Status and Trends of Land Change in the Western United States—1973 to 2000
Edited by Benjamin M. Sleeter, Tamara S. Wilson, and William Acevedo
U.S. Geological Survey Professional Paper 1794–A, 2012

Chapter 19

Southern and Central California Chaparral and Oak Woodlands Ecoregion

By Darrell E. Napton

Ecoregion Description

The Southern and Central California Chaparral and Oak Woodlands Ecoregion, which covers approximately 102,110 km^2 (39,425 mi^2), is characterized by a Mediterranean climate with cool, moist winters and hot, dry summers (Omernik, 1987; U.S. Environmental Protection Agency, 1997). Natural vegetation includes chaparral (for example, manzanita, *Arctostaphylos* spp.) and oak (*Quercus* spp.) woodlands with extensive grassland and shrubland cover. The low mountains and foothills of the ecoregion border or parallel the Pacific Ocean from Mexico to Point Reyes, California, and continue inland surrounding the Central California Valley Ecoregion (fig. 1). These mountains and hills are interrupted by limited areas of flat land generally used for development or agriculture. The largest developed area in the ecoregion is the Los Angeles Basin, followed by the San Francisco Bay area and the San Diego metropolitan area (fig. 1). The largest agricultural area

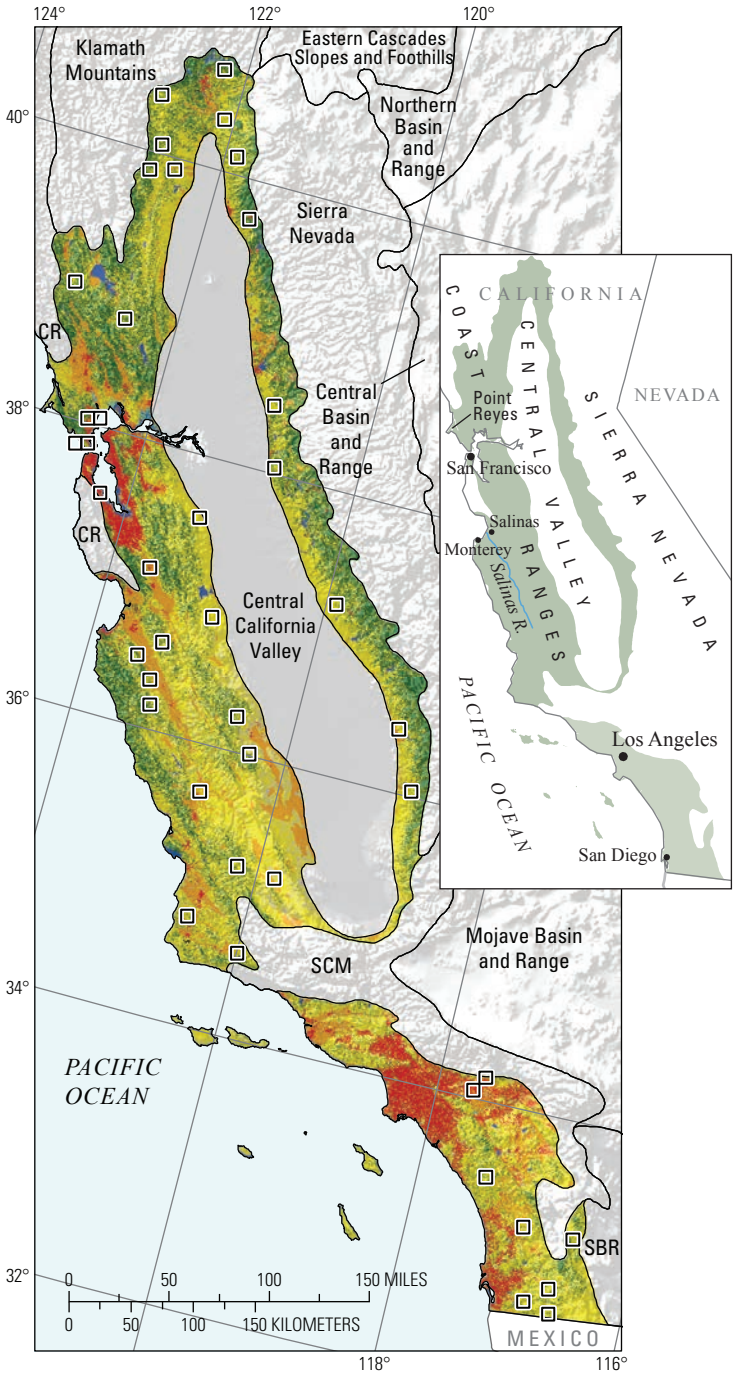

Figure 1. Map of Southern and Central California Chaparral and Oak Woodlands Ecoregion and surrounding ecoregions, showing land-use/land-cover classes from 1992 National Land Cover Dataset (Vogelmann and others, 2001); note that not all land-use/land-cover classes shown in explanation may be depicted on map; note also that, for this "Status and Trends of Land Change" study, transitional land-cover class was subdivided into mechanically disturbed and nonmechanically disturbed classes. Squares