:
Attribute_Label: Associatio
Attribute_Definition:
Association: A plant community based on dominant and up to several associated species. A recurring plant community with a characteristic range in species composition, specific diagnostic species, and a defined range in habitat conditions and physiognomy or structure. The most detailed floristic level of the national vegetation classification system
Attribute_Definition_Source:
Proposed Standards for Association and Alliances of the U.S. National Vegetation Classification
Attribute:
Attribute_Label: Class
Attribute:
Attribute_Label: Subclass
Attribute:
Attribute_Label: Formation
Attribute_Definition:

Life Form
Attribute_Definition_Source:
Vegetation Map Final Report
Attribute:
Attribute_Label: Group
Attribute_Definition:
Physiognomic Group: The level in the classification hierarchy below subclass based on leaf characters and identified and named in conjunction with broadly defined macroclimatic types to provide a structural-geographic orientation (Grossman et al. 1998).
Attribute_Definition_Source:
VegBank
Distribution_Information:

Resource_Description: Downloadable Data
Distribution_Liability:
The National Park Service shall not be held liable for improper or incorrect use of the data described and/or contained herein. These data and related graphics (i.e. “”GIF”” or “”JPG”” format files) are not legal documents and are not intended to be used as such.
The information contained in these data is dynamic and may change over time. The data are not better than the original sources from which they were derived. It is the responsibility of the data user to use the data appropriately and consistent within the limitations of geospatial data in general and these data in particular. The related graphics are intended to aid the data user in acquiring relevant data; it is not appropriate to use the related graphics as data.
The National Park Service gives no warranty, expressed or implied, as to the accuracy, reliability, or completeness of these data. It is strongly recommended that these data are directly acquired from an NPS server and not indirectly through other sources which may have changed the data in some way. Although these data have been processed successfully on computer systems at the National Park Service, no warranty expressed or implied is made regarding the utility of the data on other systems for general or scientific purposes, nor shall the act of distribution constitute any such warranty. This disclaimer applies both to individual use of the data and aggregate use with other data.
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Transfer_Size: 0.170
Fees: None
Ordering_Instructions:
Download from website, phone call or send email to request FTP download.
Metadata_Reference_Information:

Metadata_Date: 20040812
Metadata_Contact:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: **Inventory and Monitoring Program, National Park Service**
Contact_Address:
Address_Type: mailing and physical address
Address:
Fort Mason, Building 201
City: San Francisco
State_or_Province: CA
Postal_Code: 94123
Country: USA
Contact_Voice_Telephone: 415-331-3679

Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata

Metadata_Standard_Version: FGDC-STD-001-1998

Metadata_Time_Convention: local time

Metadata_Extensions:

