An Inventory of Carbon and California Oaks

California oak woodlands and forests could sequester a billion tons of carbon

By Tom Gaman
for the California Oak Foundation
Addendum to *Oaks 2040*

California Oak Foundation

Our mission is to protect and perpetuate native oak woodlands

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California Oak Foundation

Founded in 1988, the California Oak Foundation (COF) is a 501(c)(3) nonprofit educational organization committed to preserving the state's oak forest ecosystem and its rural landscapes.

COF continues to build partnerships, educate children and adults, and garner financial support in order to conserve oak woodlands in the face of the ever-increasing pressures of urbanization.

About the author

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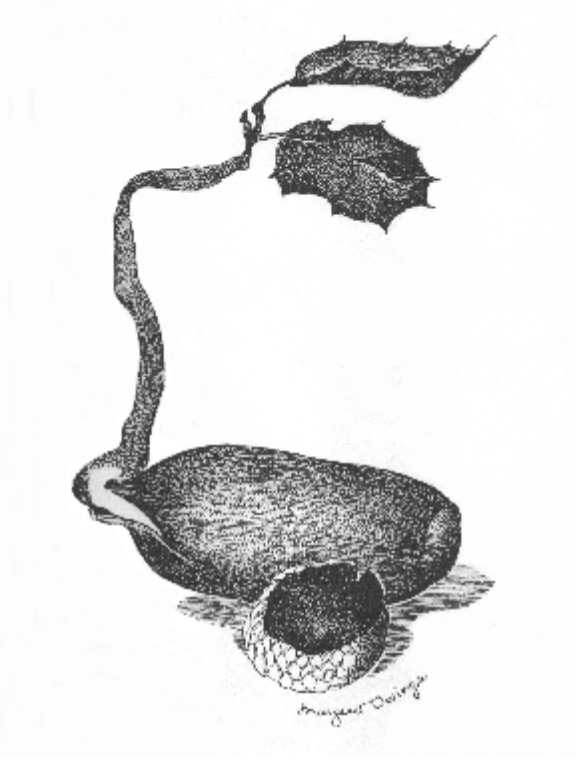

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California oak woodlands and forests could sequester a billion tons of carbon

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Abstract

Policymakers recognize that oak woodlands and forests sequester and store atmospheric carbon in quantities that contribute to the health and well-being of Californians. *Oaks 2040* identified almost 13 million acres (over five million hectares) of oak woodlands and forests in California. See Figure 1. Due to their scenic, wildlife habitat, biodiversity, and cultural values, these oak-related lands have sequestered over 325 million metric tons of carbon in live trees. Another 350 million metric tons of carbon are sequestered in understory vegetation, downed woody material, and soil horizons. This research project quantifies these carbon assets and evaluates their future ability to sequester additional carbon. Oak sequestration by oak type is provided for each California oak county.

Figure 1 – This map shows the distribution of oak woodlands and oak forests by county and by region.

Methods

The US Forest Service Forest Inventory and Analysis (FIA) plot data establish a comprehensive database of ground information obtained from more than 11,000 permanent vegetation monitoring locations throughout the State of California. California Oak Foundation obtained the FIA data for six years from 2001-2006 and the State of California "FRAP" GIS vegetation map. Using the same methods as used in *Oaks 2040*: *The Status and Future*

