

Chapter 22

Columbia Plateau Ecoregion

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Ecoregion Description

Located in eastern Washington and northern Oregon, the Columbia Plateau Ecoregion is characterized by sagebrush steppe and grasslands with extensive areas of dryland farming and irrigated agriculture. The ecoregion, which is approximately 90,059 km² (34,772 mi²), is surrounded on all sides by mountainous ecoregions: to the west, the North Cascades Ecoregion and the Eastern Cascades Slopes and Foothills

Ecoregion (and to the west of it, the Cascades Ecoregion); to the south, the Blue Mountains Ecoregion; and to the east, the Northern Rockies Ecoregion (fig. 1) (Omernik, 1987; U.S. Environmental Protection Agency, 1997). The climate is Mediterranean, with cool wet winters and hot dry summers.

The ecoregion was formed by Miocene (17 to 6 million year old) flood basalts covering approximately 200,000 km² in what is currently central and eastern Washington, northern Oregon, and western Idaho (Hooper, 1982). Other notable processes

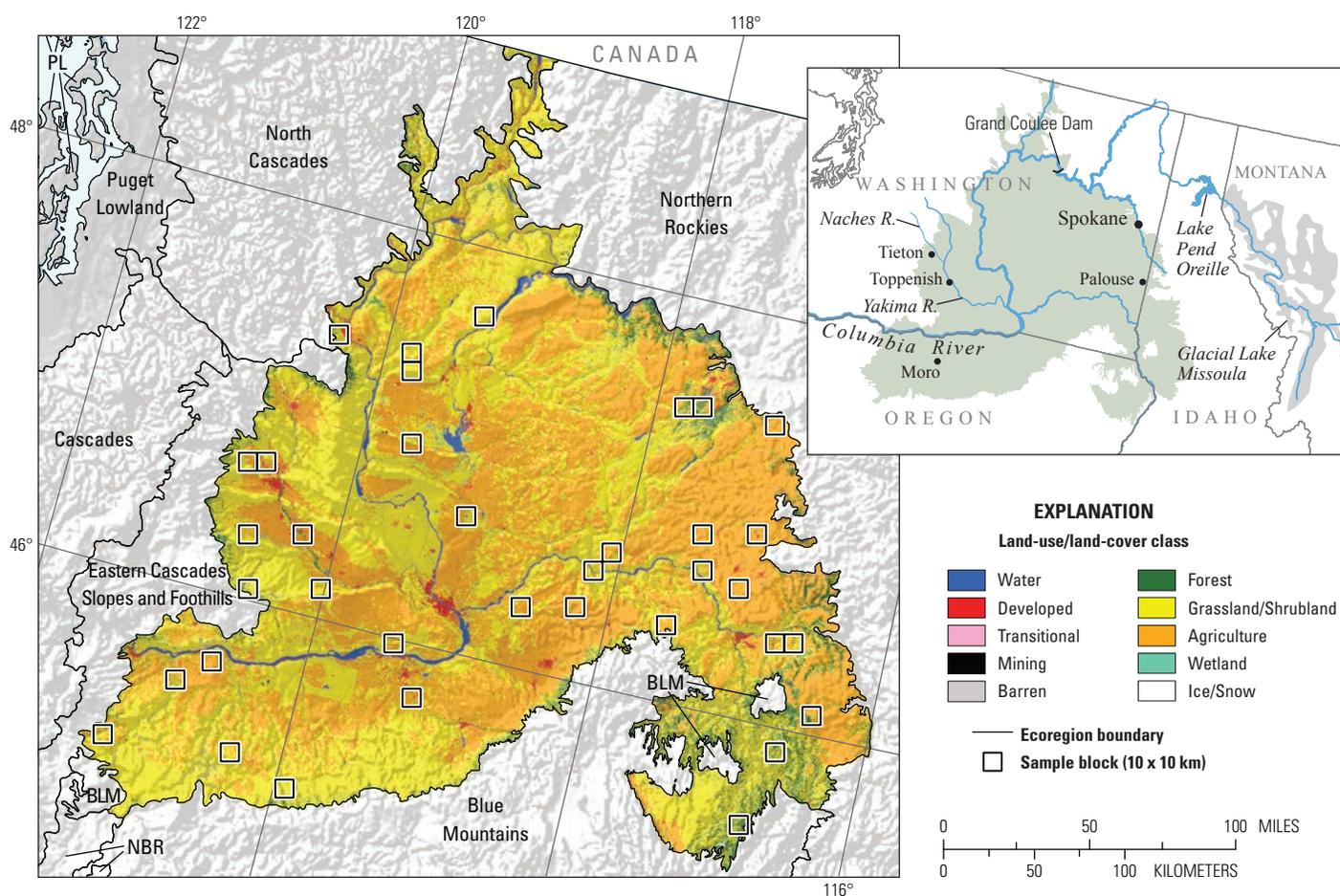


Figure 1. Map of Columbia Plateau Ecoregion and surrounding ecoregions, showing land-use/land-cover classes from 1992 National Land Cover Dataset (Vogelmann and others, 2001); note that not all land-use/land-cover classes shown in explanation may be depicted on map; note also that, for this “Status and 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.

that shaped the Columbia Plateau Ecoregion were the great Missoula floods caused by catastrophic failures of glacial dams that blocked Montana's Glacial Lake Missoula 10 to 15 thousand years ago. Massive amounts of water rushing westward from the vicinity of the present-day east end of Lake Pend Oreille, Idaho, transformed a dendritic preglacial drainage pattern into the channeled scablands of today (Bretz, 1969; Smith, 2006). The great floods resulted in the loss of loess soils that covered much of the region. The only areas spared were those not in the path of flood waters or that had high enough elevations, such as the fertile Palouse region in eastern Washington. Today (2012) these areas support vast amounts of grain farming.