Online_Linkage: http://www.esri.com/metadata/esriprof80.html

Profile_Name: ESRI Metadata Profile

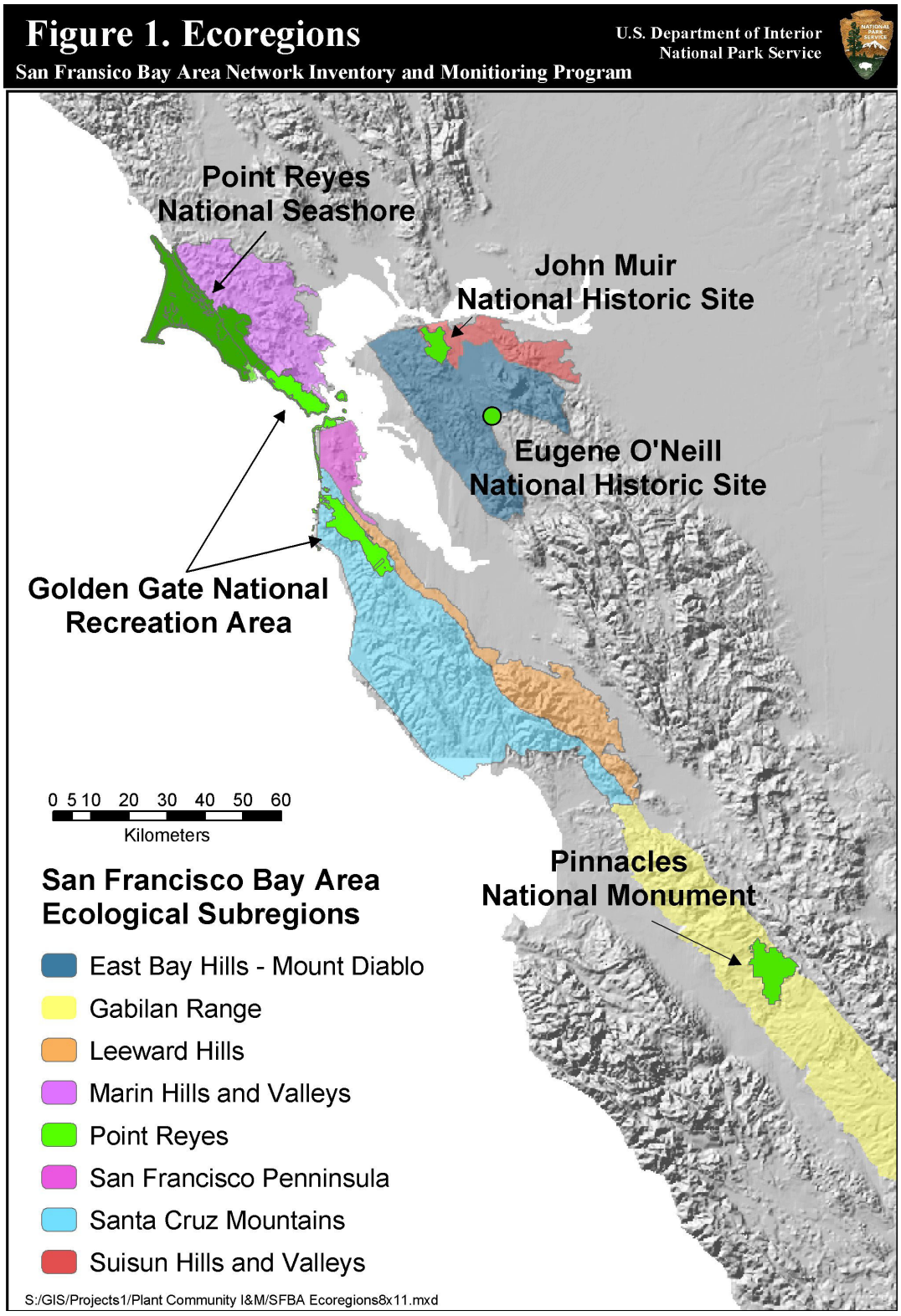

Figure 1. San Francisco Bay Area Ecoregions: Location of John Muir National Historic Site (JOMU).