Table 1 – Oak Woodland Carbon Metric Tons by County and Oak Type

REGION	COUNTY	OAK TYPE										
		Black Oak	*Blue Oak*	*Canyon Oak*	*Coast Oak*	*Engelmann Oak*	*Interior Oak*	*Mixed Oak*	*Oregon Oak*	*Tan Oak*	*Valley Oak*	**Total Oak**
North Coast	Del Norte	1,736	0	49,113	0	0	0	50,578	5,702	1,536,632	0	1,643,762
	Humboldt	346,473	0	1,012,053	167	0	0	233,526	1,612,915	5,527,237	0	8,732,370
	Mendocino	1,029,853	0	2,944,271	13,747	0	358,672	2,051,549	4,543,137	3,758,430	40,864	14,740,523
	Sonoma	66,744	0	357,295	343,982	0	31,853	3,042,995	660,105	1,092,046	5,089	5,600,110
North Interior	Lassen	173,063	0	0	0	0	0	0	10,634	0	0	183,697
	Modoc	16,013	0	0	0	0	0	0	8,961	0	0	24,973
	Shasta	3,694,257	1,683,959	1,715,732	0	0	0	0	512,932	9,518	0	7,616,397
	Siskiyou	283,603	0	1,177,036	0	0	0	0	2,369,118	159,998	0	3,989,755
	Trinity	1,111,449	1,720	1,718,984	0	0	0	0	1,960,128	446,281	0	5,238,562
Central Coast	Alameda	0	172,179	187	499,368	0	0	501,147	0	0	4,709	1,177,590
	Contra Costa	0	175,033	759	403,106	0	0	89,590	0	0	2,333	670,821
	Marin	0	1,825	0	128,526	0	0	652,570	0	0	364	783,285
	Monterey	0	1,482,783	0	3,294,628	0	0	213	0	498,663	22,404	5,298,691
	San Benito	0	363,083	0	544	0	0	13,361	0	0	27	377,015
	San Luis Obispo	0	402,398	1,413	1,035,334	0	0	450,842	0	574	29,256	1,919,818
	San Mateo	0	3,031	0	185,947	0	0	54,786	0	1,212	4,733	249,708
	Santa Barbara	0	132,627	410,408	2,116,450	0	0	0	0	3,676	9,867	2,673,029
	Santa Clara	0	341,637	1,688	919,259	0	0	1,044,482	0	192	11,955	2,319,212
	Santa Cruz	0	0	0	278,210	0	0	112,845	0	893	0	391,948
	Ventura	0	886	220,983	618,068	0	0	0	0	0	3,979	843,917
Sacramento	Butte	768,127	641,198	781,339	0	0	621,982	77,551	0	393,089	0	3,283,286
	Colusa	13,520	717,715	84,136	0	0	2,222	0	0	0	0	817,592
	El Dorado	1,375,936	294,078	619,065	0	0	1,206,834	304,714	0	0	0	3,800,627
	Glenn	223,918	528,963	588,707	0	0	311	0	0	0	0	1,341,899
	Lake	917,840	573,593	864,699	0	0	46,755	287,850	0	85,224	0	2,775,961
	Napa	47,362	395,795	23,678	0	0	89,055	1,700,920	0	904	0	2,257,715
	Nevada	1,039,751	220,338	310,364	0	0	661,695	51,489	0	6,593	0	2,290,231
	Placer	1,362,177	316,380	1,053,668	0	0	324,309	234,139	0	0	0	3,290,673
	Plumas	710,696	0	295,309	0	0	0	730	0	7,934	0	1,014,669
	Sacramento	0	46,129	0	0	0	10,517	500	0	0	0	57,147
	Sierra	352,592	49	214,292	0	0	104	51	0	6,167	0	573,256
	Solano	1,680	110,424	0	0	0	11,298	119,400	0	0	0	242,802
	Tehama	939,211	2,817,021	1,167,676	0	0	26,293	0	0	5,556	0	4,955,757
	Yolo	0	501,797	1,530	0	0	17,497	0	0	0	0	520,824
	Yuba	400,840	303,527	104,467	0	0	349,012	10,097	0	131,649	0	1,299,592
San Joaquin	Alpine	18,819	0	3,117	0	0	0	0	0	0	0	21,936
	Amador	288,011	265,043	289,254	0	0	476,347	8,776	0	0	6,932	1,334,363
	Calaveras	360,886	598,453	636,246	0	0	452,161	1,277	0	0	998	2,050,022
	Fresno	490,130	1,218,280	992,935	0	0	869,285	33,184	0	0	1,801	3,605,615
	Inyo	18,145	0	84,976	0	0	0	38	0	0	0	103,159
	Kern	514,830	819,007	1,184,646	0	0	776,626	33,878	0	0	30,009	3,358,995
	Kings	0	50,961	0	0	0	3,650	164	0	0	0	54,775
	Madera	289,459	660,627	715,146	0	0	1,047,668	2,814	0	0	9,863	2,725,577
	Mariposa	378,990	643,027	1,021,471	0	0	1,133,193	1,015	0	0	3,392	3,181,088
	Merced	0	270,721	0	0	0	58	5,898	0	0	2,260	278,936
	San Joaquin	0	93,051	0	0	0	4,643	2,503	0	0	77	100,273
	Stanislaus	0	554,644	0	0	0	13,593	1,594	0	0	768	570,599
	Tulare	1,335,575	839,489	1,035,430	0	0	720,677	49,736	0	0	1,090	3,981,995
	Tuolumne	556,373	387,477	1,151,908	0	0	768,612	518	0	0	790	2,865,678
Southern	Los Angeles	0	0	729,981	213,993	221	0	10,210	0	0	0	954,404
	Orange	0	0	29,380	72,558	0	0	0	0	0	0	101,939
	Riverside	0	0	172,551	84,290	16,319	0	1,814	0	0	0	274,974
	San Bernardino	0	0	412,380	17,609	0	0	8,015	0	0	0	438,004
	San Diego	0	0	112,414	517,718	123,636	0	89,634	0	0	0	843,403
	ALL COUNTIES	**19,126,322**	**18,628,950**	**24,241,574**	**10,743,504**	**140,176**	**10,024,921**	**11,286,415**	**11,677,930**	**12,135,838**	**193,557**	**118,199,187**

Note: These figures include above and below ground carbon sequestered in live and dead trees.
They do not include litter and duff, down logs or soil borne carbon.

of Oaks in California[1] the FIA data were overlaid onto the FRAP map and selected plots of "Oak Forests" and "Oak Woodlands" were evaluated.

