3. Data Summary and Preliminary Analyses of the Oak Inventory Database

Valley Oak

Of the 1990 assessment units in the study area, 666 or 33% contain valley oaks. Total valley oak tree canopy covers approximately 1.2% of the entire study area. From estimates of tree densities per polygon, there are a total of approximately 22,647 canopy-sized valley oaks within the study area.

Valley oaks are obviously not uniformly distributed over the study area, but are instead confined to low elevations and the eastern portion of the area (Figure 3.1).

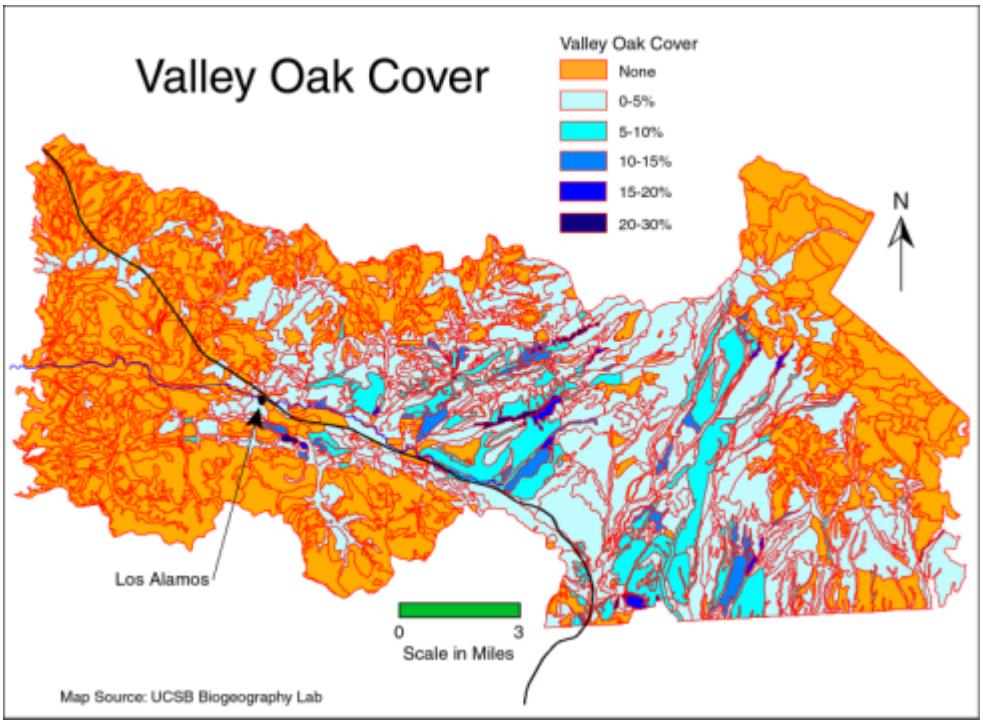

Figure 3.1. General distribution of valley oak canopy cover in the study area.

Where they occur, valley oaks are generally sparse, with mean density and cover of 1.7 trees/ha and 4% cover, respectively (Tables 3.2 and 3.3). Most polygons (91.5%) containing valley oaks had measured valley oak canopy cover of less than 10 percent, and canopy cover never exceeded 30 percent (Figure 3.2).

Table 3.2. Valley oak density (#/ha; 1 hectare equala 2.47 acres) (includes only polygons containing valley oak).

Mean	1.7
Standard Error	0.1
Standard Deviation	2.0
Range	15.7
Minimum	0.0
Maximum	15.8
Count	666.0

Table 3.3. Frequency distribution of valley oak density (# and % of polygons containing valley oaks of various density classes).

Density (#/ha)	Frequency	All Classes %	With Trees %
No Trees	1324	66.5	
0-5	625	31.4	93.8
5-10	36	1.8	5.4
10-15	4	0.2	0.6
15-20	1	0.1	0.2
>20	0	0.0	0.0

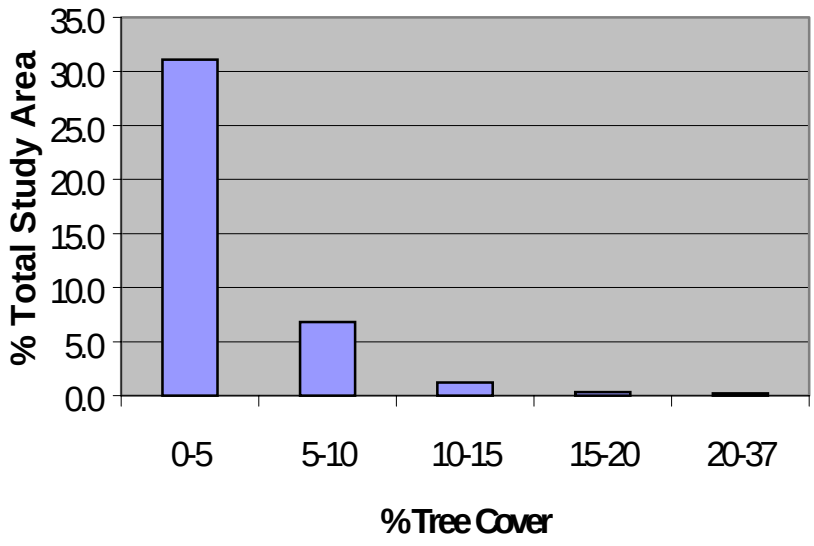

Figure 3.2. Valley oak cover classes within assessment units expressed as fractions of the total study area.