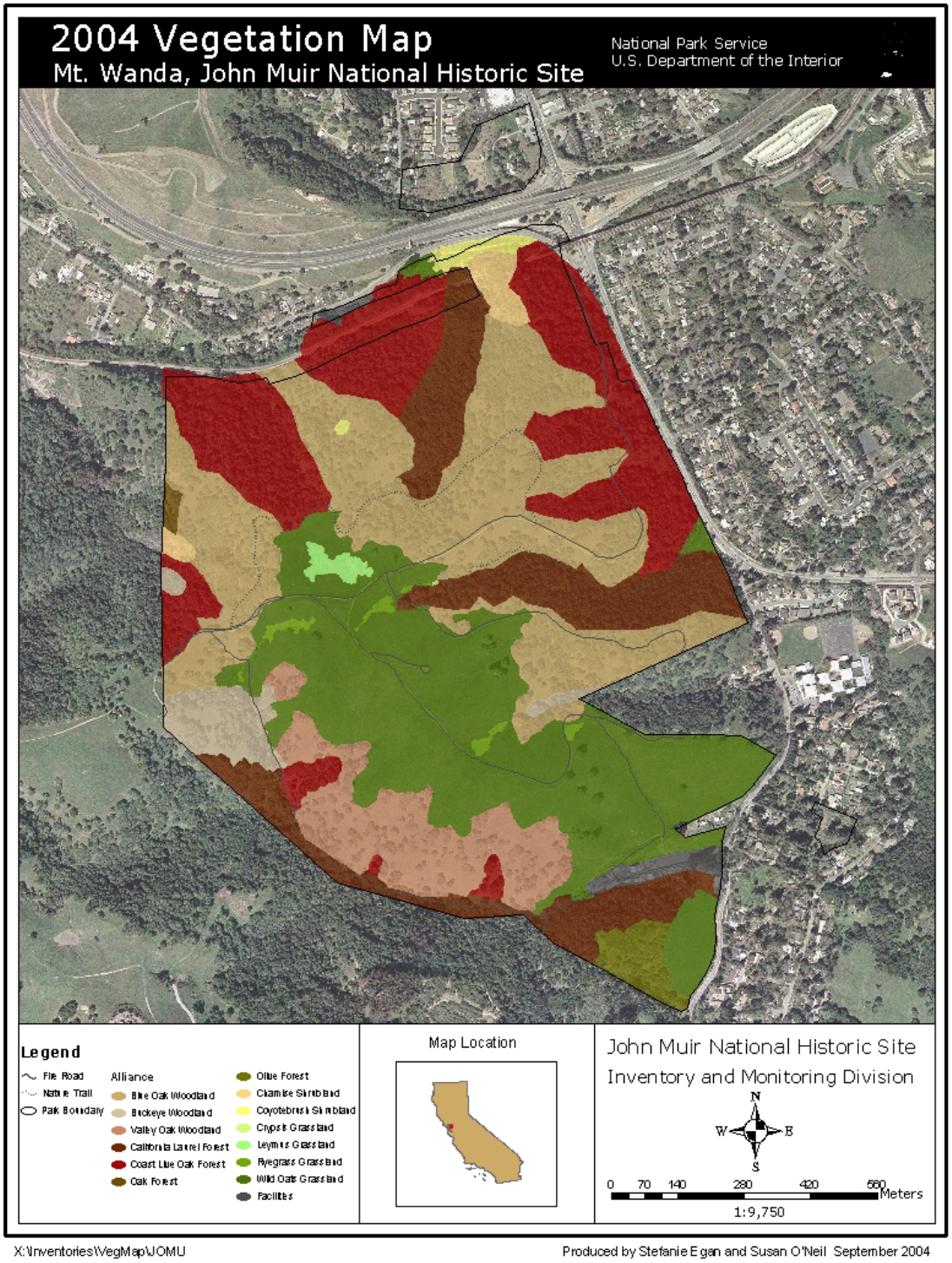

Figure 2. Vegetation alliances of Mt. Wanda, John Muir National Historic Site, 2004. (color aerial photograph 2003)