The data for live and dead trees were processed to obtain a carbon inventory for the Oak Forests and Woodlands of California by region using the methods described by the California Climate Action Registry Forest Project Protocols (California Climate Action Registry, 2007).

Only plots in Hardwood and Mixed cover types that contained oak species were measured. Ten oak types within the Hardwood (woodland) and ten oak types within the Mixed (hardwood and conifer growing intermixed) cover types – a total of 1,340 plots in twenty overall oak cover types – were measured. Of these, 469 four-point cluster plots were available in Hardwood cover types where trees were measured, and an additional 284 cluster plots fell in non-forest inclusions in Hardwood cover types. Similarly 490 forested oak plots of interest fell in Mixed cover types and an additional 98 plots fell in non-forest inclusions within Mixed cover types. Each plot that fell within a non-forest inclusion had no tree inventory and was accordingly weighted with a tree carbon value of zero.

The forest and woodland areas by county were previously computed within each mapped oak type (*Oaks 2040*, Gaman & Firman 2006, Appendix A). Accordingly, the net live and dead tree carbon values obtained from the inventory multiplied by the area within each of the 20 mapped types yield the total carbon tons. Tables 1 & 2 provide estimates of total metric tons of carbon sequestered in California oak forest and woodland trees by county. It is important to bear in mind that, since there are relatively few FIA plots in any given county, these numbers are calculated from the total number of plots within each county's regional boundary. As an example, the Mendocino County black oak forest estimate would be based upon 11 four-point plots: the nine similar black oak woodland plots from the four county (Sonoma, Mendocino, Humboldt & Del Norte) region; and two additional plots that fell in this cover type/oak type that were not forested. Therefore, 11 X 4 or 44 sample points were used to figure the average carbon forest tons per hectare, which was then multiplied by the number of hectares of that particular type. The number of forested/non-forested four-point cluster plots for each region by cover type and oak type is provided in Table 3.

Table 4 provides summaries of carbon in woodlands and forests by region and by oak type. These figures are provided in carbon metric tons per hectare in accordance with the international standard for carbon trading. All countries use these units. Carbon sequestered in California oak woodlands and forests is directly comparable to sequestration and emissions practices in other sectors.

Oak forests and woodlands also sequester carbon in the form of understory shrubs, grasses and forbs, downed woody debris (decaying logs and twigs) and soil borne carbon (not including below ground tree root systems).

[1] For information on oak types and cover types please see *Oaks 2040: The Status and Future of Oaks in California*, available at www.californiaoaks.org/Oaks 2040 .

Table 2 – Oak Forests Carbon (total sequestered Metric Tons By County and Oak Type)