Since European settlement in the mid-19th century, the region has been heavily used for agricultural production. Much of the Columbia Plateau Ecoregion is used for dryland winter wheat production (fig. 2), the typical pattern being winter-wheat, followed by summer-fallow, cultivation. Soil moisture is accumulated throughout the winter; most growth occurs in the spring, and the harvest takes place in the summer. The hot and dry summer climate is ideal for maturation of dryland grains and cereals, but without irrigation little else can flourish (Schillinger and Papendick, 2008).

The Columbia Basin Project, a large engineered irrigation network serving eastern Washington, began in the



Figure 2. Wheat fields near Moro, Oregon (A) and outside of Spokane, Washington (B).



Figure 3. Hops planted in Yakima Valley, Washington (A) and corn field near Toppenish, Washington (B).

1930s with the construction of Grand Coulee Dam, originally designed to provide irrigation to the region's farmers. World War II caused the project to shift its focus to providing hydroelectric power; the irrigation component was not functional again until the 1950s. In 2009 alone, water from the Columbia Basin Project irrigated approximately 670,000 acres of crops valued at over \$600 million annually (U.S. Bureau of Reclamation, 2009) (fig. 3).

Development in the Columbia Plateau Ecoregion generally is rural with only a few major urban areas. Population growth was slow in the 1980s, increasing only 4.9 percent. In the 1990s the ecoregion population increased by 20 percent to just under one million people (U.S. Census Bureau, 2000) (table 1).

Contemporary Land-Cover Change (1973 to 2000)

An estimated 9.2 percent of the Columbia Plateau Ecoregion land cover changed at least once between 1973 and 2000 (table 2). Compared to other ecoregions, change in the

