Photo Series
For Quantifying Natural Fuels

Oak-Bay Woodlands, Douglas-fir, and Redwood Forests
on Midpeninsula Regional Open Space District Lands

ABSTRACT

This report and associated fuel assessment were heavily informed by *Stereo photo series for quantifying natural fuels. Volume XIII: grasslands, shrublands, oak-bay woodlands, and eucalyptus forests in the East Bay of California* (Wright & Vihnanek 2014. PNW-GTR-893).

Four series of photographs display a range of conditions and fuel loadings for oak woodlands, bay woodland, Douglas-fir forests and redwood forest ecosystems on Midpeninsula Regional Open Space District (Midpen, District) lands, typical of coastal mountain forests of the central coast of California. Each group of photos includes inventory information summarizing vegetation composition, structure, and loading; woody material loading and density by size class; forest floor depth and loading; and various site characteristics. This photo series is designed to help land managers appraise fuel and vegetation conditions on District lands.

WHAT IS THE NATURAL FUELS PHOTO SERIES?

This Natural Fuels Photo Series is a set of photographs with accompanying fuel bed characteristics data from sites in various stages of fuel loading and need of fuel reduction and forest thinning treatment. Sites include photographs supplemented with information on living and dead fuels, vegetation, and stand structure and composition within the area visible in the photographs (fig. 1). While this work was informed and constructed by the East Bay Natural Fuels Photo Series and expands on the vegetation alliances within the Bay Area, this effort does not continue the Natural Fuels Photo Series (Wright & Vihnanek 2014) or any of the other associated volumes (Ottmar et al. 2000, Ottmar et al. 2004).

WHY IS THE PHOTO SERIES NEEDED?

The photo series is a land management tool that can be used to assess landscapes through appraisal of living and dead woody material and vegetation (i.e., fuels) and stand characteristics. Once an assessment has been completed, stand treatment options, such as prescribed fire, mechanical or hand fuel reduction, or harvesting, can be planned and implemented with greater detail and precision to better achieve desired effects while minimizing negative impacts on other resources.

The photo series has application in several branches of natural resource science and management. Inventory data such as these can be used as inputs for evaluating animal habitat, nutrient cycling, and microclimate, for example. Fire managers will find these data useful for predicting fuel consumption, smoke production, fire behavior, and fire effects during wildfires and prescribed fires. In

addition, the photo series can be used to appraise carbon sequestration, an important factor in predictions of future climate, and to link remotely sensed signatures to live and dead fuels on the ground. Other photo series have proved useful in discussions of proposed treatment options with citizens, public officials, and agency administrators.

Ground-based inventory procedures that directly measure site conditions (e.g., fuel loading and arrangement, vegetation structure and composition, etc.) exist for most ecosystem types and are useful when a high degree of accuracy is required. Ground-based inventory is time consuming and expensive, however. Photo series can be used to make quick, easy, and inexpensive determinations of fuel quantities and stand conditions when less precise estimates are acceptable.

HOW WAS THE PHOTO SERIES DEVELOPED?

Sites photographed for the series in this volume were selected to represent a range of conditions in ecosystem types that are common throughout Midpeninsula Regional Open Space lands. They are also characteristic of sites in similar ecosystem types through the greater San Francisco Bay area, as well as adjoining lands to the north and south. The sites are organized into four series: oak woodlands, bay woodland, Douglas-fir forests and redwood forest. Photographs were taken, and fuel loading, stand structure, and composition data were collected by using modified procedures of Wright & Vihnanek 2014, which were developed using Maxwell and Ward (1980a) as a guide.

PHOTOGRAPHS

Photographs are included with all series to help land managers appraise natural fuel, vegetation, and stand structure conditions. The marker in all of the photographs is a 1-ft square, and the pole is painted in contrasting colors at 1-ft intervals to provide scale. The pole is 6-ft tall and 30 ft from the camera. The summary data relate to the field of view of the stereo-pair photographs. Note that no sampling occurs in the foreground between the camera and the sign.

PHOTOGRAPH AND INFORMATION ARRANGEMENT

The photographs and accompanying data summaries are presented as single sites organized into four series. Each site shown includes photographs and summaries of vegetation composition and structure. The series also includes general site information and summary vegetation information, as well as data describing the shrub, litter, and dead and down woody fuel components. Each site is arranged to occupy two facing pages. The upper page contains a photograph and general site and stand information. The lower page

includes the summaries of overstory structure and composition; understory vegetation structure and composition; and downed woody material loading and density by size class.

SITE AND STAND INFORMATION

The camera point of each site was located with a global positioning system receiver, and aspect and slope were measured with a compass and clinometer, respectively. Fine Scale Map Class, vegetation types determined from vegetation mapping done Tuckman Geospatial and adhering to National Vegetation Classification (NVCS) map classes, and ecological community classification to the association level (Buck-Diaz et al. 2012, NatureServe 2013) were assigned for all sites. A list of the most common grass, forb, and shrub species is included. The listing of species was not meant to be a complete vegetation inventory and represents only a portion of the species richness of the sampled areas.

Tree composition and density were determined by a partial inventory (three 0.02-ac subplots) of the sample area for all trees greater than 3 in diameter at breast height (d.b.h.) and on three 0.005-ac circular plots for all trees greater than 4.5 ft tall and less than or equal to 3 in d.b.h. (fig. 1); trees less than 4.5 ft tall were considered seedlings. Seedling composition and density were also measured on three 0.005-ac circular plots.