REGION	COUNTY	OAK TYPE										
		Black Oak	*Blue Oak*	*Canyon Oak*	*Coast Oak*	*Engelmann Oak*	*Interior Oak*	*Mixed Oak*	*Oregon Oak*	*Tan Oak*	*Valley Oak*	**Total Oak**
North Coast	Del Norte	70,406	0	63,075	0	0	0	397,600	26,070	7,110,271	0	7,667,422
	Humboldt	971,830	0	1,283,570	0	0	0	1,921,521	1,203,171	28,230,027	0	33,610,119
	Mendocino	2,054,243	0	1,315,934	0	0	0	1,772,471	1,915,466	21,521,836	0	28,579,950
	Sonoma	35,353	0	102,510	0	0	0	2,139,902	213,560	3,724,615	0	6,215,940
North Interior	Lassen	123,993	0	0	0	0	0	0	0	0	0	123,993
	Shasta	11,730,474	56,611	2,510,751	0	0	0	859	459,709	42,061	0	14,800,465
	Siskiyou	1,638,191	0	9,330,770	0	0	0	2,624,401	3,300,416	7,717,400	0	24,611,178
	Trinity	3,877,856	0	6,708,818	0	0	0	7	1,644,514	5,553,138	0	17,784,333
Central Coast	Alameda	0	0	0	28,385	0	0	41,653	0	0	0	70,038
	Contra Costa	0	0	2,945	68,508	0	0	23,829	0	0	0	95,282
	Marin	0	0	0	7,768	0	0	1,526,817	0	202,467	0	1,737,052
	Monterey	0	0	0	1,605,742	0	0	556	0	2,201,735	0	3,808,033
	San Benito	0	0	0	0	0	0	0	0	0	0	0
	San Luis Obispo	0	0	0	76,374	0	0	179,201	0	0	0	255,575
	San Mateo	0	0	0	533,452	0	0	236,906	0	3,882,426	0	4,652,784
	Santa Barbara	0	0	412,904	316,451	0	0	0	0	0	0	729,355
	Santa Clara	0	0	0	334,020	0	0	431,140	0	492,676	0	1,257,836
	Santa Cruz	0	0	0	3,838,548	0	0	754,399	0	4,242,382	0	8,835,329
	Ventura	0	0	834,501	52,649	0	0	0	0	0	0	887,150
Sacramento	Butte	2,284,093	38,008	1,071,894	0	0	82,830	521,952	0	2,630,348	0	6,629,125
	Colusa	94,684	2,439	228,265	0	0	0	0	29,435	0	0	354,823
	El Dorado	2,685,674	1,978	609,998	0	0	72,941	431,993	0	6,346	0	3,808,930
	Glenn	250,422	944	148,649	0	0	0	0	28,646	0	0	428,661
	Lake	803,861	6,346	679,837	0	0	3,762	309,025	59,642	18,033	0	1,880,506
	Napa	18,614	857	19,259	0	0	0	959,864	1,830	633	0	1,001,057
	Nevada	3,432,138	9,138	699,381	0	0	72,559	22,451	0	84,252	0	4,319,919
	Placer	3,144,419	1,845	832,780	0	0	13,206	472,785	0	0	0	4,465,035
	Plumas	1,952,677	0	412,806	0	0	0	8,062	0	15,042	0	2,388,587
	Sierra	1,337,630	0	477,711	0	0	0	4,647	0	27,076	0	1,847,064
	Solano	0	0	0	0	0	101	0	0	0	0	101
	Tehama	1,460,289	12,673	623,239	0	0	3,023	0	24,832	3,893	0	2,127,949
	Yuba	1,108,816	1,084	198,191	0	0	30,281	35,763	0	1,093,840	0	2,467,975
San Joaquin	Alpine	10,066	0	3,188	0	0	0	0	0	0	0	13,254
	Amador	623,411	0	264,361	0	0	56,962	26,624	0	0	0	971,358
	Calaveras	918,628	0	1,262,694	0	0	247,530	13,771	0	0	0	2,442,623
	Fresno	1,560,312	8,698	1,323,719	0	0	21,326	1,045	0	0	0	2,915,100
	Inyo	6,950	0	289,243	0	0	0	0	0	0	0	296,193
	Kern	942,164	3,219	1,335,224	0	0	10,460	15,341	0	0	0	2,306,408
	Kings	0	836	0	0	0	0	0	0	0	0	836
	Madera	994,450	146	847,441	0	0	95,978	368	0	0	0	1,938,383
	Mariposa	1,437,403	134	928,449	0	0	217,595	715	0	0	0	2,584,296
	Tulare	1,507,403	36	504,412	0	0	5,962	10,213	0	0	0	2,028,026
	Tuolumne	1,519,285	326	1,480,667	0	0	258,059	507	0	0	0	3,258,844
Southern	Los Angeles	67,414	9,044	704,832	0	0	0	0	0	0	0	781,290
	Orange	0	0	15,211	0	0	0	0	0	0	0	15,211
	Riverside	69,413	0	535,463	0	0	0	0	0	0	0	604,876
	San Bernardino	1,092,565	0	580,341	0	0	0	0	0	0	0	1,672,906
	San Diego	383,888	0	138,887	0	0	0	0	0	0	0	522,775
	ALL COUNTIES	**50,209,015**	**154,362**	**38,781,920**	**6,861,897**	**0**	**1,192,575**	**14,886,388**	**8,907,291**	**88,800,497**	**0**	**209,793,945**

Note: These figures include above and below ground carbon sequestered in live and dead trees.
They do not include litter and duff, down logs or soil borne carbon.

These contributors store significant quantities of sequestered carbon. The US Forest Service Carbon Online Estimator Tool (USFS 2008) provides estimates of these additional carbon pools. The resulting values appeared to be consistent across the variety of oak types (Table 5).

Sequestration in understory shrubs ranged from 11-21 metric tons per hectare, depending on shrub density and increasing with stand age. Coarse woody debris varied according to fuel loading at 5-14 tons per hectare on average, actually decreasing with stand age. Duff and litter carbon varied from 28-31 tons per hectare and stayed consistent across age classes. Soil organic matter, down to a depth of one meter, was also consistent at 28 tons per hectare in these forest and woodland types. From these additional carbon pools, an additional 350 million tons of carbon are stored in oak woodlands and oak forests. Therefore, California oak woodlands and forests combined sequester over 675 million metric tons of carbon.