Table 3.4. Valley oak calculated cover class frequency distribution expressed as a percentage of assessment units (see also Figure 3.2)

Cover Class	Frequency	All units (%)	Units With Trees %
No Trees	1324	66.5	
0-5%	488	24.5	73.3
5-10%	121	6.1	18.2
10-15%	34	1.7	5.1
15-20%	12	0.6	1.8
20-30%	11	0.6	1.7

COAST LIVE OAK

Of the 1990 assessment units in the study area, 1515 or 76% contained coast live oaks. Within these 1515 polygons, the species has an average tree density of 12.6 trees/ha and an average tree canopy cover of 15.0 percent (Tables 3.5-3.7), values considerably higher than those for valley oak. Coast live oak generally displays densities of less than 10 trees/hectare (59.7% of the polygons) and less than 10 percent canopy cover (56.5% of the polygons). However, a substantial fraction of assessment units support higher densities and cover of the species, especially on steep north-facing slopes.

Figure 3.4 illustrates the distribution of coast live oak canopy cover in the study area. Unlike valley oak, coast live oak occurs throughout the entire study area, though the canopy cover varies considerably over short distances. This variation reflects variation in local ecological factors such as topography, soils and fire history, as well as modern and historical land use.

Table 3.5. Coast live oak density (# trees/hectare; 1 hectare = 10,000 m^2).

Mean	12.4
Standard Error	0.4
Standard Deviation	14.8
Range	81.6
Minimum	0.0
Maximum	81.6
Count	1515.0

Table 3.6. Relative frequency of coast live oak density classes (# and % of polygons containing coast live oaks of various density classes).

Density (#/ha)	Frequency	All Classes (%)	With Trees (%)
No Trees	475	23.9	
0-5	707	35.5	46.7
5-10	197	9.9	13.0
10-20	251	12.6	16.6
20-30	153	7.7	10.1
30-50	166	8.3	11.0
>50	41	2.1	2.7

Table 3.7. Coast Live Oak Cover (percent of polygon area)

Mean	14.8%
Standard Error	0.5
Standard Deviation	17.6
Range	97.1
Minimum	0.0
Maximum	97.1
Count	1515.0

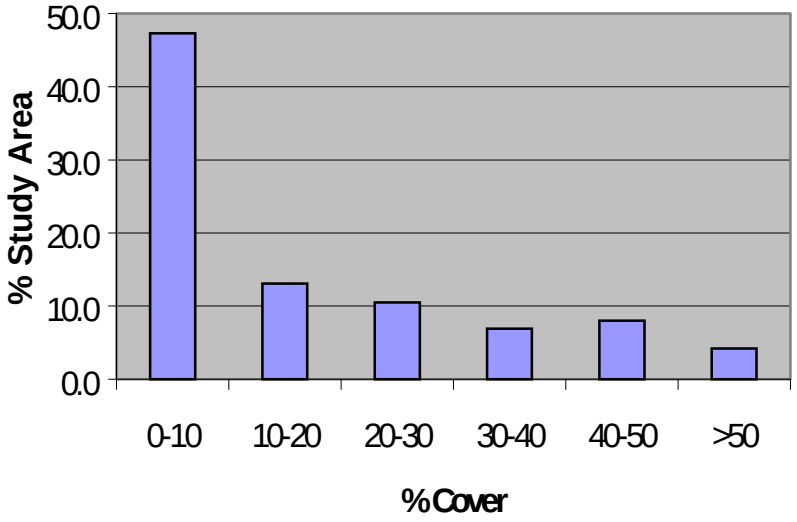

Figure 3.3. Coast live oak canopy cover classes within assessment units a percent of the total study area.