indicate locations of 10 x 10 km sample blocks analyzed in study. Index map shows locations of geographic features mentioned in text. Abbreviations for Western United States ecoregions are listed in appendix 2. See appendix 3 for definitions of land-use/land-cover classifications.

Figure 2. Typical Southern and Central California Chaparral and Oak Woodlands Ecoregion landscape, consisting of grassland/shrubland or forest land cover.

is the Salinas River valley south of Monterey, California. Most of the ecoregion consists of rangelands classified as grassland/shrubland and forest land covers (figs. 1,2).

Contemporary Land-Cover Change (1973 to 2000)

The overall spatial change (that is, the percentage of area that changed at least one time between 1973 and 2000) in the ecoregion was estimated at 9.7 percent (table 1). The amount of change in the Southern and Central California Chaparral and Oak Woodlands Ecoregion was close to the median among the western United States ecoregions (fig. 3). Nearly seventy percent of the converted landscape changed land-cover class only one time, whereas thirty percent changed land cover twice (table 1). Fire, which produces a landscape classified as nonmechanically

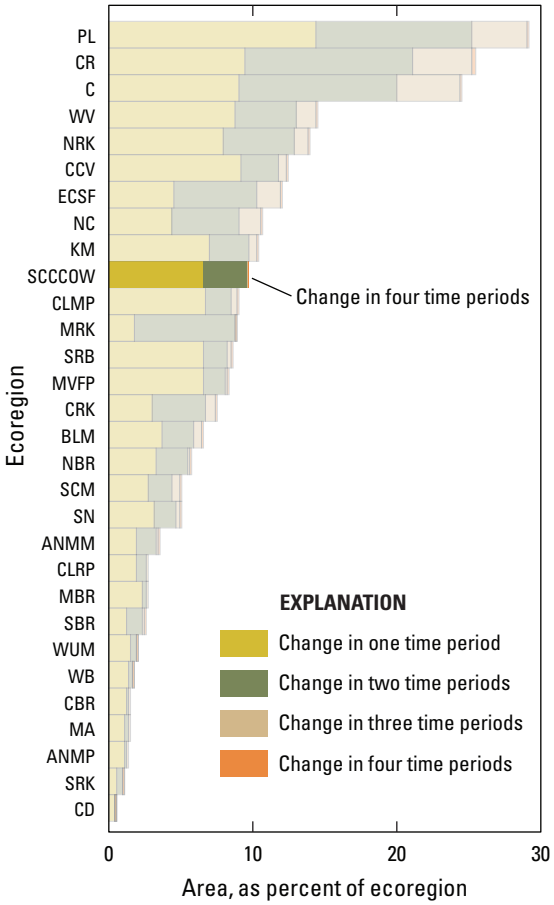

Figure 3. Overall spatial change in Southern and Central California Chaparral and Oak Woodlands Ecoregion (SCCCOW; darker bars) compared with that of all 30 Western United States ecoregions (lighter bars). Each horizontal set of bars shows proportions of ecoregion that changed during one, two, three, or four time periods; highest level of spatial change in Southern and Central California Chaparral and Oak Woodlands Ecoregion (four time periods) labeled for clarity. See table 2 for years covered by each time period. See appendix 2 for key to ecoregion abbreviations.