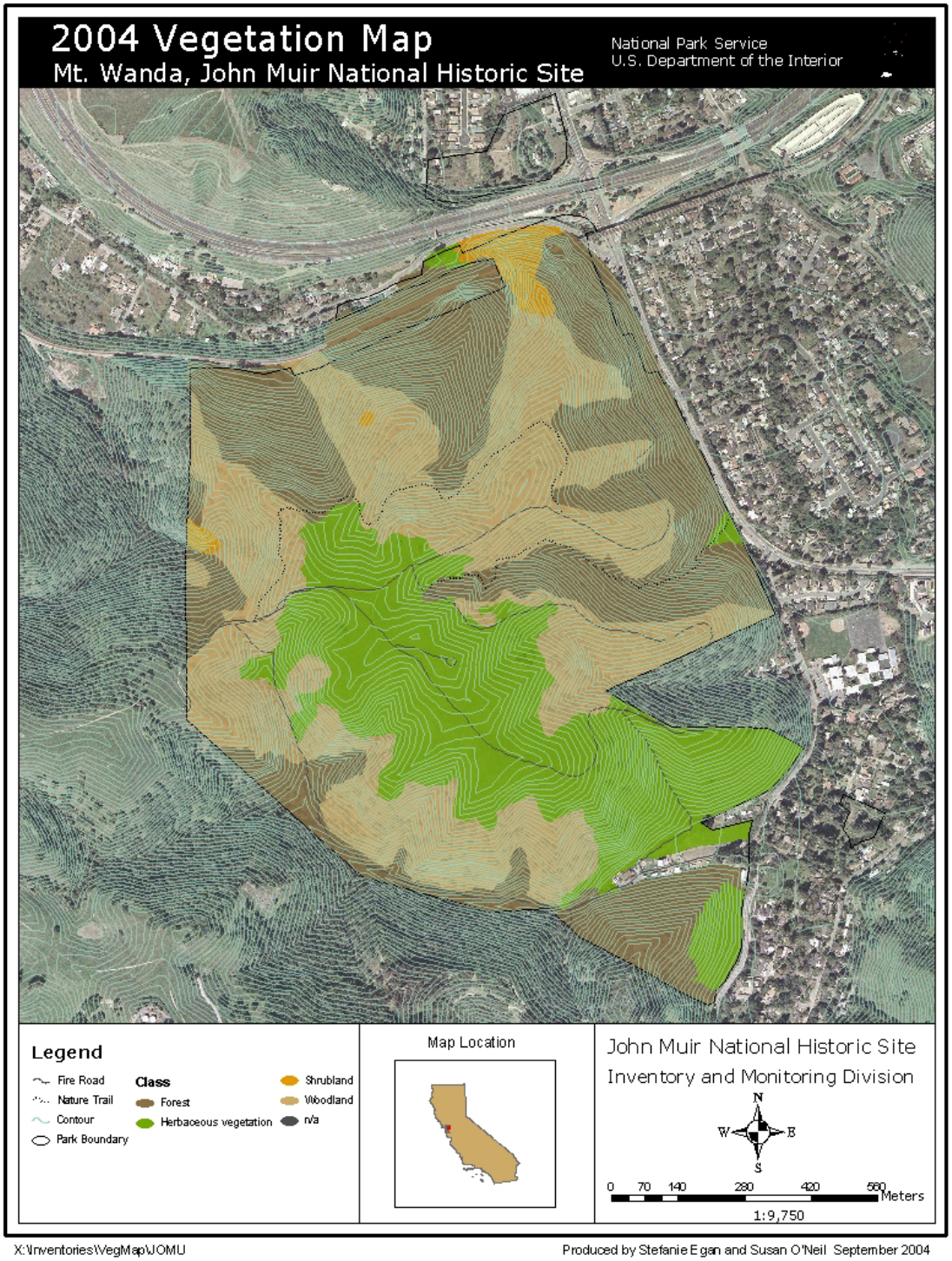

Figure 3. Vegetation classes of Mt. Wanda, John Muir National Historic Site, 2004 (color aerial photograph 2003).