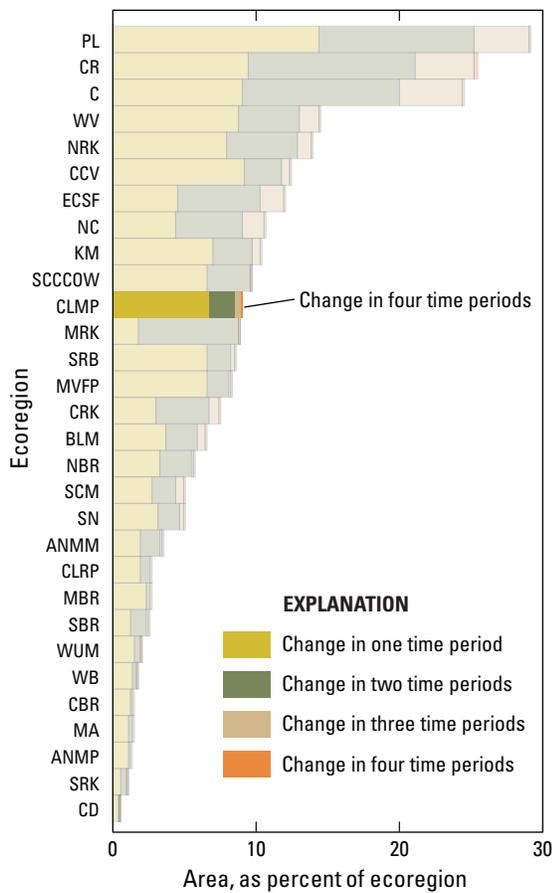


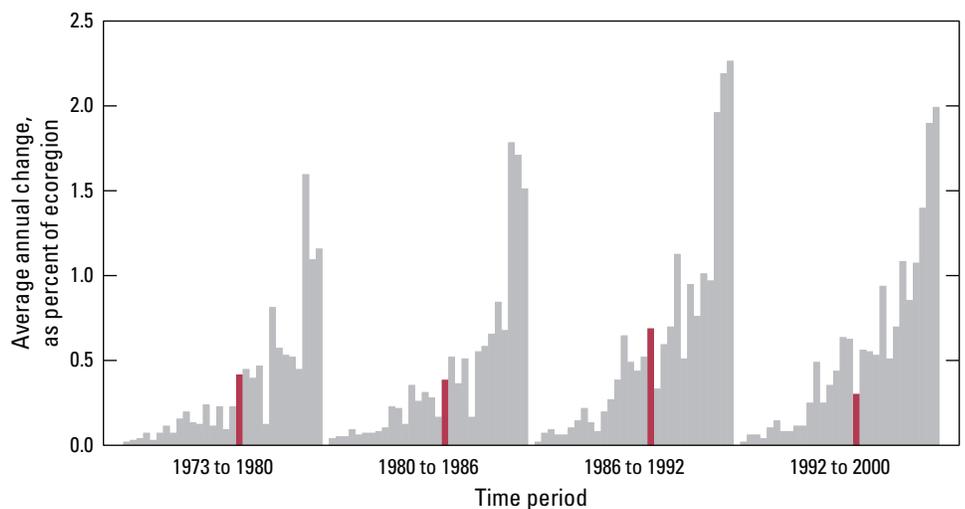
Figure 4. Overall spatial change in Columbia Plateau Ecoregion (CLMP; darker bars) compared with that of all 30 Western United States ecoregions (lighter bars). Each horizontal set of bars shows proportions of ecoregion that changed during one, two, three, or four time periods; highest level of spatial change in Columbia Plateau Ecoregion (four time periods) labeled for clarity. See table 3 for years covered by each time period. See appendix 2 for key to ecoregion abbreviations.

Columbia Plateau Ecoregion is considered modest (fig. 4). Of the total area, 2.3 percent changed in more than one of the four time periods analyzed (table 3), mostly a result of farmland cycling in and out of production. Changes to ecoregion land cover were not spread evenly throughout the entire 27-year study period. As is the case in many other agricultural regions, the period between 1986 and 1992 experienced the greatest amount of change, owing, in large part, to the conversion of marginal agricultural lands to grassland/shrubland (see appendix 3 for definitions of land-cover classes). The average annual rate of change during this period was 0.7 percent, whereas the other three periods experienced rates roughly one-half that amount (table 3; fig. 5).

Agricultural lands made up approximately 48.8 percent of the ecoregion in 1973 (table 4). By 1986 the agriculture land-cover class had increased an estimated 1,475 km² to make up 50.4 percent of the ecoregion. Between 1986 and 1992, agricultural lands declined by an estimated 1,531 km² (fig. 6), decreasing to approximately 48.7 percent of total ecoregion land cover. By 2000, agriculture had once again increased to account for 49.4 percent of the ecoregion (table 4). The Conservation Reserve Program (CRP), a federal policy to encourage landowners to convert marginal farmlands to native vegetation, played an important role in the Columbia Plateau Ecoregion. After the onset of the program, the ecoregion reversed the prior trend of increasing agricultural land use, and by 1997 enrollment in the CRP program totaled 3,311 km² (U.S. Department of Agriculture, 1999). Expiration of 10-year CRP contracts in the late 1990s contributed to 0.6 percent of the ecoregion converting back into agricultural land use by 2000. During the study period, dryland wheat farming experienced a sharp decline, whereas other areas of agriculture intensified with the addition of new irrigated lands. Historical levels of dryland wheat, irrigated cropland, and CRP enrollments are summarized in figure 7.