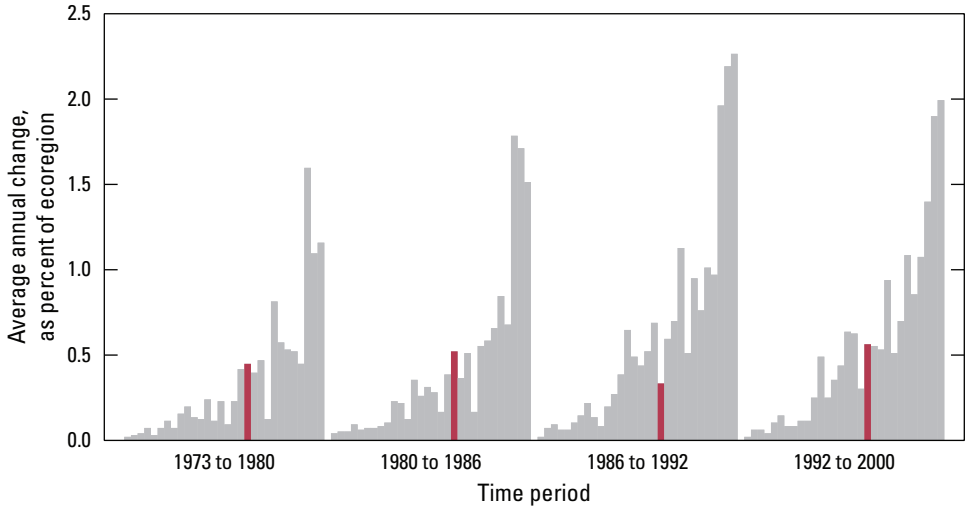

Figure 4. Estimates of land-cover change per time period, normalized to annual rates of change for all 30 Western United States ecoregions (gray bars). Estimates of change for Southern and Central California Chaparral and Oak Woodlands Ecoregion are represented by red bars in each time period.

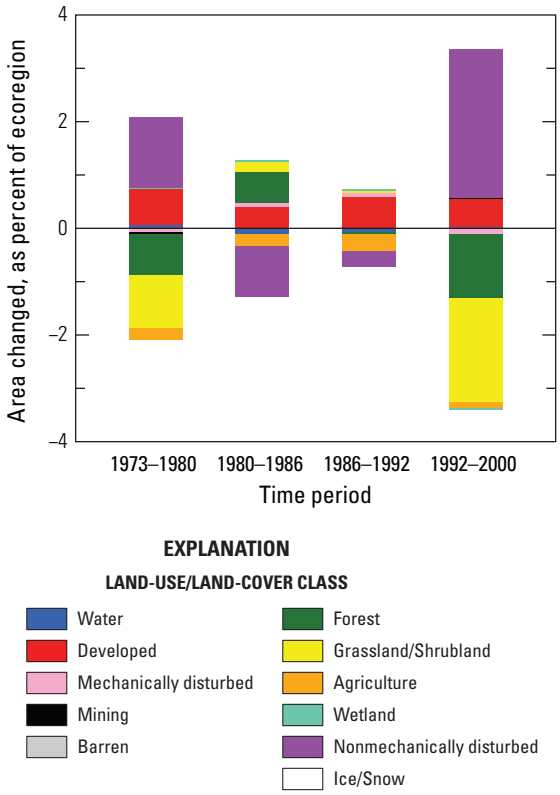

Figure 5. Normalized average net change in Southern and Central California Chaparral and Oak Woodlands Ecoregion by time period for each land-cover class. Bars above zero axis represent net gain, whereas bars below zero represent net loss. Note that not all land-cover classes shown in explanation may be represented in figure. See appendix 3 for definitions of land-use/land-cover classifications.

disturbed, was the primary cause of land-cover change in areas that experienced two or more changes during the study period. Land-conversion rates varied temporally with the fastest annual rates occurring between 1992 and 2000 (at 0.6 percent) and slowest rate between 1986 and 1992 (at 0.3 percent) (table 2; fig. 4).

Figure 5 provides an overview of the net land-cover change by time period. Forest and grassland/shrubland losses were associated with net increases in nonmechanical disturbances, a conversion normally attributed to fire, which is a major presence in the Southern and Central California Chaparral and Oak Woodlands Ecoregion. Cool, wet winters bring a growth of annual grasses providing the necessary fuel load for fires to spread during the ecoregion's hot, dry summers. Many of the endemic chaparral plant species here are adapted to survive low-frequency fires, and some species even depend on fire as part of their life-cycle strategy (fig. 6; see also, Halsey, 2005). Developed land cover increased throughout the study period and accounted for virtually all of the net change occurring between 1986 and 1992. A net loss of agriculture occurred during each time period in the study. As agriculture here typically occurs on flat, easily developed land, agriculture lands are often best suited for urban expansion (fig. 7).

Figure 6. Grassland/shrubland and forest in Southern and Central California Chaparral and Oak Woodlands Ecoregion, two land-cover classes that are prone to fires during dry summers associated with Mediterranean climate of ecoregion.