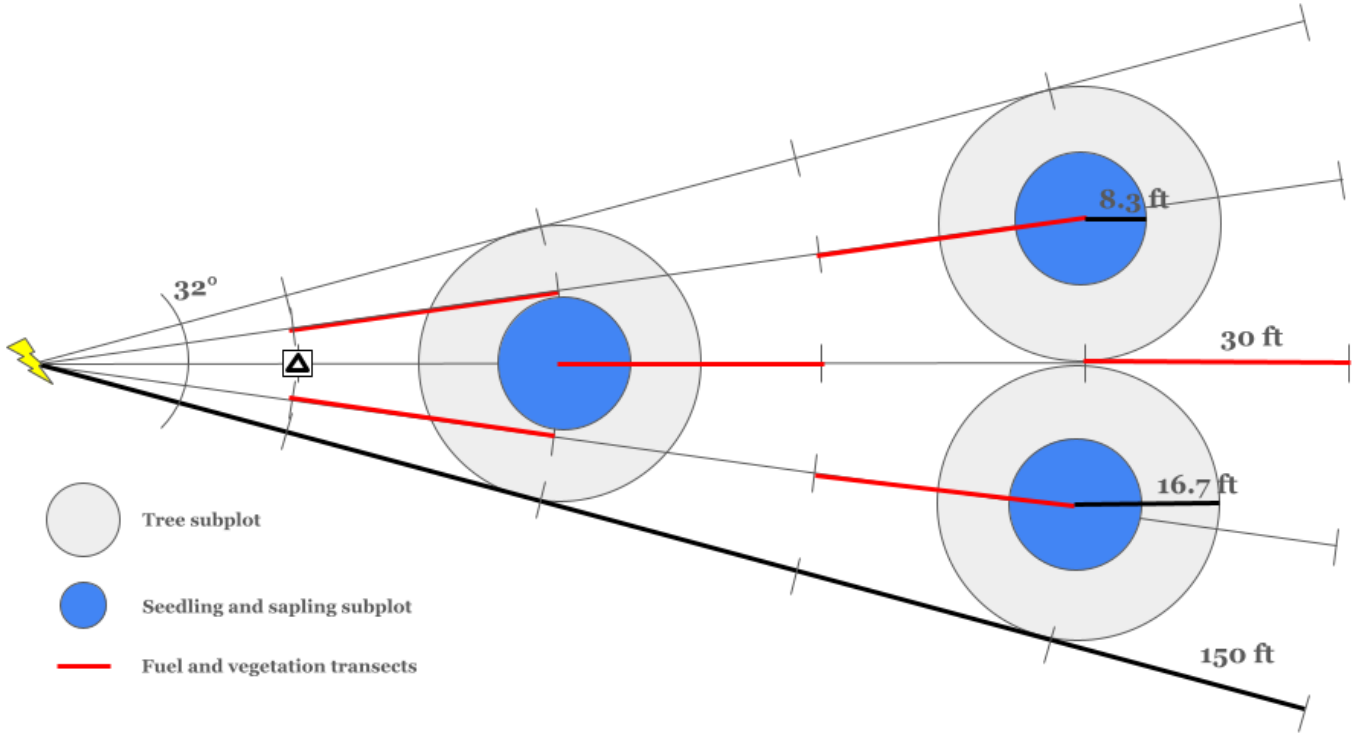

Figure 1. Photo series sample area layout. The sample area extended 150ft from the camera. Six planar intercept transects for measuring dead and down woody fuels and vegetation were located throughout the sample area. Trees, seedlings, and saplings were inventoried and measured within the three systematically located sample plots.

VEGETATION COVER AND BIOMASS ESTIMATION

Shrub, herbaceous, and grass coverage (along with litter coverage and mineral soil exposure) were estimated by using line intercept transects (Canfield 1941). Vegetation cover and heights was measured along six 30-ft transects located systematically throughout the sample area. Vegetation biomass was estimated using equations from Brown and Marsden (1976).

LITTER AND DUFF

Litter coverage (and mineral soil exposure) was measured by using the line intercept method (Canfield 1941), and is reported with site information. Litter and duff loading was estimated by recording each respective depth (thickness) at two points along each of the six transects. To compute litter and duff weights per unit area, the depth was multiplied by bulk density for the forest type and a unit-conversion factor. Since the depth was measured in inches, the unit-conversion factor of 1.815 was applied to yield tons per acre (GTR NRS-22).

WOODY MATERIAL

Measurement techniques used for inventorying dead and down woody material were patterned after the planar intersect method outlined by Brown (1974) and described by Maxwell and Ward (1980a). Transects within the sample area were used to determine woody material loading and density (fig. 1). Woody material data are reported by size classes that correspond to timelag fuel classes used in fire behavior modeling (see, for example, Burgan and Rothermel 1984). Woody material in 1-, 10-, and 100-hour and-larger size classes was tallied on transects that were 6, 6, and 10 ft long, respectively. The decay class and the actual diameter at the point of intersection were measured for all pieces greater than 3 inches in diameter. All woody material less than or equal to 3 inches in diameter was considered sound. Woody material loading was calculated from relationships that use number of pieces intersected and transect length (and wood specific gravity for loading) developed by Brown (1974).

SAPLINGS AND TREES

Overstory tree (i.e., trees greater than 3 in d.b.h.) composition and density were determined by a partial inventory of the sample area. Sapling (i.e., trees less than or equal to 3 in d.b.h. and greater than 4.5 ft tall) composition and density were estimated by using three 0.005-ac circular plots located systematically throughout the sample area (fig. 1). Tree measurement data were summarized by d.b.h. size class and by tree status (all, live, or dead). Each stem was measured in cases where trees forked below 4.5 ft. The two most abundant tree species for each size class are listed with their relative density. Height to crown base was defined as the height of the lowest, continuous live or dead branch material of the tree canopy, and height to live crown was defined as the height of the lowest continuous live branches of the tree canopy. All height measurements were made by using a laser rangefinder with an inclinometer.