Results and discussion

There are approximately 325 million tons of above- and below-carbon sequestered in live and dead oak trees on 12.9 million acres (5.2 million hectares) of oak woodlands and forests in California. Dead trees account for approximately four percent of the total. The calculations are comparable to those that can be generated by the Carbon Online Estimator tool (USFS 2008).

Thirty-eight percent of plots fell in non-forest inclusion areas in oak woodlands. These areas, a minimum of one acre in size, are non-stocked areas too small to be mapped as non-forest (using the FRAP methodology). If these plots are more or less evenly distributed among the woodland types, that would mean that California has the capacity to reforest these areas, thereby increasing the carbon sequestration in our oak woodlands by 103 million metric tons in tree biomass alone. If this is to be done over a 75-year period, then we may have the capacity to capture an additional 1.3 million tons of carbon per year through reforestation and conservation of trees in California's existing oak woodlands.

California is estimated to be at risk of losing 750,000 acres of oak forest and woodland by the year 2040 (*Oaks 2040*, Gaman and Firman 2006). Using the above figures, this means that up to 33 million tons of sequestered carbon are at risk of entering the atmosphere should development processes eliminate these oak woodlands and forests, and their associated carbon pools.

Oaks are long-lived trees. If we assume that our current oak woodlands and forests average 100 years of age, then we can expect to sequester almost three million tons of additional carbon a year by protecting and conserving these trees throughout the 21st century. Other methods, including interplanting, improved grazing management, and conservation-based sustainable forestry, have the ability to capture additional carbon, measurable on a case-by-case basis. California, despite its large and growing population, has the capacity to significantly enhance its oaks to the point where oak woodlands and forests could sequester a billion tons of carbon during this century.

Table 3 – Number of Woodland and Forest Cluster Plots

Number of Woodland Cluster Plots (wooded plots as a proportion of all plots including non forest) by Oak Type

REGION	OAK TYPE									
	Black Oak	*Blue Oak*	*Canyon Oak*	*Coast Oak*	*Engelmann Oak*	*Interior Oak*	*Mixed Oak*	*Oregon Oak*	*Tan Oak*	*Valley Oak*
North Coast	3 / 3	0 / 1	8 / 9	2 / 3	0 / 0	2 / 2	19 / 32	22 / 34	21 / 29	2 / 2
North Interior	17 / 24	11 / 17	10 / 16	0 / 0	0 / 0	0 / 0	0 / 0	18 / 22	1 / 1	0 / 0
Central Coast	0 / 0	29 / 53	5 / 6	33 / 59	0 / 0	0 / 0	13 / 21	0 / 0	1 / 1	1 / 3
Sacramento	8 / 9	47 / 92	18 / 22	0 / 0	0 / 0	18 / 25	9 / 14	0 / 0	2 / 2	0 / 0
San Joaquin	6 / 9	69 / 117	24 / 32	0 / 0	0 / 0	30 / 47	3 / 9	0 / 0	0 / 0	1 / 4
Southern	0 / 1	0 / 1	8 / 15	5 / 12	1 / 2	0 / 0	1 / 1	0 / 0	0 / 0	0 / 0
TOTAL (wooded / all plots)	**34 / 46**	**156 / 281**	**73 / 100**	**40 / 74**	**1 / 2**	**50 / 74**	**45 / 77**	**40 / 56**	**25 / 33**	**4 / 9**

Number of Forest Cluster Plots (forested plots as a proportion of all plots including non forest) by Oak Type

REGION	OAK TYPE									
	Black Oak	*Blue Oak*	*Canyon Oak*	*Coast Oak*	*Engelmann Oak*	*Interior Oak*	*Mixed Oak*	*Oregon Oak*	*Tan Oak*	*Valley Oak*
North Coast	9 / 11	0 / 0	8 / 11	0 / 0	0 / 0	0 / 0	11 / 12	9 / 12	98 / 119	0 / 0
North Interior	36 / 40	6 / 10	46 / 49	0 / 0	0 / 0	0 / 0	5 / 5	17 / 22	17 / 18	0 / 0
Central Coast	0 / 0	0 / 1	4 / 5	14 / 17	0 / 0	0 / 0	3 / 3	0 / 0	16 / 18	0 / 0
Sacramento	52 / 61	17 / 21	19 / 22	0 / 0	0 / 0	8 / 11	6 / 7	2 / 2	5 / 6	0 / 0
San Joaquin	24 / 27	3 / 7	23 / 26	0 / 0	0 / 0	11 / 18	1 / 1	0 / 0	0 / 0	0 / 0
Southern	4 / 6	1 / 1	15 / 18	0 / 1	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0	0 / 0
TOTAL (non-forest / all plots)	**125 / 145**	**27 / 40**	**115 / 131**	**14 / 18**	**0 / 0**	**19 / 29**	**26 / 28**	**28 / 29**	**136 / 161**	**0 / 0**