Figure 7. Conversion of grassland/shrubland to agriculture was most common nonfire land-cover change in Southern and Central California Chaparral and Oak Woodlands Ecoregion during study period.

Figure 8. Conversions of grassland/shrubland and agriculture to developed land were two common land-cover changes in Southern and Central California Chaparral and Oak Woodlands Ecoregion during study period.

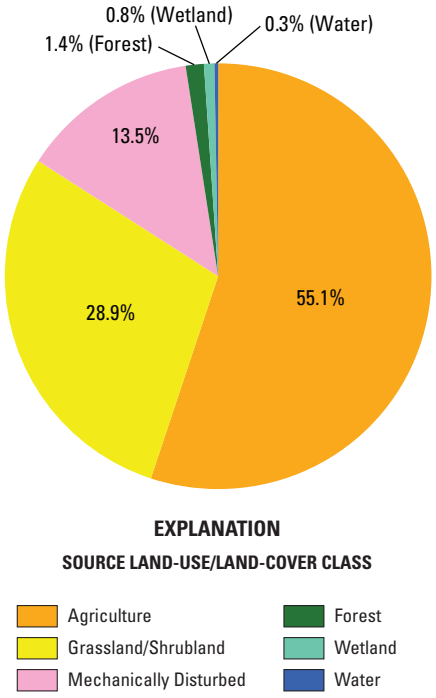

Figure 9. Areal percentages of sources of developed land in Southern and Central California Chaparral and Oak Woodlands Ecoregion during study period.

Grassland/shrubland land cover makes up the largest share of this ecoregion, followed by forest, agriculture, and developed lands (table 3). These four land-cover classes accounted for 96 percent of the ecoregion in 1973 but only 93.2 percent in 2000, largely because of the net increase in nonmechanically disturbed land cover coupled with a decrease in forest and grassland/shrubland land covers. Developed land increased 33 percent during the study period as population in the Southern and Central California Chaparral and Oak Woodlands Ecoregion increased from 14.5 to 22.2 million between 1970 and 2000 (U.S. Census Bureau, 2000). More than half of the land converted to developed land cover came from agriculture, and nearly thirty percent was converted from grassland/shrubland (figs. 8, 9).

Between 1973 and 2000, the five most common land conversions accounted for 73 percent (by area) of the change in the ecoregion (table 4). The most common land-cover conversion was grassland/shrubland to nonmechanically disturbed, accounting for nearly one-quarter of all area converted, whereas forest to nonmechanically disturbed accounted for an additional 19 percent. These conversions largely represent the impact of wildfire in the ecoregion. The third and fifth most common conversions (nonmechanically disturbed back to grassland/shrubland and nonmechanically disturbed back to forest) reflect the cyclic nature of landscape changes associated with wildfire and postfire vegetation recovery. The numbers do not balance because there is a lag time between fire occurrence and the conversion back to the original land cover, especially in the case of forests where an intermediate, successional vegetation cover is likely to occur. The conversion of agriculture to developed land was the fourth most common conversion and accounted for nearly 10 percent of the land-cover change in the ecoregion.

The Southern and Central California Chaparral and Oak Woodlands Ecoregion is the most populous of the nation's ecoregions. Many people find the ecoregion's Mediterranean climate desirable, but little accessible, flat land suitable for affordable housing is available. Additionally, water shortages and drought are common, and much of the ecoregion's water is imported from other ecoregions. Consequently, most of the ecoregion's landscape remains open rangeland with land covers of grassland/shrubland mixed with oak forest. The region's limited farmland is used for specialty crops such as wine grapes, table grapes, and strawberries. New development has resulted in the conversion of some agricultural land, but the largest driver of land-cover change has been the periodic burning of grassland/shrubland and forested land during the ecoregion's long, hot, and dry summers.

Table 1. Percentage of Southern and Central California Chaparral and Oak Woodlands Ecoregion that changed at least one time during study period (1973–2000) and associated statistical error.

[Most sample pixels remained unchanged (90.3 percent), whereas 9.7 percent changed at least once throughout study period]

Number of changes	Percent of ecoregion	Margin of error (+/– %)	Lower bound (%)	Upper bound (%)	Standard error (%)	Relative error (%)
1	6.7	2.3	4.4	9.0	1.5	23.1
2	2.9	1.6	1.3	4.5	1.1	37.9
3	0.1	0.1	0.0	0.1	0.0	50.5
4	0.0	0.0	0.0	0.0	0.0	87.5
Overall spatial change	9.7	2.9	6.7	12.6	2.0	20.8

Table 2. Raw estimates of change in Southern and Central California Chaparral and Oak Woodland. land cover, computed for each of four time periods between 1973 and 2000, and associated error at 85-percent confidence level.