USING THE PHOTO SERIES

The natural fuels photo series is a tool for quickly and inexpensively evaluating a variety of fuel and vegetation conditions. Because of its ease of use, care must be taken when evaluating field sites to compare only with photo series sites that are appropriate matches. It is acceptable, however, to use the data from more than one site from the photo series when evaluating a site in the field (e.g., woody material loading from one site in the photo series and tree density from another site in the photo series to best match the conditions of a given field site).

Make a visual inventory of the site by observing fuel and stand conditions within the field of view and comparing them with the photographs as follows, remembering that the data tables relate to the area behind the sign in the photographs:

· Observe each fuel and vegetation characteristic (e.g., 1.1- to 3.0-in woody material loading).

· Select a photo series site (or sites) that nearly matches (or brackets) the observed characteristics.

· Obtain the quantitative value for the characteristic being estimated from the data summary accompanying the selected photo series site, or interpolate a value between sites.

· Repeat these steps for each characteristic of interest.

The total biomass or stand condition can then be calculated by summing the estimates. If the site being inventoried has areas with obvious differences in composition, structure, or condition, the user should make separate determinations for each area and then weight and sum the characteristics for the whole site.

Characteristics not distinguishable in the photographs are litter or forest floor depth, loading, and bulk density. If values for these characteristics are desired in the inventory, they must be derived from independent sampling or observations.

Midpeninsula Regional Open Space District

OAK WOODLAND PHOTO SERIES

A SERIES OF FOUR SITES
QUAG 01 – QUAG 04

NOTES TO USERS:

1. The sites in this series are arranged in order of increasing tree density.

2. This series represents some woodland types in the Santa Cruz mountains. Sites with similar vegetation and fuel attributes from other Natural Fuels Photo Series publications can be referenced to supplement the sites reported here. Figure 4 shows where sites from this series fit relative to other sites in the series.

3. Although referred to as “woodlands,” the sites dominated by *Quercus agrifolia* and *Umbellularia californica* in this series are quite dense and do not meet the typical definition of woodlands for which canopy coverage is generally considered to be between 25 and 60 percent.

4. Photographs were taken and sampling was performed in June 2025.

5. The marker in these photographs is a 1-ft square, and the pole is painted in contrasting colors at 1-ft intervals. The pole is 30 ft from the camera and is 6 ft tall. Note that no sampling occurs in the foreground between the camera and the sign.

6. A distinction is made between rotten and sound woody material for pieces larger than 3 inches in diameter.

QUAG 01 OAK WOODLAND

SITE AND STAND INFORMATION

Site Location: 37.332018, -122.175785
Elevation: 1,942 ft Aspect: 256° Slope: 36%
Preserve: Los Trancos

Fine Scale Map Class: *Quercus agrifolia* Alliance

Litter loading: 3.8 tons/acre
Litter depth: 0.6 inches
Litter coverage: 91.4%

Trees (Density (trees/acre); % of stems)
Quercus agrifolia: 187 TPA, 79%
Arbutus menziesii: 34 TPA, 14%

Saplings (Density; % of stems)
Umbellularia californica: 134 TPA, 100%

Seedlings (Density; % of stems)
Quercus agrifolia: 2144 TPA, 97%
Umbellularia californica: 67 TPA, 3%

Crown closure: 65%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	UMCA	QUAG	QUAG	QUAG	QUAG
Second most common species	--	--	ARME	--	ARME
Tree density (stems/ac)					
Live	17	17	136	17	187
Dead	--	17	34	--	51
Avg. height (ft)					
Live	19.4	33.9	49.8	69.2	47.4
Dead	--	16.8	23.1	--	21.0
Avg. d.b.h. (in)	3.2	7.1	15.4	35.0	14.7
Avg. HCB (ft)	7.9	3.9	20.2	29.9	17.7
Avg. HLC (ft)	7.9	3.9	20.2	29.9	17.7

HCB: height to crown base (live and dead branches)
HCL: height to live crown (live branches only)

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	1.4	--	1.4
10-hr	9.7	--	9.7
100-hr	10.8	--	10.8
3.0-9.0 in	1.6	16.0	17.6
>9.0 in	--	--	--
Total	23.5	16.0	39.5

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	--	7.2	1.4
Avg height (ft)	--	0.4	0.8
Biomass (tons/ac)	--	0.4	0.8

QUAG 01 OAK WOODLAND

QUAG 02 OAK WOODLAND

SITE AND STAND INFORMATION

Site Location: 37.331735, -122.177033
Elevation: 1,882 ft Aspect: 180° Slope: 29%
Preserve: Los Trancos

Fine Scale Map Class: *Quercus agrifolia* Alliance

Litter loading: 9.7 tons/acre
Litter depth: 1.6 inches
Litter coverage: 93.6%

Trees (Density (trees/acre); % of stems)
Quercus agrifolia: 187 TPA, 52%
Umbellularia californica: 170 TPA, 48%

Saplings (Density; % of stems)
Quercus agrifolia: 268 TPA, 80%
Umbellularia californica: 67 TPA, 20%

Seedlings (Density; % of stems)
Quercus agrifolia: 2144 TPA, 80%
Umbellularia californica: 536 TPA, 20%

Crown closure: 67%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	--	UMCA	QUAG	--	QUAG
Second most common species	--	QUAG	UMCA	--	UMCA
Tree density (stems/ac)					
Live	17	102	153	--	272
Dead	--	51	34	--	85
Avg. height (ft)					
Live	22.4	33.8	53.1	--	44.0
Dead	--	19.5	16.9	--	18.4
Avg. d.b.h. (in)	3.2	7.2	13.0	--	10.0
Avg. HCB (ft)	4.5	9.8	20.6	--	15.2
Avg. HLC (ft)	4.5	9.8	20.6	--	15.2

HCB: height to crown base (live and dead branches)
HCL: height to live crown (live branches only)