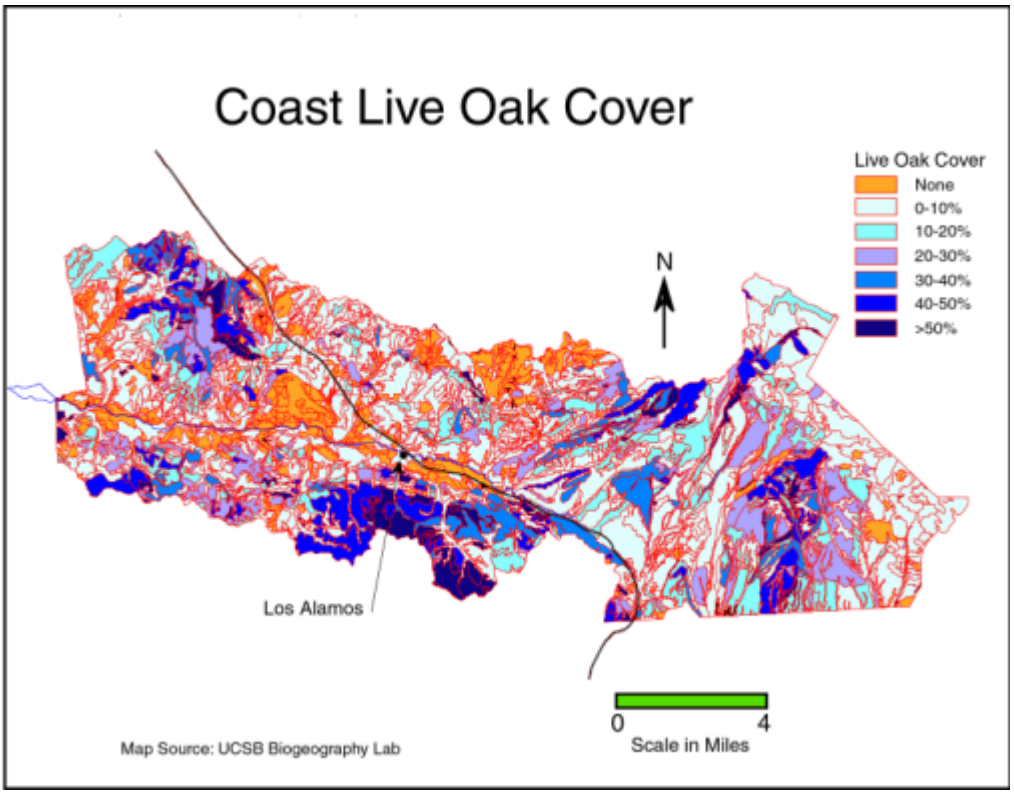

Figure 3.4. Mapped distribution of coast live oak in the pilot study area.

BLUE OAK

Of the 1990 assessment units in the study area, 186 or nine percent contained blue oaks. Tables 3.8-3.10 summarize the information on blue oak density and cover within these 186 units.

Table 3.8: Blue oak density (# trees/hectare; 1 hectare = 10,000 m^2).

Mean	7.8
Standard Error	0.6
Standard Deviation	8.4
Range	47.8
Minimum	0.0
Maximum	47.8
Count	186.0

Table 3.9. Blue oak density class frequency distribution.

		All Classes	With
No Trees	1804	90.7	
0-5	91	4.6	48.9
5-10	44	2.2	23.7
10-20	38	1.9	20.4
20-40	11	0.6	5.9
>40	2	0.1	1.1

Table 3.10. Blue oak canopy cover as percent of polygon area.

Mean	9.2%
Standard Error	0.7
Standard Deviation	9.9
Range	56.4
Minimum	0.0
Maximum	56.5
Count	186.0

Within the study area, blue oak is found in relatively low densities (mean of 7.8 trees/hectare) and low canopy cover (9.2 percent cover) (Tables 3.8-3.10). The species is confined to a small area in the eastern portion of the study area on the western and southern flanks of Figueroa Mountain (Figure 3.5). Within this area, monospecific blue oak stands attain up to 56% canopy cover. As with valley oak and coast live oak, normally the species occurs at densities of less than 10 trees per hectare (72.6% of the polygons) and at canopy cover class of less than 10% (67.2% of the polygons having blue oak).

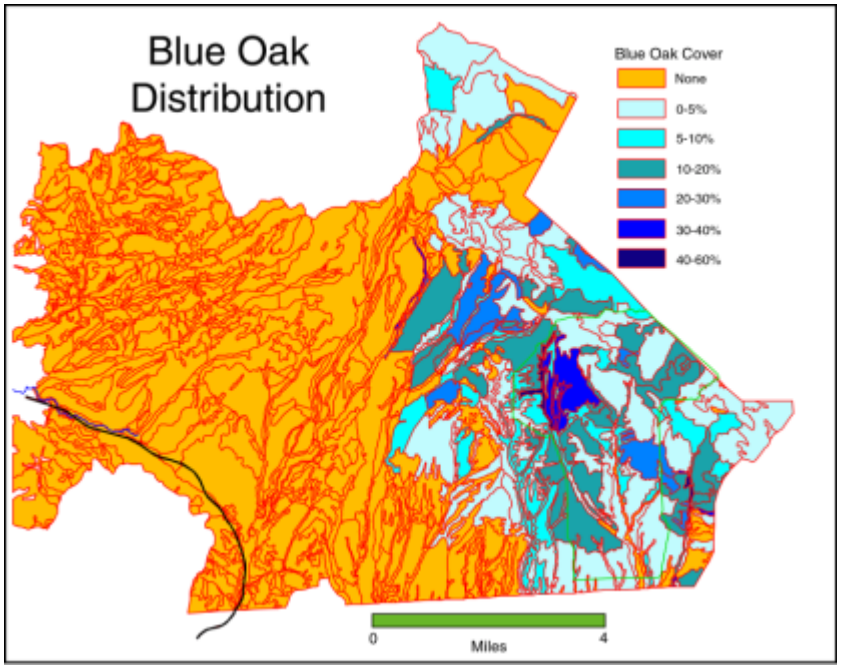

Figure 3.5. Distribution of blue oak in the pilot study area.

CHANGES IN OAK DISTRIBUTIONS SINCE THE 1930'S

The Vegetation Type Mapping (VTM) crews recorded the presence or absence of major tree species during their surveys of the 1930s. If, after visual estimation, a particular area had total tree canopy cover greater than 20 percent and within that coverage, if any one tree species comprised greater than 20 percent of the relative tree cover, then that tree species was recorded as being present. Otherwise, the tree species would not be recorded as present in the area.