[Estimates of change per period normalized to annual rate of change for each period]

Period	Total change (% of ecoregion)	Margin of error (+/– %)	Lower bound (%)	Upper bound (%)	Standard error (%)	Relative error (%)	Average rate (% per year)
Estimate of change, in percent stratum							
1973–1980	3.1	1.7	1.5	4.8	1.1	36.1	0.4
1980–1986	3.1	1.6	1.5	4.7	1.1	35.8	0.5
1986–1992	2.0	0.9	1.1	2.9	0.6	29.6	0.3
1992–2000	4.5	2.2	2.3	6.8	1.5	33.8	0.6
Estimate of change, in square kilometers							
1973–1980	3,216	1,704	1,512	4,921	1,161	36.1	459
1980–1986	3,149	1,653	1,496	4,802	1,126	35.8	525
1986–1992	2,037	. 885	1,151	2,922	. 603	29.6	339
1992–2000	4,607	2,286	2,321	6,893	1,557	33.8	576

Table 3. Estimated area (and margin of error) of each land-cover class in Southern and Central California Chaparral and Oak Woodlands Ecoregion, calculated five times between 1973 and 2000. See appendix 3 for definitions of land-cover classifications.

	Water		Developed		Mechanically disturbed		Mining		Barren		Forest		Grassland/ Shrubland		Agriculture		Wetland		Non-mechanically disturbed	
	%	+/–	%	+/–	%	+/–	%	+/–	%	+/–	%	+/–	%	+/–	%	+/–	%	+/–	%	+/–
Area, in percent stratum																				
1973	2.5	1.7	6.6	3.6	0.1	0.1	0.2	0.2	0.3	0.3	21.3	4.2	58.0	5.7	10.1	3.1	0.6	0.4	0.3	0.2
1980	2.5	1.7	7.3	4.0	0.1	0.1	0.2	0.2	0.3	0.3	20.5	4.0	57.0	5.7	9.9	3.1	0.6	0.4	1.6	1.6
1986	2.5	1.7	7.7	4.0	0.2	0.1	0.2	0.2	0.3	0.3	21.1	4.1	57.2	5.6	9.7	3.0	0.6	0.4	0.6	0.6
1992	2.4	1.7	8.3	4.2	0.2	0.1	0.2	0.2	0.3	0.3	21.0	4.0	57.2	5.7	9.4	3.0	0.6	0.4	0.3	0.2
2000	2.5	1.7	8.8	4.4	0.1	0.1	0.2	0.2	0.3	0.3	19.8	3.5	55.3	5.6	9.3	3.0	0.6	0.4	3.1	2.1
Net change	0.0	0.1	2.2	1.4	0.0	0.1	0.0	0.1	0.0	0.0	−1.5	1.6	−2.7	1.3	−0.8	1.1	0.0	0.0	2.8	2.0
Gross change	0.4	0.3	2.2	1.4	0.6	0.3	0.1	0.1	0.0	0.0	3.2	2.4	6.1	2.2	2.3	1.1	0.1	0.1	7.5	3.8
Area, in square kilometers																				
1,973	2,507	1,776	6,743	3,650	140	112	199	234	339	291	21,741	4,296	59,216	5,777	10,340	3,200	627	424	257	212
1,980	2,601	1,773	7,417	4,039	62	71	188	220	338	291	20,924	41,20	58,220	5,783	10,121	3,170	644	440	1,595	1,586
1,986	2,505	1,770	7,836	4,101	155	93	187	220	338	291	21,520	4,216	58,408	5,763	9,905	3,103	654	428	602	598
1,992	2,455	1,772	8,456	4,279	216	140	168	161	337	291	21,491	4,133	58,447	5816	9,563	3,069	663	432	315	221
2,000	2,502	1,773	8,977	4,443	116	71	214	169	346	291	20,234	3,611	56,471	5,707	9,478	3,043	626	416	3,146	2,097
Net change	−5	55	2,234	1,381	−25	99	15	88	7	15	−1,506	1,677	−2,746	1,326	−862	1,170	−1	31	2,889	2,057
Gross change	447	278	2,234	1,381	612	314	135	91	13	15	3,305	2,499	6,221	2,247	2,346	1,076	116	80	7,620	3,843

Table 4. Principal land-cover conversions in Southern and Central California Chaparral and Oak Woodlands Ecoregion, showing amount of area changed (and margin of error, calculated at 85-percent confidence level) for each conversion during each of four time periods and also during overall study period. See appendix 3 for definitions of land-cover classifications.