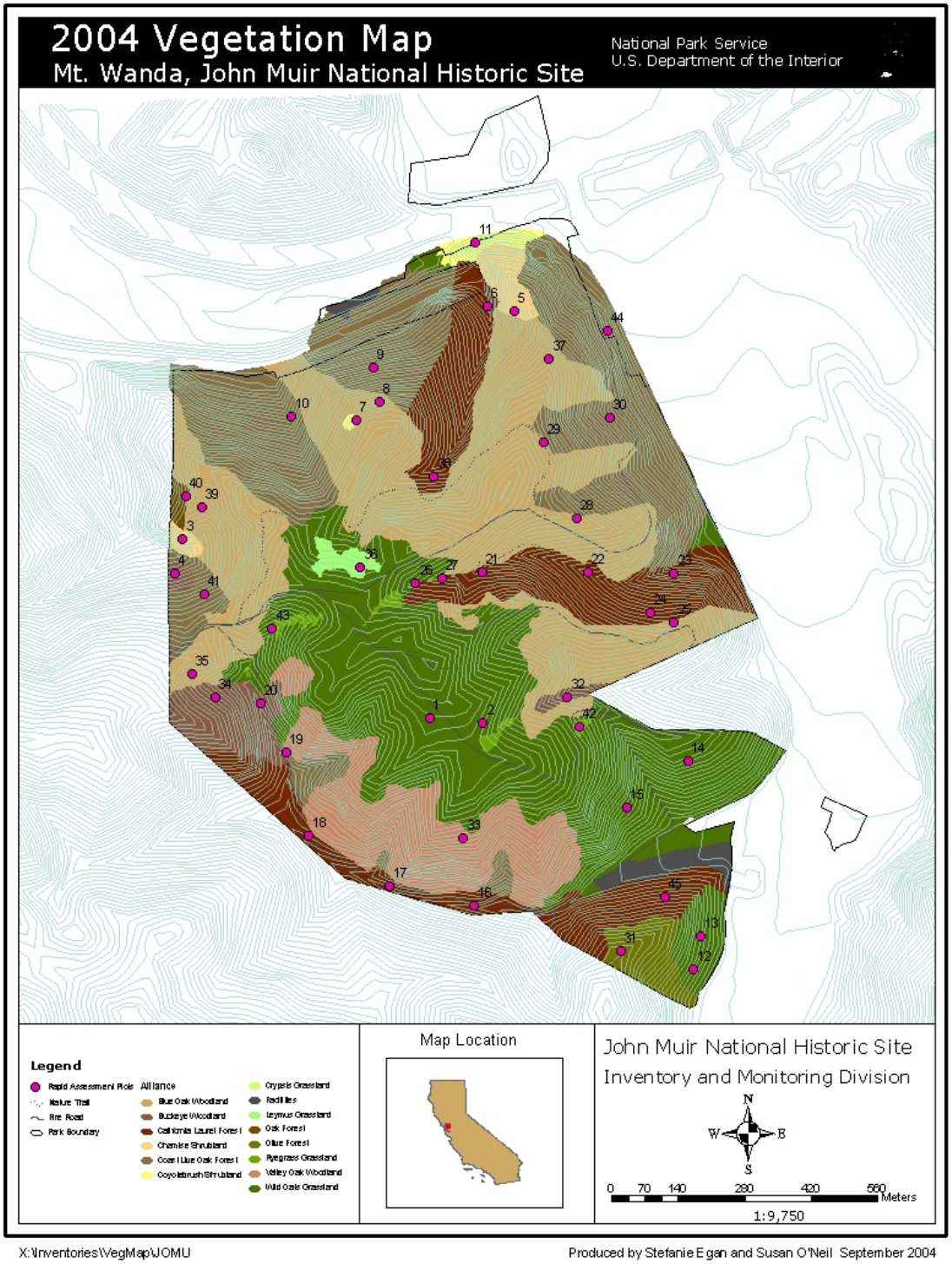

Figure 4. Rapid assessment plots of Mt. Wanda, John Muir National Historic Site, 2004.