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	2.6	--	2.6
10-hr	12.7	--	12.7
100-hr	16.6	--	16.6
3.0-9.0 in	27.0	44.0	71.0
>9.0 in	50.1	--	50.1
Total	109.0	44.0	153.0

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	2.5	2.8	1.1
Avg height (ft)	1.5	0.7	0.5
Biomass (tons/ac)	0.4	0.6	0.5

QUAG 03 OAK WOODLAND

SITE AND STAND INFORMATION

Site Location: 37.314018, -122.175515
Elevation: 2,037 ft Aspect: 304° Slope: 18%
Preserve: Monte Bello

Fine Scale Map Class: *Quercus agrifolia* Alliance

Litter loading: 8.1 tons/acre
Litter depth: 1.3 inches
Litter coverage: 87.9 %

Trees (Density (trees/acre); % of stems)
Quercus agrifolia: 391 TPA, 100%

Saplings (Density; % of stems)
Quercus agrifolia: 670 TPA, 100%

Seedlings (Density; % of stems)
Quercus agrifolia: 5293 TPA, 100%

Crown closure: 75%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	QUAG	QUAG	QUAG	--	QUAG
Second most common species	--	--	--	--	--
Tree density (stems/ac)					
Live	51	153	170	--	374
Dead	--	17	--	--	17
Avg. height (ft)					
Live	17.0	30.4	35.2	--	30.8
Dead	--	22.5	--	--	22.5
Avg. d.b.h. (in)	3.7	6.4	15.1	--	8.7
Avg. HCB (ft)	6.0	14.6	12.3	--	12.5
Avg. HLC (ft)	6.7	14.9	12.7	--	15.0

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	2.2	--	2.2
10-hr	12.2	--	12.2
100-hr	20.4	--	20.4
3.0-9.0 in	2.0	4.2	6.2
>9.0 in	--	--	--
Total	36.8	4.2	41.0

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	7.8	3.5	0.8
Avg height (ft)	1.5	0.5	0.8
Biomass (tons/ac)	1.1	0.5	0.6

QUAG 03 OAK WOODLAND

QUAG 04 OAK WOODLAND

SITE AND STAND INFORMATION

Site Location: 37.332545, -122.176272
Elevation: 1,967 ft Aspect: 118° Slope: 18%
Preserve: Los Trancos

Fine Scale Map Class: *Quercus agrifolia* Alliance

Litter loading: 8.5 tons/acre
Litter depth: 1.4 inches
Litter coverage: 92.5%

Trees (Density (trees/acre); % of stems)
Quercus agrifolia: 442 TPA, 90%
Arbutus menziesii: 17 TPA, 3%

Saplings (Density; % of stems)
Quercus agrifolia: 4020 TPA, 87%
Arbutus menziesii: 603 TPA, 13%

Seedlings (Density; % of stems)
Quercus agrifolia: 3350 TPA, 100%

Crown closure: 90%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	QUAG	QUAG	QUAG	--	QUAG
Second most common species	ARME	--	--	--	ARME
Tree density (stems/ac)					
Live	68	323	102	--	493
Dead	--	--	--	--	--
Avg. height (ft)					
Live	21.3	22.5	32.2	--	24.3
Dead	--	--	--	--	--
Avg. d.b.h. (in)	3.7	6.0	13.5	--	7.2
Avg. HCB (ft)	2.8	3.9	10.5	--	5.1
Avg. HLC (ft)	8.9	8.2	10.5	--	8.7

HCB: height to crown base (live and dead branches)
HCL: height to live crown (live branches only)

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	3.1	--	3.1
10-hr	8.0	--	8.0
100-hr	1.5	--	1.5
3.0-9.0 in	1.6	--	1.6
>9.0 in	12.8	--	12.8
Total	27.0	--	27.0

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	1.1	0.6	--
Avg height (ft)	0.5	0.3	--
Biomass (tons/ac)	0.2	0.3	--

QUAG 04 OAK WOODLAND

Midpeninsula
Regional Open Space District

BAY WOODLAND
PHOTO SERIES

A SERIES OF FOUR SITES
UMCA 01 – UMCA 04

NOTES TO USERS:

1. The sites in this series are arranged in order of increasing tree density.

2. This series represents some woodland types in the Santa Cruz mountains. Sites with similar vegetation and fuel attributes from other Natural Fuels Photo Series publications can be referenced to supplement the sites reported here. Figure 4 shows where sites from this series fit relative to other sites in the series.

3. Although referred to as “woodlands,” the sites dominated by *Quercus agrifolia* and *Umbellularia californica* in this series are quite dense and do not meet the typical definition of woodlands for which canopy coverage is generally considered to be between 25 and 60 percent.

4. Photographs were taken and sampling was performed in June 2025.

5. The marker in these photographs is a 1-ft square, and the pole is painted in contrasting colors at 1-ft intervals. The pole is 30 ft from the camera and is 6 ft tall. Note that no sampling occurs in the foreground between the camera and the sign.

6. A distinction is made between rotten and sound woody material for pieces larger than 3 inches in diameter.

UMCA 01 BAY WOODLAND

SITE AND STAND INFORMATION

Site Location: 37.340885, -122.219963
Elevation: 1,953 ft Aspect: 0° Slope: 32%
Preserve: Russian Ridge

Fine Scale Map Class: *Umbellularia californica* Mapping Unit

Litter loading: 7.2 tons/acre
Litter depth: 1.2 inches
Litter coverage: 66.7%

Trees (Density (trees/acre); % of stems)
Umbellularia californica: 102 TPA, 60%
Arbutus menziesii: 51 TPA, 30%