Table 4 – Metric Tons per Hectare of Oak Woodland and Forest Carbon Stored in Trees by Region and Oak Type

Averaged to *include* non-forest areas

	REGION	*Black Oak*	*Blue Oak*	*Canyon Oak*	*Coast Oak*	*Engelmann Oak*	*Interior Oak*	*Mixed Oak*	*Oregon Oak*	*Tan Oak*	*Valley Oak*
Woodlands	North Coast	51	0	120	39	0	53	43	40	89	24
	North Interior	54	15	50	0	0	0	0	60	70	0
	Central Coast	0	15	38	31	0	0	44	0	46	8
	Sacramento	95	16	62	0	0	33	47	0	193	0
	San Joaquin	76	13	59	0	0	26	4	0	0	11
	Southern	0	0	30	17	17	0	26	0	0	0
Forests	North Coast	128	0	96	0	0	0	110	67	132	0
	North Interior	123	27	126	0	0	0	87	81	222	0
	Central Coast	0	0	74	161	0	0	249	0	204	0
	Sacramento	110	29	92	0	0	43	135	27	155	0
	San Joaquin	99	9	87	0	0	45	38	0	0	0
	Southern	56	72	40	0	0	0	0	0	0	0

Averaged to *exclude* non-forest areas

	REGION	*Black Oak*	*Blue Oak*	*Canyon Oak*	*Coast Oak*	*Engelmann Oak*	*Interior Oak*	*Mixed Oak*	*Oregon Oak*	*Tan Oak*	*Valley Oak*
Woodlands	North Coast	51	0	135	59	0	53	72	61	123	24
	North Interior	76	24	81	0	0	0	0	73	70	0
	Central Coast	0	27	45	55	0	0	71	0	46	25
	Sacramento	107	31	76	0	0	46	74	0	193	0
	San Joaquin	114	22	79	0	0	41	11	0	0	42
	Southern	0	0	56	41	34	0	26	0	0	0
Forests	North Coast	157	0	132	0	0	0	121	90	161	0
	North Interior	139	45	135	0	0	0	87	105	233	0
	Central Coast	0	0	92	195	0	0	249	0	231	0
	Sacramento	132	38	105	0	0	58	157	27	186	0
	San Joaquin	110	34	99	0	0	72	38	0	0	0
	Southern	114	72	52	0	0	0	0	0	0	0

Note: Figures in both tables include above and below ground carbon sequestered in live and dead trees. They do not include litter and duff, down logs or soil borne carbon.

Table 5 – Associated Non-tree Carbon Pools in Metric Tons per Hectare

SOURCE	OAK TYPE								
	Black Oak	*Blue Oak*	*Canyon Oak*	*Coast Oak*	*Engelmann Oak*	*Interior Oak*	*Mixed Oak*	*Oregon Oak*	*Valley Oak*
Understory Shrubbery and Forbs	11	15	14	18	15	14	13	13	21
Downed Woody Debris	6	12	8	15	12	8	5	6	14
Duff and Litter Layers	29	30	29	31	30	29	28	29	31
Soil Organics	28	28	28	28	28	28	28	28	28
TOTAL ASSOCIATED POOLS	**74**	**84**	**78**	**91**	**84**	**78**	**73**	**76**	**93**

Notes:
Source USFS Carbon Online Tool
Blue oak figures substituted for Engelmann Oak; tanoak not available

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OAK WOODLANDS ARE FOUND THROUGHOUT CALIFORNIA. TWENTY SPECIES OF OAKS AND THEIR ASSOCIATED HABITATS SUPPORT 365 SPECIES OF WILDLIFE, AS DESIGNATED IN THE CALIFORNIA WILDLIFE HABITAT RELATIONSHIPS SYSTEM, WHICH DESCRIBES THE MANAGEMENT STATUS, DISTRIBUTION, LIFE HISTORY, AND HABITAT REQUIREMENTS OF CALIFORNIA'S WILDLIFE SPECIES.