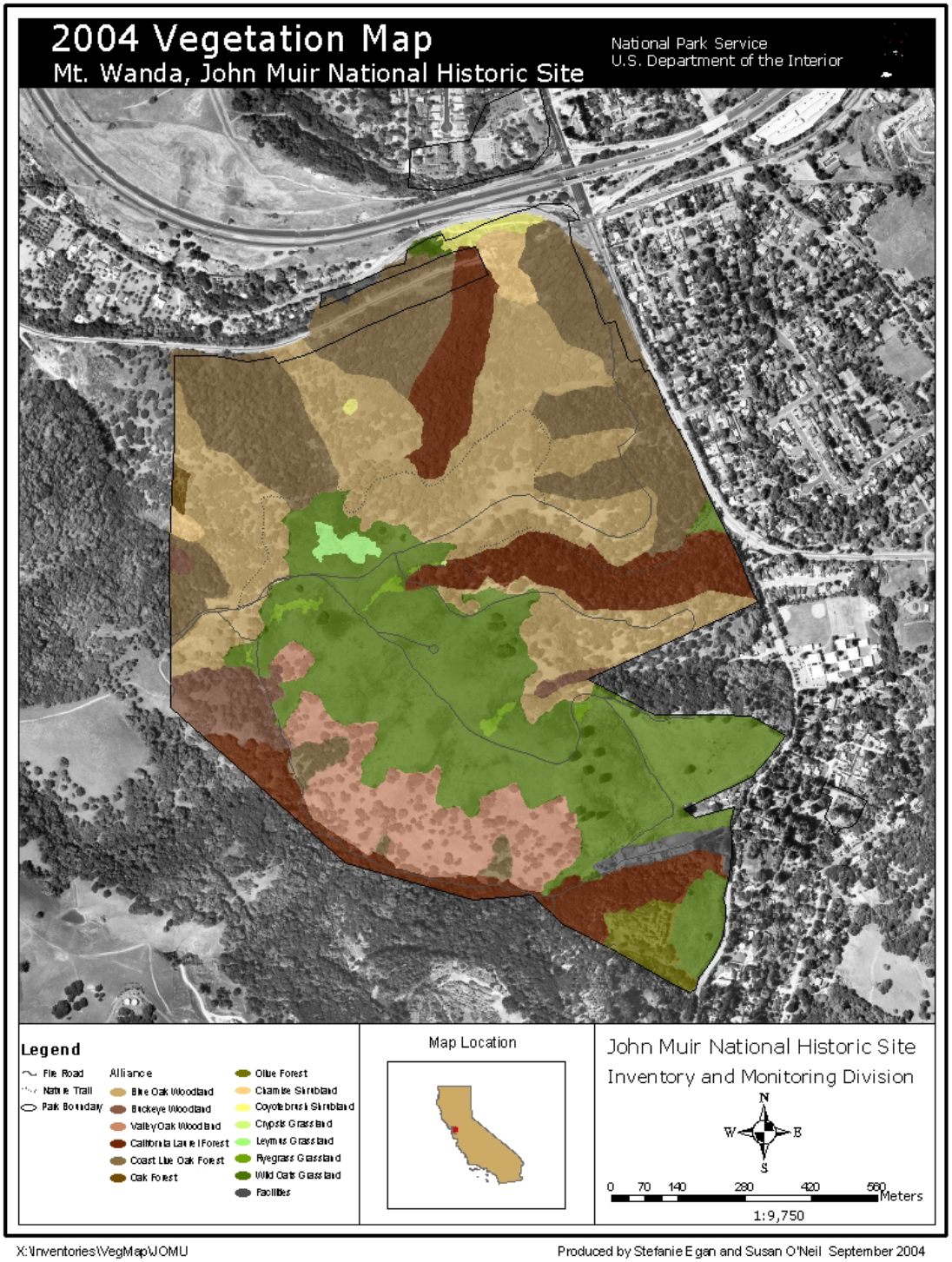

Figure 5. Vegetation alliances of Mt. Wanda, John Muir National Historic Site, 2004 (black and white aerial photograph 2000).