Saplings (Density; % of stems)
Alnus rubra: 134 TPA, 100%

Seedlings (Density; % of stems)
Quercus agrifolia: 134 TPA, 100%

Crown closure: 48%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	--	UMCA	UMCA	QUAG	UMCA
Second most common species	--	ARME	ARME	ARME	ARME
Tree density (stems/ac)					
Live	--	51	51	34	136
Dead	--	--	34	--	34
Avg. height (ft)					
Live	--	29.9	40.2	38.5	34.1
Dead	--	--	26.7	--	26.7
Avg. d.b.h. (in)	--	7.2	14.8	21.6	13.9
Avg. HCB (ft)	--	11.3	11.5	17.6	12.7
Avg. HLC (ft)	--	12.1	11.5	17.6	12.9

HCB: height to crown base (live and dead branches)
HCL: height to live crown (live branches only)

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	1.5	--	1.5
10-hr	7.7	--	7.7
100-hr	8.9	--	8.9
3.0-9.0 in	--	2.8	2.8
>9.0 in	--	14.2	14.2
Total	18.1	17.0	35.1

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	4.7	28.6	--
Avg height (ft)	1.4	0.6	--
Biomass (tons/ac)	0.7	0.6	--

UMCA 02 BAY WOODLAND

SITE AND STAND INFORMATION

Site Location: 37.331710, -122.176233
Elevation: 1,962 ft Aspect: 132° Slope: 21%
Preserve: Los Trancos

Fine Scale Map Class: *Umbellularia californica* Mapping Unit

Litter loading: 9.1 tons/acre
Litter depth: 1.5 inches
Litter coverage: 80.2%

Trees (Density (trees/acre); % of stems)
Umbellularia californica: 272 TPA, 80%
Quercus agrifolia: 68 TPA, 20%

Saplings (Density; % of stems)
None

Seedlings (Density; % of stems)
Quercus agrifolia: 1072 TPA, 50%
Arbutus menziesii: 1072 TPA, 50%

Crown closure: 67%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	QUAG	UMCA	UMCA	--	UMCA
Second most common species	--	--	QUAG	--	QUAG
Tree density (stems/ac)					
Live	68	85	187	--	340
Dead	--	--	--	--	--
Avg. height (ft)					
Live	19.7	41.6	57.7	--	46.1
Dead	--	--	--	--	--
Avg. d.b.h. (in)	3.5	7.3	12.3	--	9.3
Avg. HCB (ft)	7.3	24.9	29.3	--	23.8
Avg. HLC (ft)	7.3	24.9	29.3	--	23.8

HCB: height to crown base (live and dead branches)
HCL: height to live crown (live branches only)

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	0.9	--	0.9
10-hr	5.0	--	5.0
100-hr	8.9	--	8.9
3.0-9.0 in	--	35.2	35.2
>9.0 in	22.8	97.7	120.5
Total	37.6	132.9	170.5

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	0.2	11.3	8.3
Avg height (ft)	0.3	0.8	1.0
Biomass (tons/ac)	0.0	0.7	0.7

UMCA 03 BAY WOODLAND

SITE AND STAND INFORMATION

Site Location: 37.173283, -121.869070
Elevation: 1,476 ft Aspect: 58° Slope: 28%
Preserve: Sierra Azul

Fine Scale Map Class: *Umbellularia californica* Mapping Unit

Litter loading: 12.4 tons/acre
Litter depth: 2.0 inches
Litter coverage: 97.9%

Trees (Density (trees/acre); % of stems)
Umbellularia californica: 238 TPA, 100%

Saplings (Density; % of stems)
Umbellularia californica: 1005 TPA, 100%

Seedlings (Density; % of stems)
Umbellularia californica: 670 TPA, 100%

Crown closure: 75%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	UMCA	UMCA	UMCA	--	UMCA
Second most common species	--	--	--	--	--
Tree density (stems/ac)					
Live	119	85	34	--	238
Dead	--	--	--	--	--
Avg. height (ft)					
Live	22.7	32.8	44.6	--	29.4
Dead	--	--	--	--	--
Avg. d.b.h. (in)	3.7	6.4	15.1	--	6.3
Avg. HCB (ft)	6.7	14.9	12.7	--	10.5
Avg. HLC (ft)	6.9	14.9	12.7	--	10.5

HCB: height to crown base (live and dead branches)
HCL: height to live crown (live branches only)

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	2.2	--	2.2
10-hr	11.4	--	11.4
100-hr	17.6	--	17.6
3.0-9.0 in	--	47.1	47.1
>9.0 in	34.8	104.5	139.3
Total	66.0	151.6	217.6

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	--	1.0	1.1
Avg height (ft)	--	0.5	.08
Biomass (tons/ac)	--	0.5	0.6

UMCA 04 BAY WOODLAND

SITE AND STAND INFORMATION

Site Location: 37.173102, -121.868644
Elevation: 1,503 ft Aspect: 322° Slope: 47%
Preserve: Sierra Azul

Fine Scale Map Class: *Umbellularia californica* Mapping Unit

Litter loading: 5.7 tons/acre
Litter depth: 0.9 inches
Litter coverage: 77.9%

Trees (Density (trees/acre); % of stems)
Quercus agrifolia: 255 TPA, 47%
Umbellularia californica: 221 TPA, 41%

Saplings (Density; % of stems)
Umbellularia californica: 1139 TPA, 100%

Seedlings (Density; % of stems)
Quercus agrifolia: 1876 TPA, 61%
Umbellularia californica: 1206 TPA, 39%

Crown closure: 77%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	QUAG	UMCA	UMCA	--	UMCA
Second most common species	UMCA	QUAG	ARME	--	QUAG
Tree density (stems/ac)					
Live	119	323	34	17	493
Dead	34	17	--	--	51
Avg. height (ft)					
Live	21.3	26.8	41.5	36.5	25.7
Dead	15.0	15.0	--	--	15.0
Avg. d.b.h. (in)	3.8	6.2	10.1	22.0	6.2
Avg. HCB (ft)	7.7	11.3	12.5	15.5	10.5
Avg. HLC (ft)	9.9	12.0	12.5	15.5	11.6

HCB: height to crown base (live and dead branches)
HCL: height to live crown (live branches only)

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	1.6	--	1.6
10-hr	8.8	--	8.8
100-hr	13.5	--	13.5
3.0-9.0 in	6.4	10.6	17.0
>9.0 in	--	--	--
Total	30.3	10.6	40.9

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	3.9	17.2	--
Avg height (ft)	1.0	0.7	--
Biomass (tons/ac)	0.6	0.7	--

UMCA 04 BAY WOODLAND

Midpeninsula Regional Open Space District

DOUGLAS-FIR FOREST PHOTO SERIES

A SERIES OF FOUR SITES
PSME 01 – PSME 04

NOTES TO USERS:

1. The sites in this series are arranged in order of increasing surface fuel (i.e., dead and down woody fuel, litter, and understory vegetation) loading.