Since the VTM crews used different, and usually larger, assessment units for their surveys than were used in the present study, comparison of the historical data to those collected for this study is difficult. Nevertheless, it is possible to detect gross changes in the distribution of the three oak species by comparing VTM maps to those developed for this project.

Valley oak was entirely lost from at least 99 polygons (Figure 3.6). Major areas of change include sites east of Los Alamos along Highway 101 that have been recently cleared for vineyards, as well as vineyard areas along Foxen Canyon Road.

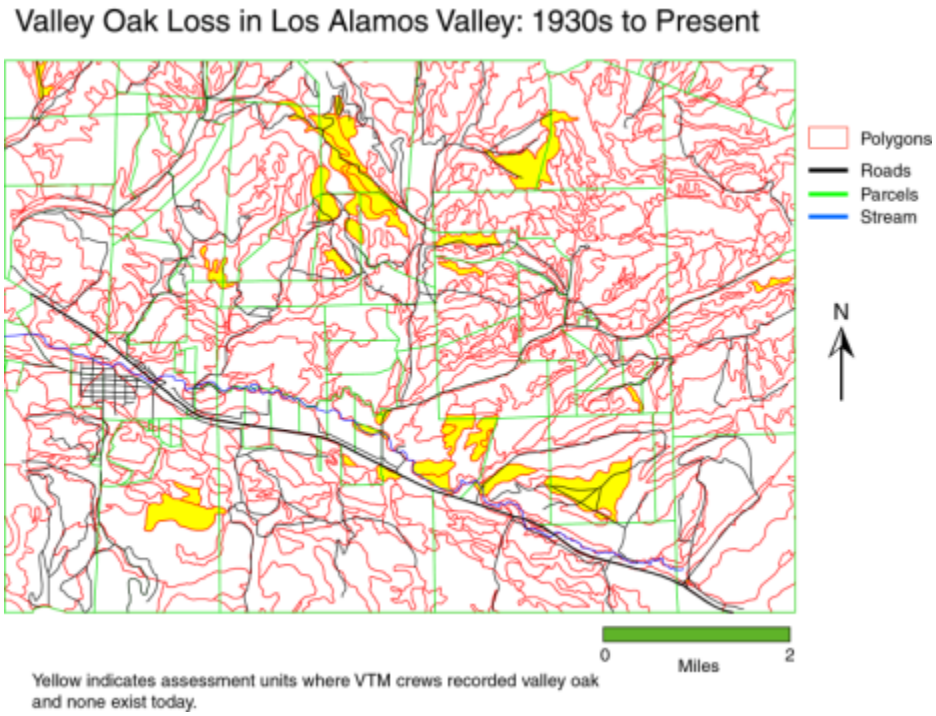

Figure 3.6. Yellow areas are localities where valley oak is absent today but was mapped as a canopy dominant by VTM crews during 1930's field surveys.

Coast live oak was lost from at least 181 polygons that are scattered throughout the study area (Figure 3.7).

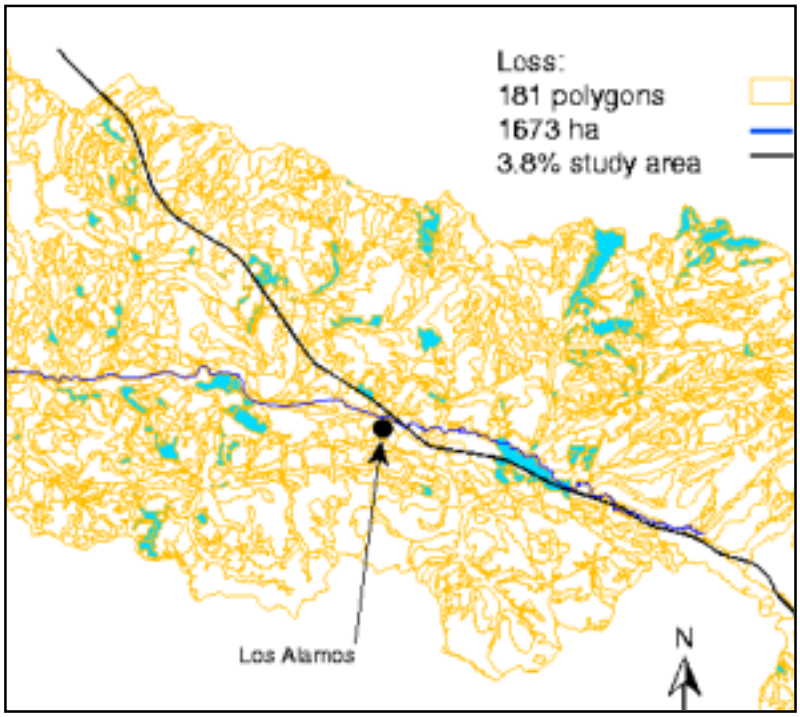

Figure 3.12. Blue areas are localities where coast live oak is absent today but was mapped as a canopy dominant by VTM crews during 1930 field surveys.

Blue oak was lost from at least 43 polygons, most of them from rangeland and cropland between Figueroa Mountain Road and Zaca Ranch Road (Figure 3.8).