[Values given for "other" class are combined totals of values for other land-cover classes not listed in that time period. Abbreviations: n/a, not applicable]

Period	From class	To class	Area changed (km^2)	Margin of error (+/– km^2)	Standard error (km^2)	Percent of ecoregion	Percent of all changes
1973–1980	Forest	Nonmechanically disturbed	825	990	674	0.8	25.6
	Grassland/Shrubland	Nonmechanically disturbed	755	803	547	0.7	23.5
	Agriculture	Developed	481	437	298	0.5	14.9
	Grassland/Shrubland	Agriculture	409	306	209	0.4	12.7
	Nonmechanically disturbed	Grassland/Shrubland	226	186	127	0.2	7.0
	Other	Other	520	n/a	n/a	0.5	16.2
		Totals	3,216			3.1	100.0
1980–1986	Nonmechanically disturbed	Grassland/Shrubland	810	841	573	0.8	25.7
	Nonmechanically disturbed	Forest	769	926	631	0.8	24.4
	Grassland/Shrubland	Nonmechanically disturbed	448	523	357	0.4	14.2
	Agriculture	Developed	210	184	125	0.2	6.7
	Agriculture	Grassland/Shrubland	156	141	96	0.2	5.0
	Other	Other	756	n/a	n/a	0.7	24.0
		Totals	3,149			3.1	100.0
1986–1992	Nonmechanically disturbed	Grassland/Shrubland	485	526	358	0.5	23.8
	Agriculture	Developed	327	328	224	0.3	16.1
	Grassland/Shrubland	Developed	210	124	85	0.2	10.3
	Grassland/Shrubland	Nonmechanically disturbed	169	123	84	0.2	8.3
	Forest	Nonmechanically disturbed	134	170	116	0.1	6.6
	Other	Other	712	n/a	n/a	0.7	34.9
		Totals	2,037			2.0	100.0
1992–2000	Grassland/Shrubland	Nonmechanically disturbed	1,771	1,230	838	1.7	38.4
	Forest	Nonmechanically disturbed	1,353	1,589	1,082	1.3	29.4
	Grassland/Shrubland	Agriculture	261	174	119	0.3	5.7
	Agriculture	Developed	213	147	100	0.2	4.6
	Grassland/Shrubland	Developed	183	107	73	0.2	4.0
	Other	Other	826	n/a	n/a	0.8	17.9
		Totals	4,607			4.5	100.0
1973–2000 (overall)	Grassland/Shrubland	Nonmechanically disturbed	3,144	1,643	1,119	3.1	24.2
	Forest	Nonmechanically disturbed	2,442	2,018	1,375	2.4	18.8
	Nonmechanically disturbed	Grassland/Shrubland	1,680	1,080	736	1.6	12.9
	Agriculture	Developed	1,230	931	634	1.2	9.5
	Nonmechanically disturbed	Forest	1,007	939	640	1.0	7.7
	Other	Other	3,506	n/a	n/a	3.4	27.0
		Totals	13,009			12.7	100.0

References Cited

Halsey, R.W., 2005, Fire, chaparral, and survival in southern California, San Diego, CA: Sunbelt Publications.

Omernik, J.M., 1987, Ecoregions of the conterminous United States: Annals of the Association of American Geographers, v. 77, no. 1, p. 118–125.

U.S. Census Bureau, 2000, Census of population 1970 through 2000: U.S. Census Bureau database, accessed at http://www.census.gov/prod/www/abs/decennial/index.htm.

U.S. Environmental Protection Agency, 1997, Descriptions of level III ecological regions for the CEC report on ecological regions of North America: U.S. Environmental Protection Agency database, accessed April 12, 2006, at http://www.epa.gov/wed/pages/ecoregions/na_eco.htm#Downloads.

Vogelmann, J.E., Howard, S.M., Yang, L., Larson, C.R., Wylie, B.K., and van Driel, N., 2001, Completion of the 1990s National Land Cover Data Set for the conterminous United States from Landsat Thematic Mapper data and ancillary data sources: Photogrammetric Engineering & Remote Sensing, v. 67, p. 650–662.