2. This series represents some forest types in the Santa Cruz mountains. Sites with similar vegetation and fuel attributes from other Natural Fuels Photo Series publications can be referenced to supplement the sites reported here. Figure 4 shows where sites from this series fit relative to other sites in the series.

3. Photographs were taken and sampling was performed in June 2025.

4. The marker in these photographs is a 1-ft square, and the pole is painted in contrasting colors at 1-ft intervals. The pole is 30 ft from the camera and is 6 ft tall. Note that no sampling occurs in the foreground between the camera and the sign.

5. A distinction is made between rotten and sound woody material for pieces larger than 3 inches in diameter.

PSME 01 DOUGLAS-FIR FOREST

SITE AND STAND INFORMATION

Site Location: 37.331449, -122.211373
Elevation: 2,155 ft Aspect: 346° Slope: 31%
Preserve: Coal Creek

Fine Scale Map Class: *Pseudotsuga menziesii - Notholithocarpus densiflorus/ Vaccinium ovatum* Association

Litter loading: 8.5 Tons/acre
Litter depth: 1.4 inches
Litter coverage: 30%

Trees (Density (trees/acre); % of stems)
Pseudotsuga menziesii: 68 TPA 100%

Saplings (Density; % of stems)
None

Seedlings (Density; % of stems)
Pseudotsuga menziesii: 67 TPA 100%

Crown closure: 70%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	--	--	PSME	PSME	PSME
Second most common species	--	--	--	--	--
Tree density (stems/ac)					
Live	--	--	51	17	68
Dead	--	--	--	--	--
Avg. height (ft)					
Live	--	--	88.2	104.4	92.3
Dead	--	--	--	--	--
Avg. d.b.h. (in)	--	--	15.2	29	18.7
Avg. HCB (ft)	--	--	18.7	11.3	16.9
Avg. HLC (ft)	--	--	36.8	42.7	38.2

HCB: height to crown base (live and dead branches)
HCL: height to live crown (live branches only)

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	2.8	--	2.8
10-hr	13.4	--	13.4
100-hr	22.8	--	22.8
3.0-9.0 in	18.0	3.7	21.7
>9.0 in	34.6	0.0	34.6
Total	91.6	3.7	95.3

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	--	63.1	6.9
Avg height (ft)	--	0.9	1.3
Biomass (tons/ac)	--	1.0	0.8

PSME 02 DOUGLAS-FIR FOREST

SITE AND STAND INFORMATION

Site Location: 37.278143, -122.150085
Elevation: 2,313 ft Aspect: 250° Slope: 21%
Preserve: Long Ridge

Fine Scale Map Class: *Pseudotsuga menziesii - Notholithocarpus densiflorus/ Vaccinium ovatum* Association

Litter loading: 8.3 ton/acre
Litter depth: 1.4 inches
Litter coverage: 77.5 %

Trees (Density (trees/acre); % of stems)
Pseudotsuga menziesii: 119 TPA, 54%
Umbellularia californica: 51 TPA, 23%

Saplings (Density; % of stems)
Umbellularia californica: 134 TPA, 67%
Notholithocarpus densiflorus: 67 TPA, 33%

Seedlings (Density; % of stems)
Quercus agrifolia: 938 TPA, 93%
Umbellularia californica: 67 TPA, 7%

Crown closure: 58%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	--	PSME	PSME	PSME	PSME
Second most common species	--	UMCA	--	--	UMCA
Tree density (stems/ac)					
Live	--	102	--	51	153
Dead	--	34	34	--	68
Avg. height (ft)					
Live	--	43.4	--	140.1	75.6
Dead	--	31.8	53.1	--	42.5
Avg. d.b.h. (in)	--	7.0	12.9	37.7	15.0
Avg. HCB (ft)	--	11.7	--	51.6	19.1
Avg. HLC (ft)	--	11.7	--	51.6	19.1

HCB: height to crown base (live and dead branches)
HCL: height to live crown (live branches only)

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	2.2	--	2.2
10-hr	10.3	--	10.3
100-hr	5.9	--	5.9
3.0-9.0 in	0.0	24.1	24.1
>9.0 in	0.0	94.6	94.6
Total	18.4	118.7	137.1

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	10.0	8.1	2.3
Avg height (ft)	4.5	0.6	1.3
Biomass (tons/ac)	1.5	0.6	0.7

PSME 03 DOUGLAS-FIR FOREST

SITE AND STAND INFORMATION

Site Location: 37.308604, -122.201847
Elevation: 2,047 ft Aspect: 181° Slope: 2%
Preserve: Russian Ridge

Fine Scale Map Class: *Pseudotsuga menziesii - Notholithocarpus densiflorus/ Vaccinium ovatum* Association

Litter loading: 5.3 tons/acre
Litter depth: 0.9 inches
Litter coverage:46.7 %

Trees (Density (trees/acre); % of stems)
Pseudotsuga menziesii: 238 TPA, 93%
Quercus agrifolia: 17 TPA, 7%