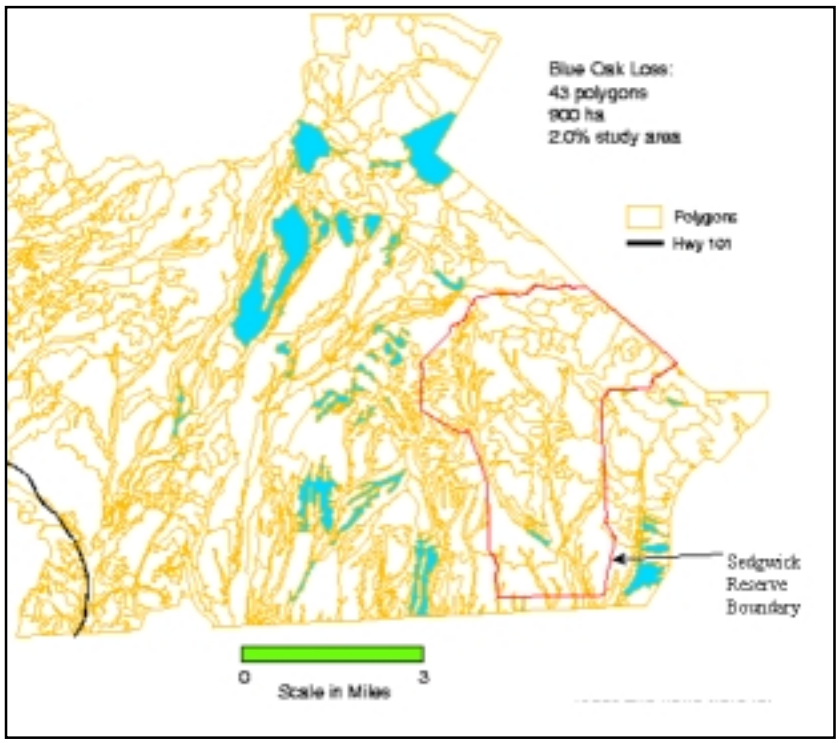

Figure 3.8. Blue areas are localities where blue oak is absent today but was mapped as a canopy dominant by VTM crews during 1930's field surveys.

ASSOCIATION OF OAKS AND MAPPED SOIL TYPES

The County soil survey characterizes each mapped soil type by physical variables such as texture (loam, sand, clay), slope class, and drainage characterizes. When grouped according to texture, parent material, and/or geomorphic setting, roughly 83% of the study area is classified as loamy soil and another 18% as sand (Table 3.11). Valley oaks tend to prefer loamy soils and are less likely to be found on sandy or clay soils (Table 3.11). The likely reason that the loam soil type has such a relatively low percentage of valley oak presence (36.5%) is that these soils are prime agricultural soils where oaks were previously cleared to make way for crops. Loamy terrace escarpments that border areas with loamy soil have a high occurrence rate of valley oak and most likely have escaped clearing and conversion to agriculture due to their steep slopes (average 40% slope). Valley oaks are rare or absent in rocky soils and soils with a clay pan. The species was not mapped on rocky clay loam, rocky loam, sedimentary rock, and igneous rock soils, and was infrequent on San Andreas Tierra (clay), Climara-Toomes (shallow soil on bedrock), silty clay, shaly clay loam and silty clay soil types (Table 3.11).

Table 3.11. Distribution of oak species on general soil types of the study area (aggregated from described soil series). The total number polygons does not equal 1990 because categories such as exposed rock, lakes, and swamp were not included in the analysis.

Major Soil Type	# units	% of Study Area	# Units With Valley Oak	% with Valley Oak	# With Live Oak	% with Live Oak	# With Blue Oak	% with Blue Oak
sand	282	17.8	40	14.2	230	81.6	4	1.4
loamy sand	146	4.5	28	19.2	90	61.6	0	0.0
sandy loam	155	5.9	52	33.5	106	68.4	2	1.3
fine sandy loam	32	1.8	26	81.3	29	90.6	7	21.9
loamy escarpments	21	0.5	19	90.5	20	95.2	1	4.8
loam	255	11.6	93	36.5	172	67.5	9	3.5
clay loam	263	10.5	86	32.7	182	69.2	3	1.1
silty clay loam	83	5.2	31	37.3	68	81.9	34	41.0
shaly clay loam	39	4.5	6	15.4	35	89.7	5	12.8
shaly loam	319	21.8	210	65.8	289	90.6	66	20.7
rocky clay loam	4	0.7	0	0.0	3	75.0	4	100.0
rocky loam	6	0.8	0	0.0	6	100.0	3	50.0
silty clay	39	1.3	10	25.6	21	53.8	6	15.4
sedimentary rock	20	1.8	0	0.0	17	85.0	3	15.0
igneous rock	8	0.3	0	0.0	4	50.0	5	62.5
San Andreas-Tierra	173	7.3	38	22.0	142	82.1	1	0.6
riverwash	5	3.2	2	40.0	4	80.0	0	0.0
gullied	25	0.2	10	40.0	24	96.0	5	20.0
Climara-Toomes	28	0.5	3	10.7	25	89.3	24	85.7

Coast live oak is present at high rates on all major soil types. On all soil types, occurrence equals or exceeds 50 percent and averages 79.3 percent. It would appear that the species is tolerant of or adapted to live on many soil types.