Tiger Salamander • Northwestern Salamander • Long Toed Salamander • Pacific Giant Salamander • Olympic Salamander • Rough-Skinned Newt • California Newt • Red-Bellied Newt • **VALLEY OAK** (*Quercus lobata*) • Del Norte Salamander • Ensatina • California Slender Salamander • Black-Bellied Slender Salamander • Pacific Slender Salamander • Kern Canyon Slender Salamander • Tehachapi Slender Salamander • Black Salamander • Clouded Salamander • Arboreal Salamander • Shasta Salamander • Limestone Salamander • Tailed Frog • Western Spadefoot • Western Toad • **COAST LIVE OAK** (*Quercus agrifolia*) • Southwestern Toad • California Treefrog • Pacific Treefrog • Foothill Yellow-Legged Frog • Mountain Yellow-Legged Frog • Bullfrog • Double-Crested Cormorant • Great Blue Heron • Great Egret • Snowy Egret • Cattle Egret • Green-Backed Heron • Black-Crowned Night Heron • Wood Duck • Mallard • Common Merganser • Turkey Vulture • California Condor • Osprey • White-Tailed Kite • Bald Eagle • Northern Harrier • Sharp-Shinned Hawk • Cooper's Hawk • Northern Goshawk • Red-Shouldered Hawk • Swainsen's Hawk • Red-Tailed Hawk • **INTERIOR LIVE OAK** (*Quercus wislizenii*) • Ferruginons Hawk • Rough-Legged Hawk • Golden Eagle • American Kestrel • Merlin • Peregrine Falcon • Prairie Falcon • Chukar • Ring-Necked Pheasant • Blue Grouse • Ruffed Grouse • Turkey • California Quail • Mountain Quail • Virginia Rail • Band-Tailed Pigeon • Mourning Dove • Yellow-Billed Cuckoo • **BLUE OAK** (*Quercus douglasii*) • Greater Roadrunner • Common Barn Owl • Flammulated Owl • Western Screech Owl • Great Horned Owl • Northern Pygmy Owl • Burrowing Owl • Spotted Owl • Long-Eared Owl • Short-Eared Owl • Northern Saw-Whet Owl • Lesser Nighthawk • Common Nighthawk • Common Poorwill • Whip-Poor-Will • Black Swift • **BLACK OAK** (*Quercus kelloggii*) • Vaux's Swift • White-Throated Swift • Black-Chinned Hummingbird • Anna's Hummingbird • Costa's Hummingbird • Calliope Hummingbird • Rufous Hummingbird • Allen's Hummingbird • Belted Kingfisher • Lewis' Woodpecker • Acorn Woodpecker • Rcd-Naped Sapsucker • Red-Breasted Sapsucker • **OREGON OAK** (*Quercus garryana*) • Nuttall's Woodpecker • Downy Woodpecker • Hairy Woodpecker • White-Headed Woodpecker • Northern Flicker • Pileated Woodpecker • Olive-Sided Flycatcher • Western Wood-Pewee • Willow Flycatcher • Hammonds' Flycatcher • Dusky Flycatcher • Pac-Slope/Cordilleran Flycatcher • Black Phoebe • Say's Phoebe • Ash-Throated Flycatcher • Cassin's Kingbird • Western Kingbird • Horned Lark • Purple Martin • Tree Swallow • Violet-Green Swallow • Northern Rough-Winged Swallow • Bank Swallow • Cliff Swallow • Barn Swallow • Steller's Jay • Scrub Jay • **ENGELMANN OAK** (*Quercus engelmannii*) • Yellow-Billed Magpie • American Crow • Common Raven • Mountain Chickadee • Chestnut-Backed Chickadee • Plain Titmouse • Bushtit • Red-Breasted Nuthatch • White-Breasted Nuthatch • Brown Creeper • Rock Wren • Canyon Wren • Bewick's Wren • House Wren • Winter Wren • Marsh Wren • **CANYON OAK** (*Quercus chyrsolepis*) • American Dipper • Golden-Crowned Kingler • Ruby-Crowned Kinglet • Blue-Gray Gnatcatcher • Western Bluebird • Mountain Bluebird • Townsend's Solitaire • Swainson's Thrush • Hermit Thrush • American Robin • Varied Thrush • Wrentit • Northern Mockingbird • California Thrasher • Cedar Waxwing • Phainopepla • Northern Shrike • Loggerhead Shrike • European Starling • Bell's Vireo • Solitary Vireo • Hutton's Vireo • **ISLAND OAK** (*Quercus tomentella*) • Warbling Vireo • Orange-Crowned Warbler • Nashville Warbler • Yellow Warbler • Yellow-Rumped Warbler • Black-Throated Gray Warbler • Townsend's Warbler • Hermit Warbler • Macgillivray's Warbler • Common Yellowthroat • Wilson's Warbler • Yellow-Breasted Chat • Summer Tanager • Western Tanager • Black-Headed Grosbeak • **SCRUB OAK** (*Quercus berberidifolia*) • Blue Grosbeak • Lazuli Bunting • Green-Tailed • Towhee • Rufous-Sided