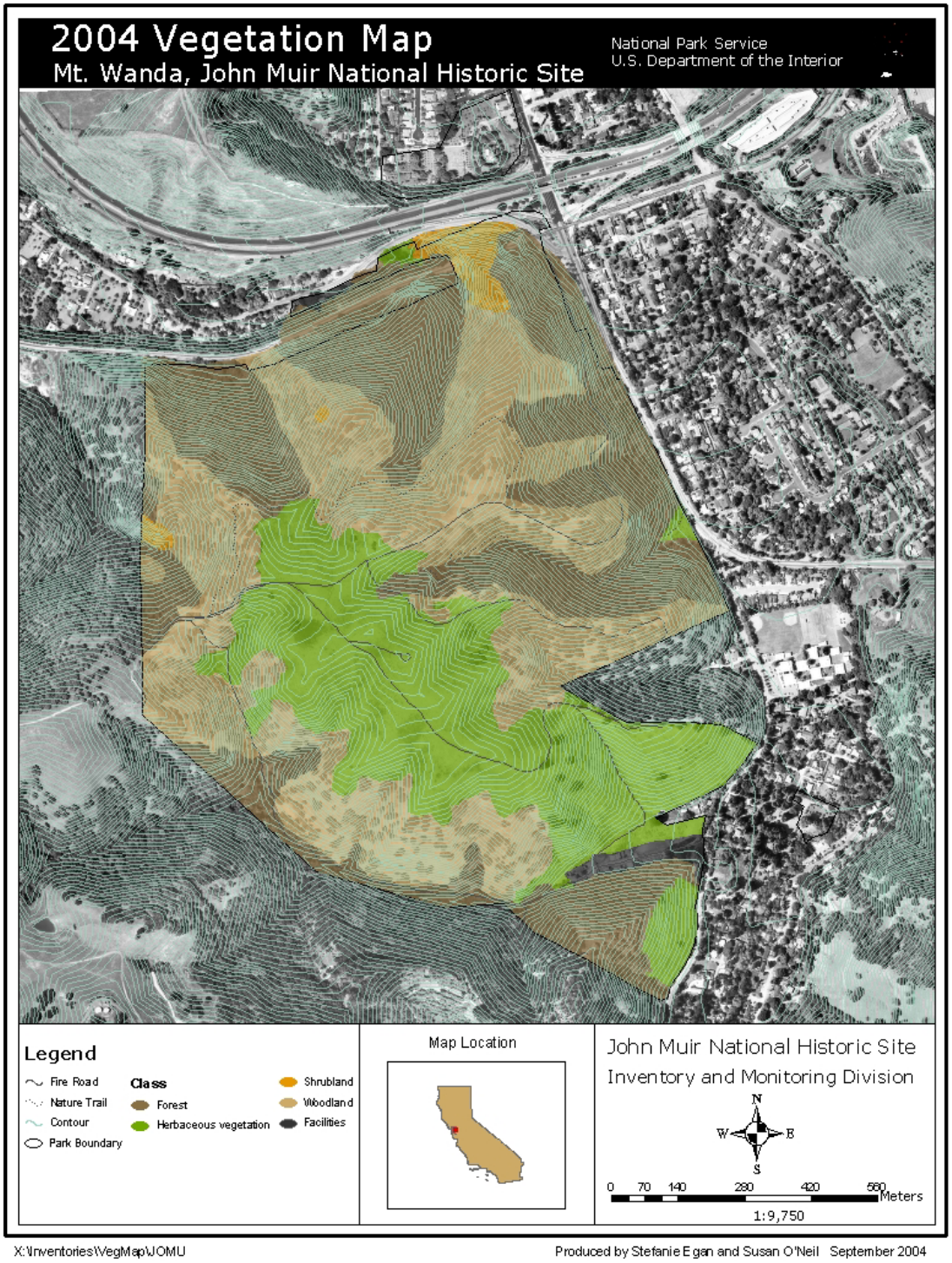

Figure 6. Vegetation classes of Mt. Wanda, John Muir National Historic Site, 2004 (black and white aerial photograph 2000).