Blue oak, unlike both valley and coast live oak, is nearly absent from loamy soils and instead is associated with rocky soils and soils with clay layers. It has a high occurrence rate on rocky clay loam (100 percent), rocky loam (50 percent), igneous rock (62.5 percent), and Climara-toomes (85.7 percent), a shallow clay or clay loam soil on top of bedrock.

We measured the strength of association between oaks with soil type using simple chi-squared tests, recognizing that the data are not a statistical sample but rather represent entire mapped

populations. The chi-squared statistic provides a measure of how far actual distributions depart from random association (Neu et al., 1974; Stoms et al., 1993). Essentially, this entails comparing the observed frequency of each oak species on each major soil class to the expected freuqency based on the proportion of each class available in the study area.

Table 3.12: Occurrence of valley oak on major soil types; expected, observed, proportions (proport) and significant differences.

	Total Area (hectares)	Proport. of Total Area (p)	Observed Valley Oak	Expected Valley Oak	Proport. Observ.	95% Confidence interval		Signif. α=0.05
sand	7176.5	0.1777	40	109.1	0.061	0.030	0.092	-
loamy sand	1804.9	0.0447	28	27.4	0.043	0.017	0.069	
sandy loam	2380.9	0.059	52	36.2	0.080	0.045	0.114	
fine sandy loam	732.2	0.0181	26	11.1	0.040	0.015	0.065	
loamy escarpments	193.7	0.0048	19	2.9	0.029	0.007	0.051	+
loam	4668.6	0.1156	93	71.0	0.142	0.097	0.187	
clay loam	4225.2	0.1046	86	64.2	0.131	0.088	0.175	
silty clay loam	2103.0	0.0521	31	32.0	0.047	0.020	0.075	
shaly clay loam	1826.6	0.0452	6	27.8	0.009	-0.003	0.021	-
shaly loam	8792.0	0.2177	210	133.7	0.321	0.261	0.381	+
rocky clay loam	274.8	0.0068	0	4.2	0.000	0.000	0.000	-
rocky loam	337.0	0.0083	0	5.1	0.000	0.000	0.000	-
silty clay	544.3	0.0135	10	8.3	0.015	-0.001	0.031	
sedimentary rock	708.4	0.0175	0	10.8	0.000	0.000	0.000	-
igneous rock	134.6	0.0033	0	2.0	0.000	0.000	0.000	-
San Andreas-Tierra	2947.1	0.073	38	44.8	0.058	0.028	0.088	
Climara-Toomes	1274.5	0.0316	3	19.4	0.005	-0.004	0.013	-
riverwash	70.9	0.0018	2	1.1	0.003	-0.004	0.010	
gullied	185.0	0.0046	10	2.8	0.015	-0.001	0.031	

All three species show strongly non-random patterns of association with soils. For example, valley oaks preferentially grow on loamy escarpments and shaly loam and occur less frequently than expected on sandy soils, shaly clay loams rocky clay loams, rocky loams, igneous rock, and Climara-Toomes (clay and clay loams on top of bed rock) (Table 3.12). The last column in Table 3.12 indicates strong positive (+) or negative (-) associations (Probability of Type 2 error < 0.05%). The units are not really independent samples so the statistical test is admittedly

somewhat arbitrary. We apply this test here simply to call attention to relatively strong non-random association.

Table 3.13: Association of coast live oak and general soil types.

Soil Class	Total Area (hectares)	Proport. of Total Area (p)	# observ. of Live Oak	# Expected Live Oak	Proport. Observed	Confidence intervals		Signif. α=0.05
sand	7176.5	0.1777	230	260.7	0.157	0.125	0.188	
loamy sand	1804.9	0.0447	90	65.6	0.061	0.041	0.082	
sandy loam	2380.9	0.059	106	86.5	0.072	0.050	0.095	
fine sandy loam	732.2	0.0181	29	26.6	0.020	0.008	0.032	
loamy escarpments	193.7	0.0048	20	7.0	0.014	0.004	0.024	
loam	4668.6	0.1156	172	169.6	0.117	0.090	0.145	
clay loam	4225.2	0.1046	182	153.5	0.124	0.096	0.152	
silty clay loam	2103.0	0.0521	68	76.4	0.046	0.028	0.064	
shaly clay loam	1826.6	0.0452	35	66.4	0.024	0.011	0.037	-
shaly loam	8792.0	0.2177	289	319.4	0.197	0.163	0.231	
rocky clay loam	274.8	0.0068	3	10.0	0.002	-	0.006	-
rocky loam	337.0	0.0083	6	12.2	0.004	-	0.010	
silty clay	544.3	0.0135	21	19.8	0.014	0.004	0.025	
sedimentary rock	708.4	0.0175	17	25.7	0.012	0.002	0.021	
igneous rock	134.6	0.0033	4	4.9	0.003	-	0.007	
San Andreas-Tierra	2947.1	0.073	142	107.1	0.097	0.071	0.122	
Climara-Toomes	1274.5	0.0316	25	46.3	0.017	0.006	0.028	-
riverwash	70.9	0.0018	4	2.6	0.003	-	0.007	
gullied	185.0	0.0046	24	6.7	0.016	0.005	0.027	+

Coast live oak is only found on gullied (eroded) soils at a rate greater than expected based on the soil's availability (Table 3.13). However, coast live oak occurs at rates less than is expected on shaly clay loams, rocky clay loams, and Climara-Toomes (shallow clay and clay loams on top of bedrock).