Towhee • California Towhee • Chipping Sparrow • Vesper Sparrow • Lark Sparrow • Savannah Sparrow • Fox Sparrow • Song Sparrow • Lincoln's Sparrow • Golden-Crowned Sparrow • White-Crowned Sparrow • Dark-Eyed Junco • Red-Winged Blackbird • Tricolored Blackbird • Western Meadowlark • Brewer's Blackbird • Brown-Headed Cowbird • **LEATHER OAK** (*Quercus durata*) • Hooded Oriole • Northern Oriole • Scott's Oriole • Purple Finch • House Finch • Pine Siskin • Lesser Goldfinch • Lawrence's Goldfinch • American Goldfinch • Evening Grosbeak • House Sparrow • Virginia Opossum Vagrant Shrew • Pacific Shrew • Ornate Shrew • Water Shrew • Marsh Shrew • **DESERT SCRUB OAK** (*Quercus turbinella*) • Trowbridge's Shrew • Shrew-Mole • Townsend's Mole • Coast Mole • Broad-Footed Mole • California Leaf-Nosed Bat • Little Brown Myotis • Yuma Myotis • Long-Eared Myotis • Fringed Myotis • Long-Legged Myotis • California Myotis • Western Small-Footed Myotis • Silver-Haired Bat • Western Pipistrelle • Big Brown Bat • Western Red Bat • Hoary Bat • Southern Yellow Bat • Spotted Bat • Townsend's Big-Eared Bat • Pallid Bat • Brazilian Free-Tailed Bat • Western Mastiff Bat • Brush Rabbit • Desert Cottontail • Black-Tailed Hare • Mountain Beaver • **HUCKLEBERRY OAK** (*Quercus vaccinifolia*) • Yellow-Pine Chipmunk • Yellow-Cheeked Chipmunk • Allen's Chipmunk • Siskiyou Chipmunk • Sonoma Chipmunk • Merriam's Chipmunk • California Chipmunk • Belding's Ground Squirrel • California Ground Squirrel • Golden-Mantled Ground Squirrel • Gray Squirrel • Western Gray Squirrel • Fox Squirrel • Douglas' Squirrel • **DEER OAK** (*Quercus sadleriana*) • Northern Flying Squirrel • Botta's Pocket Gopher • Northern Pocket Gopher • Western Pocket Gopher • Mountain Pocket Gopher • Little Pocket Mouse • San Joaquin Pocket Mouse • Great Basin Pocket Mouse • California Pocket Mouse • Narrow-Faced Kangaroo Rat • Pacific Kangaroo Rat • Heermann's Kangaroo Rat • California Kangaroo Rat • San Joaquin Kangaroo Rat • Beaver • Western Harvest Mouse • California Mouse • **PALMER OAK** (*Quercus palmeri*) • Deer Mouse • Brush Mouse • Pinyon Mouse • Southern Grasshopper Mouse • Desert Woodrat • Dusky-Footed Woodrat • Bushy-Tailed Woodrat • Western Red-Backed Vole • Heather Vole • California Red Tree Vole • California Vole • Townsend's Vole • Long-Tailed Vole • Creeping Vole • Muskrat • Black Rat • **MULLER OAK** (*Quercus cornelius-mulleri*) • Norway Rat • House Mouse • Western Jumping Mouse • Pacific Jumping Mouse • Porcupine • Coyote • Red Fox • Kit Fox • Gray Fox • Island Fox • Black Bear • Ringtail • Raccoon • Marten • Fisher • Ermine • Long-Tailed Weasel • Mink • Wolverine • Badger • Western Spotted Skunk • Striped Skunk • River Otter • Mountain Lion • Bobcat • Wild Horse • Wild Pig • Elk • Fallow Deer • Sambar • Mule Deer • Barbary Sheep • **COASTAL SCRUB OAK** (*Quercus dumosa*) • Himalayan Tahr • Feral Goat • Western Pond Turtle • Blunt-Nosed Leopard Lizard • Desert Spiny Lizard • Granite Spiny Lizard • Western Fence Lizard • Sagebrush Lizard • Side-Blotched Lizard • Small-Scaled Lizard • Coast Horned Lizard • Granite Night Lizard • Desert Night Lizard • Western Skink • Gilbert's Skink • **ISLAND SCRUB OAK** (*Quercus parvula*) • Orange-Throated Whiptail • Western Whiptail • Southern Alligator Lizard • Northern Alligator Lizard • California Legless Lizard • Western Blind Snake • Rubber Boa • Ringneck Snake • Sharp-Tailed Snake • Racer • Coachwhip • California Whipsnake • Western Patch-Nosed Snake • Glossy Snake • Gopher Snake • Common Kingsnake • California Mountain Kingsnake • Long-Nosed Snake • Common Garter Snake • Western Terrestrial Garter Snake • Western Aquatic/Giant Garter Snake • Northwestern Garter Snake • Western Black-Headed Snake • Lyre Snake • **TUCKER OAK** (*Quercus john-tuckeri*) • Night Snake • Red Diamond Rattlesnake • Speckled Rattlesnake • Western Rattlesnake • **ORACLE OAK** (*Quercus x morehus*)