Saplings (Density; % of stems)
Notholithocarpus densiflorus: 201 TPA, 75%
Umbellularia californica: 67 TPA, 25%

Seedlings (Density; % of stems)
Quercus agrifolia: 201 TPA, 60%
Notholithocarpus densiflorus: 134 TPA, 40%

Crown closure: 67%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	PSME	PSME	PSME	PSME	PSME
Second most common species	--	--	QUAG	--	QUAG
Tree density (stems/ac)					
Live	--	85	68	51	204
Dead	17	--	34	--	51
Avg. height (ft)					
Live	--	36.0	70.2	88.9	60.6
Dead	16.3	--	13.9	--	14.7
Avg. d.b.h. (in)	3.5	6.6	15.3	33.7	15.3
Avg. HCB (ft)	--	21.1	22.2	25.9	21.1
Avg. HLC (ft)	--	21.1	22.2	25.9	21.1

HCB: height to crown base (live and dead branches)
HCL: height to live crown (live branches only)

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	2.0	--	2.0
10-hr	6.4	--	6.4
100-hr	17.4	--	17.4
3.0-9.0 in	14.1	39.7	53.8
>9.0 in	92.7	0.0	92.7
Total	132.6	39.7	172.3

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	1.9	42.5	8.9
Avg height (ft)	1.2	1.0	1.3
Biomass (tons/ac)	0.3	0.9	0.8

PSME 04 DOUGLAS-FIR FOREST

SITE AND STAND INFORMATION

Site Location: 37.278600, -122.158088
Elevation: 2,493 ft Aspect: 60° Slope: 21%
Preserve: Long Ridge

Fine Scale Map Class: *Pseudotsuga menziesii - Notholithocarpus densiflorus/ Vaccinium ovatum* Association

Litter loading: 8.6 tons/acre
Litter depth: 1.4 inches
Litter coverage: 80 %

Trees (Density (trees/acre); % of stems)
Umbellularia californica: 119 TPA, 58%
Pseudotsuga menziesii: 68 TPA, 33%

Saplings (Density; % of stems)
Notholithocarpus densiflorus: 201 TPA, 60%
Umbellularia californica: 134 TPA, 40%

Seedlings (Density; % of stems)
Umbellularia californica: 335 TPA, 56%
Quercus agrifolia: 268 TPA, 44%

Crown closure: 70%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	QUAG	UMCA	UMCA	PSME	UMCA
Second most common species	--	--	PSME	--	PSME
Tree density (stems/ac)					
Live	17	34	119	17	187
Dead	--	--	--	17	17
Avg. height (ft)					
Live	15.5	51.4	56.3	139.1	59.3
Dead	--	--	--	39.2	39.2
Avg. d.b.h. (in)	4.0	8.5	13.2	59.6	19.4
Avg. HCB (ft)	3.0	17.0	23.8	14.1	19.3
Avg. HLC (ft)	3.0	17.0	23.8	14.1	19.3

HCB: height to crown base (live and dead branches)
HCL: height to live crown (live branches only)

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	3.0	--	3.0
10-hr	14.9	--	14.9
100-hr	25.2	--	25.2
3.0-9.0 in	12.2	22.7	34.9
>9.0 in	102.3	119.9	222.2
Total	157.6	142.6	300.2

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	10.3	8.2	1.4
Avg height (ft)	1.9	0.9	1.0
Biomass (tons/ac)	1.5	0.7	0.7

Midpeninsula Regional Open Space District

REDWOOD FOREST PHOTO SERIES

A SERIES OF FOUR SITES
SESE 01 – SESE 04

NOTES TO USERS:

1. The sites in this series are arranged in order of increasing surface fuel (i.e., dead and down woody fuel, litter, and understory vegetation) loading.

2. This series represents some forest types in the Santa Cruz mountains. Sites with similar vegetation and fuel attributes from other Natural Fuels Photo Series publications can be referenced to supplement the sites reported here. Figure 4 shows where sites from this series fit relative to other sites in the series.

3. Photographs were taken and sampling was performed in June 2025.

4. The marker in these photographs is a 1-ft square, and the pole is painted in contrasting colors at 1-ft intervals. The pole is 30 ft from the camera and is 6 ft tall. Note that no sampling occurs in the foreground between the camera and the sign.

5. A distinction is made between rotten and sound woody material for pieces larger than 3 inches in diameter.

SESE 01 REDWOOD FOREST

SITE AND STAND INFORMATION

Site Location: 37.442791, -122.325507
Elevation: 2,088 ft Aspect: 20° Slope: 2%
Preserve: Purisima Creek

Fine Scale Map Class: *Sequoia sempervirens* Alliance

Litter loading: 15.5 tons/acre
Litter depth: 2.6 inches
Litter coverage: 98.1%

Trees (Density (trees/acre); % of stems)
Sequoia sempervirens: 102 TPA, 75%
Arbutus menziesii: 17 TPA, 13%

Saplings (Density; % of stems)
None

Seedlings (Density; % of stems)
Notholithocarpus densiflorus: 871 TPA, 93%
Sequoia sempervirens: 67 TPA, 7%

Crown closure: 75%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	--	SESE	SESE	SESE	SESE
Second most common species	--	--	--	ARME	ARME
Tree density (stems/ac)					
Live	--	17	17	85	119
Dead	--	--	17	--	17
Avg. height (ft)					
Live	--	45.8	68.1	116.4	99.4
Dead	--	--	20.0	--	20.0
Avg. d.b.h. (in)	--	8.8	12.0	39.5	28.8
Avg. HCB (ft)	--	10.0	12.7	46.1	33.2
Avg. HLC (ft)	--	10.0	12.7	56.6	39.8

HCB: height to crown base (live and dead branches)
HCL: height to live crown (live branches only)