Blue oak preferentially occurs on silty clay loams, shaly loams, and Climara-Toomes (shallow clay and clay loams on top of bedrock) (Table 3.14). This species occurs less frequently than expected on sand, loamy sand, sandy loam, loam, clay loam, San Andreas-Tierra (fine sandy loams and clay loams), and riverwash (riverbeds).

Table 3.14: Occurrence of blue oak on major soil types; expected, observed, and significant differences.

Soil Class	Total Area (hectares)	Proport. of Total Area (p)	# observed Blue Oak	# Expected Blue Oak	Proport. Observ. in each class (pi)	Confidence intervals		Signif. α=0.05
sand	7176.5	0.1777	4	32.3	0.0	-0.014	0.058	-
loamy sand	1804.9	0.0447	0	8.1	0.000	0.000	0.000	-
sandy loam	2380.9	0.059	2	10.7	0.011	-0.015	0.036	-
fine sandy loam	732.2	0.0181	7	3.3	0.038	-0.009	0.086	
loamy escarpments	193.7	0.0048	1	0.9	0.005	-0.013	0.024	
loam	4668.6	0.1156	9	21.0	0.049	-0.004	0.102	-
clay loam	4225.2	0.1046	3	19.0	0.016	-0.015	0.048	-
silty clay loam	2103.0	0.0521	34	9.5	0.187	0.091	0.282	+
shaly clay loam	1826.6	0.0452	5	8.2	0.027	-0.013	0.067	
shaly loam	8792.0	0.2177	66	39.6	0.363	0.245	0.480	+
rocky clay loam	274.8	0.0068	4	1.2	0.022	-0.014	0.058	
rocky loam	337.0	0.0083	3	1.5	0.016	-0.015	0.048	
silty clay	544.3	0.0135	6	2.5	0.033	-0.011	0.077	
sedimentary rock	708.4	0.0175	3	3.2	0.016	-0.015	0.048	
igneous rock	134.6	0.0033	5	0.6	0.027	-0.013	0.067	
San Andreas-Tierra	2947.1	0.073	1	13.3	0.005	-0.013	0.024	-
Climara-Toomes	1274.5	0.0316	24	5.7	0.132	0.049	0.215	+
riverwash	70.9	0.0018	0	0.3	0.000	0.000	0.000	-
gullied	185.0	0.0046	5	0.8	0.027	-0.013	0.067	

OAK OCCURRENCE, SOILS, AND LAND USE

By examining the association of human land uses and soil type we can refine our view of the distribution of oak habitats in the landscape. Here we define a polygon as “developed” when the majority of the polygon is in either agriculture or residential/urban use. It is obvious from Table 3.15 that developed lands are primarily associated with those soil types preferred by valley oaks, such as loam, clay loam, sandy loam, and shaly loam

Table 3.15: Occurrence rates (percentages) for all three oaks and agriculture/urban land use. Percentages are based on number of observations, not area.

Soil Type	Valley oak	Live oak	Blue oak	Ag/Urban
sand	6.1	15.7	2.2	21.9
loamy sand	4.3	6.1	0.0	14.3
sandy loam	8.0	7.2	1.1	11.2
fine sandy loam	4.0	2.0	3.8	3.7
loamy escarpments	2.9	1.4	0.5	0.6
loam	14.2	11.7	4.9	25.3
clay loam	13.1	12.4	1.6	9.0
silty clay loam	4.7	4.6	18.7	4.2
shaly clay loam	0.9	2.4	2.7	0.0
shaly loam	32.1	19.7	36.3	7.0
rocky clay loam	0.0	0.2	2.2	0.0
rocky loam	0.0	0.4	1.6	0.0
silty clay	1.5	1.4	3.3	0.6
sedimentary rock	0.0	1.2	1.6	0.0
igneous rock	0.0	0.3	2.7	0.3
San Andreas-Tierra	5.8	9.7	0.5	1.1
Climara-Toomes	0.5	1.7	13.2	0.0
riverwash	0.3	0.3	0.0	0.6
gullied	1.5	1.6	2.7	0.3
Total	100.0	100.0	100.0	100.0

OAK OCCURRENCE AND SAWYER & KEELER-WOLF VEGETATION TYPES

The Sawyer&Keeler-Wolf vegetation classification system is based on both structure and dominant species. Oaks can be constituents of grassland, shrubland, woodland or forest types. Table 3.16 summarizes the distribution of the occurrences of the three oak species into the Sawyer land cover classes. For example, land cover in 58.5% of polygons containing valley oak has been classified as California annual grassland. Valley oak usually occurs in very low densities within the study area and rarely do monospecific stands achieve woodland status. Valley oak does occur as a component (along with another oak) of mixed oak woodlands (e.g. 18.3 percent of its occurrences are as part of woodland dominated by coast live oak).