Trends in grassland/shrubland mirrored those of the agriculture class. Grassland/shrubland made up 41.0 percent of the ecoregion in 1973 and 39.9 percent in 2000, a net

Figure 5. 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 Columbia Plateau Ecoregion are represented by red bars in each time period.



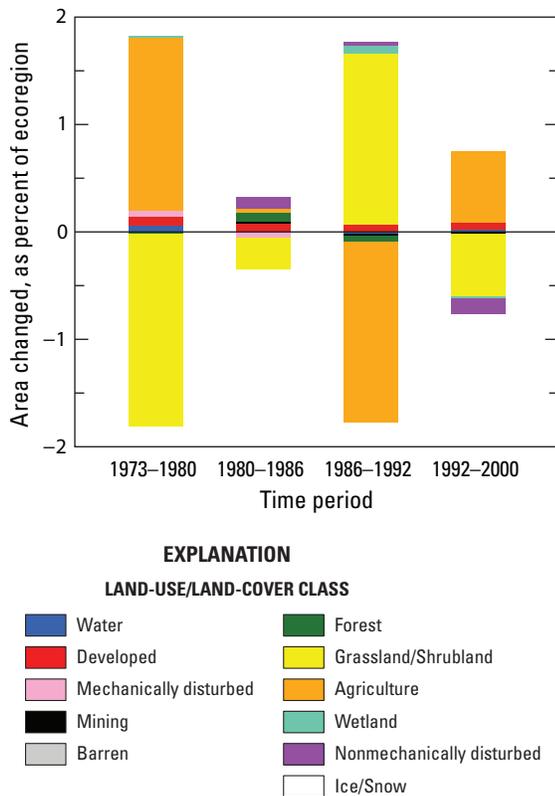


Figure 6. Normalized average net change in Columbia Plateau Ecoregion by time period for each land-cover class. Bars above zero axis represent net gain, whereas bars below zero represent net loss. Note that not all land-cover classes shown in explanation may be represented in figure. See appendix 3 for definitions of land-use/land-cover classifications.

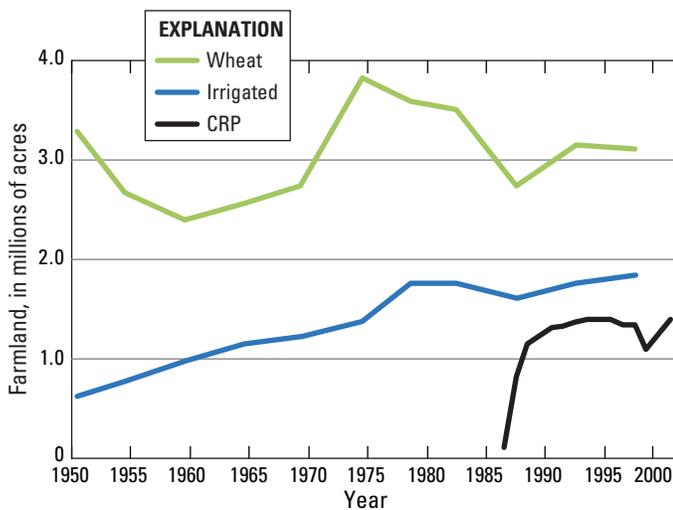


Figure 7. Historical trends in acreage for irrigated agriculture, dryland wheat, and Conservation Reserve Program enrollments (CRP). Total annual values were summed for all counties that have their centroid within Columbia Plateau Ecoregion. Data from United States Department of Agriculture’s agriculture census (U.S. Department of Agriculture, 1999).

loss of 973 km². Developed land accounted for a very small proportion of the ecoregion (about 1.0 percent), an estimated net increase of approximately 284 km² over the 27-year period. All other land-cover classes remained relatively stable (table 4).

As expected, the most common land-cover conversions were between the agriculture and grassland/shrubland classes. In all four time periods, these were the two most common land-cover conversions. In three of the four periods, increases in conversions from agriculture to grassland/shrubland outpaced losses. The exception was between 1986 and 1992, when 2,342 km² changed from agriculture to grassland/shrubland, and only 886 km² converted from grassland/shrubland to agriculture. Other conversions of note were grassland/shrubland to nonmechanically disturbed (by fire) and agriculture to developed (table 5).