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	0.5	--	0.5
10-hr	9.7	--	9.7
100-hr	5.8	--	5.8
3.0-9.0 in	16.0	17.9	33.9
>9.0 in	--	44.8	44.8
Total	32.0	62.7	94.7

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	0.8	1.1	--
Avg height (ft)	1.5	0.8	--
Biomass (tons/ac)	0.1	0.6	--

SESE 02 REDWOOD FOREST

SITE AND STAND INFORMATION

Site Location: 37.376692, -122.276096
Elevation: 2,022 ft Aspect: 80° Slope: 31%
Preserve: La Honda Creek

Fine Scale Map Class: *Sequoia sempervirens* Alliance

Litter loading: 15.4 tons/acre
Litter depth: 2.5 inches
Litter coverage:99.7%

Trees (Density (trees/acre); % of stems)
Sequoia sempervirens: 323 TPA, 100%

Saplings (Density; % of stems)
Sequoia sempervirens: 268 TPA, 100%

Seedlings (Density; % of stems)
None

Crown closure: 78%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	SESE	SESE	SESE	SESE	SESE
Second most common species	--	--	--	--	--
Tree density (stems/ac)					
Live	17	68	68	68	221
Dead	--	85	17	--	102
Avg. height (ft)					
Live	23.9	38.2	73.7	155.2	84.0
Dead	--	28.2	15.0	--	26.0
Avg. d.b.h. (in)	3.4	6.3	14.0	44.7	16.3
Avg. HCB (ft)	--	7.2	14.9	63.9	20.8
Avg. HLC (ft)	--	8.7	23.5	68	24.6

HCB: height to crown base (live and dead branches)
HCL: height to live crown (live branches only)

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	0.7	--	0.7
10-hr	14.0	--	14.0
100-hr	30.4	--	30.4
3.0-9.0 in	--	--	--
>9.0 in	--	--	--
Total	45.1	--	45.1

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	--	0.3	--
Avg height (ft)	--	0.5	--
Biomass (tons/ac)	--	0.5	--

SESE 03 REDWOOD FOREST

SITE AND STAND INFORMATION

Site Location: 37.431733, -122.323433
Elevation: 1,665 ft Aspect: 166° Slope: 40%
Preserve: Purisima Creek

Fine Scale Map Class: *Sequoia sempervirens* Alliance

Litter loading: 17.2 tons/acre
Litter depth: 2.8 inches
Litter coverage: 89.4%

Trees (Density (trees/acre); % of stems)
Sequoia sempervirens: 476 TPA, 100%

Saplings (Density; % of stems)
Notholithocarpus densiflorus: 737 TPA, 85%
Sequoia sempervirens: 134 TPA, 15%

Seedlings (Density; % of stems)
Sequoia sempervirens: 1608 TPA, 69%
Notholithocarpus densiflorus: 737 TPA, 31%

Crown closure: 82%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	SESE	SESE	SESE	SESE	SESE
Second most common species	--	--	--	--	--
Tree density (stems/ac)					
Live	51	136	136	85	408
Dead	51	17	--	--	68
Avg. height (ft)					
Live	14.5	29.6	53.1	106.9	51.6
Dead	22.7	23.3	--	--	22.9
Avg. d.b.h. (in)	3.7	6.2	13.5	31.9	12.3
Avg. HCB (ft)	2.2	7.4	10.6	53.2	15.4
Avg. HLC (ft)	5.8	14.9	26.9	53.2	23.2

HCB: height to crown base (live and dead branches)
HCL: height to live crown (live branches only)

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	1.6	--	1.6
10-hr	16.4	--	16.4
100-hr	21.9	--	21.9
3.0-9.0 in	6.2	34.8	41.0
>9.0 in	--	49.5	49.5
Total	46.1	84.3	130.4

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	3.9	6.7	--
Avg height (ft)	4.0	1.5	--
Biomass (tons/ac)	0.6	0.7	--

SESE 04 REDWOOD FOREST

SITE AND STAND INFORMATION

Site Location: 37.376623, -122.275491
Elevation: 1,965 ft Aspect: 78° Slope: 23%
Preserve: La Honda Creek

Fine Scale Map Class: *Sequoia sempervirens* Alliance

Litter loading: 17.6 tons/acre
Litter depth: 2.9 inches
Litter coverage: 100%

Trees (Density (trees/acre); % of stems)
Sequoia sempervirens: 425 TPA, 100%

Saplings (Density; % of stems)
Sequoia sempervirens: 603 TPA, 100%

Seedlings (Density; % of stems)
None

Crown closure: 85%

TREES

	Size Class (diameter at breast height)				
	<4 in	4 - 9 in	9-20 in	>20 in	All Trees
Most common species	SESE	SESE	SESE	SESE	SESE
Second most common species	--	--	--	--	--
Tree density (stems/ac)					
Live	--	136	102	85	323
Dead	34	68	--	--	102
Avg. height (ft)					
Live	--	40.8	82.0	135.2	78.6
Dead	22.5	36.1	--	--	31.6
Avg. d.b.h. (in)	3.8	6.4	14.2	29.4	12.7
Avg. HCB (ft)	--	11.7	37.7	54.6	25.6
Avg. HLC (ft)	--	11.7	42.5	54.6	26.7

HCB: height to crown base (live and dead branches)
HCL: height to live crown (live branches only)

WOODY MATERIAL

Size Class	Loading (tons/ac)		
	Sound	Rotten	Total
1-hr	1.0	--	1.0
10-hr	19.7	--	19.7
100-hr	67.1	--	67.1
3.0-9.0 in	13.2	49.4	62.6
>9.0 in	39.8	72.3	112.1
Total	140.8	121.7	262.5

UNDERSTORY VEGETATION

	Shrub	Forb	Grass
Coverage (%)	--	--	--
Avg height (ft)	--	--	--
Biomass (tons/ac)	--	--	--