Table 3.16: Frequency of occurrence of each oak species within Sawyer&Keeler-Wolf vegetation types. Percentages based on total occurrences (valley oak = 64occurrences; live oak = 1467 occurrences; blue oak = 182 occurrences).

Vegetation Series	Valley	Live	Blue
Blue oak woodland	0.3	0.1	3.2
Coast live oak woodland	18.3	21.9	25.3
Coast live oak forest	0.6	2.4	0.5
Valley oak woodland	0.5	0.1	0.0
Mixed oak woodland	1.8	1.2	5.9
Mixed oak forest	1.0	0.5	3.8
Arroyo Willow	0.5	0.6	0.0
California sagebrush and	2.9	9.8	16.1
Chamise chaparral	0.0	0.6	1.6
Ceanothus	0.2	0.3	1.1
California annual grassland	58.5	50.0	38.7
Non-native (crops, etc.)	15.5	12.3	3.8

Because woodland status implies at least 25% canopy cover, all three oaks are most often found as rare or uncommon components of annual grasslands. For example, coast live oaks occur in coast live oak woodlands in only 21.9 percent of their occurrences. Sixteen percent of polygons containing valley oaks are classified as non-native cover types such as residential areas and cropland.

GENERAL DISTRIBUTION OF VALLEY OAK HABITATS

Figure 3.9shows the map of the major valley oak habitat areas superimposed on the soil units that formed the basis for the oak inventory database. The mapped area of valley oak includes 4,284 acres and map units range in size from less than an acre to over 600 acres. The straight eastern and southeastern boundaries indicate the limit of air photo coverage. As can be seen, there are only a few discrete areas of pure valley oak woodland and savanna in the study area. In most places valley oak is co-dominant with coast live oak, and in a few places it co-occurs with blue oak. The tendency for valley oak to increase in importance from the western to eastern sides of the study area is also apparent in the mapped distribution.

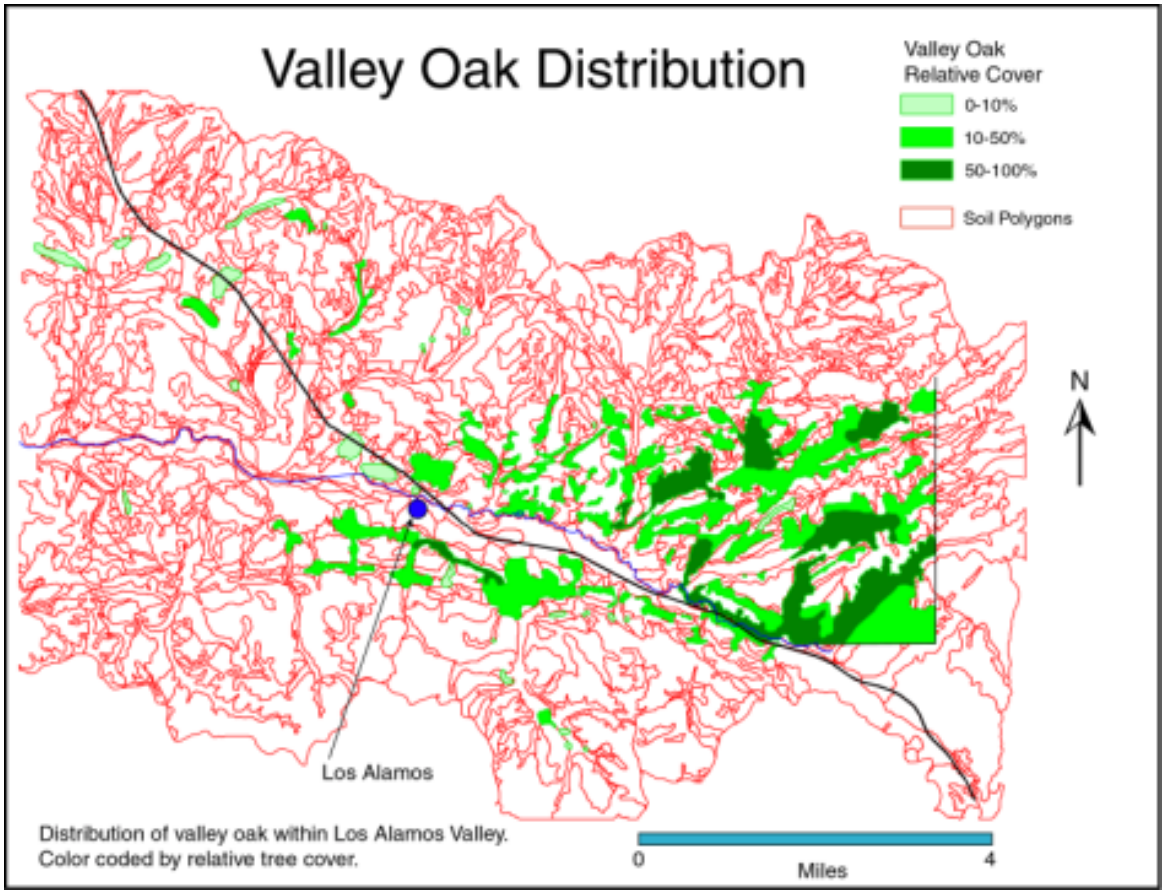

Figure 3.9 Major areas of valley oak and mixed oak woodland and savanna in the study area.

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