Irrigation technology, infrastructure development, federal conservation efforts, and population growth all acted as drivers of change on Columbia Plateau Ecoregion land cover. In the 1960s and 1970s, the spread of center-pivot irrigation technology enhanced the ability to bring marginal lands into agricultural production. The spread of irrigation was facilitated by the expansion and utilization of water-delivery infrastructure from the Columbia Basin Project, designed to irrigate more than 1 million acres of marginal lands. Estimates indicate that this period resulted in the greatest rate of change from sagebrush steppe (grassland/shrubland class) to new agriculture, adding an average of 290 km² per year between 1973 and 1980.

Whereas new lands were being added to the Columbia Plateau Ecoregion’s agriculture mosaic in each time period, in only one period, 1986 to 1992, were these additions outpaced by the reversion back to natural vegetative conditions, largely as a result of the CRP (fig. 8). In the western United States, CRP had its most substantial effect in the Columbia Plateau Ecoregion. Estimates reveal that this period (1986–1992) experienced the only net decline in agriculture land cover during the 27-year land-cover study.



Figure 8. Agricultural land converted to grassland/shrubland under Conservation Reserve Program.

Regional population growth also has had an effect on regional land-cover change. Although developed land-cover areas accounted for approximately 1 percent of the total ecoregion area, a measured increase in developed lands of approximately 32 percent occurred between 1973 and 2000. Demand for new housing and infrastructure to support an additional 200,000 people resulted in the conversion of a relatively small amount of agricultural land and, to a lesser extent, grassland/shrubland to new developed uses (fig. 9).



Figure 9. New home construction and orchard near Naches River and town of Tieton, Washington.

Table 1. Columbia Plateau Ecoregion population estimates by state for 1980, 1990, and 2000 censuses (U.S. Census Bureau, 2000). Population estimates are calculated using census tracts that have their centroid within ecoregion. Total population estimates are sums of all three states for each year.

[--, no significant change]

Census year	State	Population	Percent change from previous decade
1980	Total	777,166	
	Oregon	90,051	
	Washington	618,055	
	Idaho	69,060	
1990	Total	814,979	+4.9
	Oregon	90,861	--
	Washington	654,062	+5.8
	Idaho	70,056	+1.4
2000	Total	978,069	+20.0
	Oregon	107,212	+18.0
	Washington	792,260	+21.1
	Idaho	78,597	+12.2

Table 2. Percentage of Columbia Plateau Ecoregion land cover that changed at least one time during study period (1973–2000) and associated statistical error.

[Most sample pixels remained unchanged (90.8 percent), whereas 9.2 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	7.0	2.3	4.8	9.3	1.6	22.2
2	1.7	0.6	1.2	2.3	0.4	22.2
3	0.4	0.2	0.2	0.5	0.1	32.0
4	0.0	0.1	0.0	0.1	0.0	84.6
Overall spatial change	9.2	2.7	6.3	11.9	1.8	20.4

Table 3. Raw estimates of change in Columbia Plateau Ecoregion 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	2.9	1.4	1.5	4.3	1.0	32.8	0.4
1980–1986	2.3	0.6	1.7	3.0	0.4	18.9	0.4
1986–1992	4.1	1.4	2.7	5.5	0.9	23.0	0.7
1992–2000	2.4	0.7	1.7	3.2	0.5	21.0	0.3
Estimate of change, in square kilometers							
1973–1980	2,641	1,275	1,366	3,915	866	32.8	377
1980–1986	2,080	579	1,501	2,659	393	18.9	347
1986–1992	3,702	1,251	2,451	4,954	850	23.0	617
1992–2000	2,174	671	1,504	2,845	456	21.0	272

Table 4. Estimated area (and margin of error) of each land-cover class in Columbia Plateau 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	0.8	0.4	1.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	7.6	3.1	41.0	6.4	48.8	7.4	0.9	0.3	0.0	0.0
1980	0.8	0.4	1.1	0.7	0.0	0.1	0.0	0.0	0.0	0.0	7.6	3.0	39.2	6.1	50.4	7.3	0.9	0.3	0.0	0.0
1986	0.8	0.4	1.1	0.7	0.0	0.0	0.0	0.1	0.0	0.0	7.7	3.1	38.9	5.9	50.4	7.1	0.9	0.3	0.1	0.2
1992	0.8	0.4	1.2	0.8	0.0	0.0	0.0	0.0	0.0	0.0	7.6	3.0	40.5	6.1	48.7	7.2	0.9	0.3	0.1	0.2
2000	0.8	0.4	1.3	0.8	0.0	0.0	0.0	0.0	0.0	0.0	7.6	3.0	39.9	6.1	49.4	7.2	0.9	0.3	0.0	0.0
Net change	0.1	0.1	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	-1.1	2.5	0.6	2.5	0.1	0.1	0.0	0.0
Gross change	0.1	0.1	0.3	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.4	0.4	7.6	2.4	7.3	2.4	0.1	0.1	0.5	0.5
Area, in square kilometers																				
1973	680	360	878	580	0	0	7	8	1	1	6,836	2,754	36,943	5,742	43,946	6,674	768	291	0	0
1980	730	390	967	612	41	59	18	18	0	1	6,817	2,728	35,331	5,455	45,387	6,532	768	288	0	0
1986	738	394	1,025	647	0	0	40	46	1	2	6,894	2,779	35,068	5,350	45,421	6,435	775	288	96	139
1992	718	387	1,095	682	8	9	36	43	1	1	6,847	2,679	36,495	5,464	43,889	6,447	840	291	131	189
2000	740	388	1,162	734	5	5	29	28	4	5	6,843	2,678	35,970	5,486	44,480	6,525	826	289	0	0
Net change	61	71	284	172	5	5	21	25	3	4	7	224	-973	2,270	534	2,223	58	63	0	0
Gross change	113	83	284	172	94	118	57	61	5	7	381	325	6,881	2,166	6,561	2,144	111	74	455	463

Table 5. Principal land-cover conversions in Columbia Plateau 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	Grassland/Shrubland	Agriculture	1,960	1,139	774	2.2	74.2
	Agriculture	Grassland/Shrubland	440	301	204	0.5	16.7
	Agriculture	Developed	61	50	34	0.1	2.3
	Grassland/Shrubland	Water	51	73	50	0.1	1.9
	Forest	Mechanically disturbed	41	59	40	0.0	1.5
	Other	Other	88	n/a	n/a	0.1	3.3
	Totals			2,641			2.9
1980–1986	Grassland/Shrubland	Agriculture	944	363	246	1.0	45.4
	Agriculture	Grassland/Shrubland	822	419	285	0.9	39.5
	Grassland/Shrubland	Nonmechanically disturbed	94	135	92	0.1	4.5
	Agriculture	Developed	47	37	25	0.1	2.3
	Agriculture	Forest	42	60	41	0.0	2.0
	Other	Other	132	n/a	n/a	0.1	6.3
	Totals			2,080			2.3
1986–1992	Agriculture	Grassland/Shrubland	2,342	1,155	785	2.6	63.3
	Grassland/Shrubland	Agriculture	880	470	319	1.0	23.8
	Forest	Nonmechanically disturbed	131	189	129	0.1	3.5
	Nonmechanically disturbed	Grassland/Shrubland	96	138	94	0.1	2.6
	Grassland/Shrubland	Forest	89	76	52	0.1	2.4
	Other	Other	165	n/a	n/a	0.2	4.5
	Totals			3,702			4.1
1992–2000	Grassland/Shrubland	Agriculture	1,276	527	358	1.4	58.7
	Agriculture	Grassland/Shrubland	634	313	212	0.7	29.1
	Nonmechanically disturbed	Grassland/Shrubland	131	188	128	0.1	6.0
	Agriculture	Developed	49	44	30	0.1	2.3
	Wetland	Water	19	20	14	0.0	0.9
	Other	Other	66	n/a	n/a	0.1	3.0
	Totals			2,174			2.4
1973–2000 (overall)	Grassland/Shrubland	Agriculture	5,060	2,075	1,410	5.6	47.7
	Agriculture	Grassland/Shrubland	4,238	1,621	1,101	4.7	40.0
	Nonmechanically disturbed	Grassland/Shrubland	226	230	156	0.3	2.1
	Agriculture	Developed	211	149	102	0.2	2.0
	Forest	Nonmechanically disturbed	134	189	129	0.1	1.3
	Other	Other	729	n/a	n/a	0.8	6.9
	Totals			10,597			11.8

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