

## Chapter 9

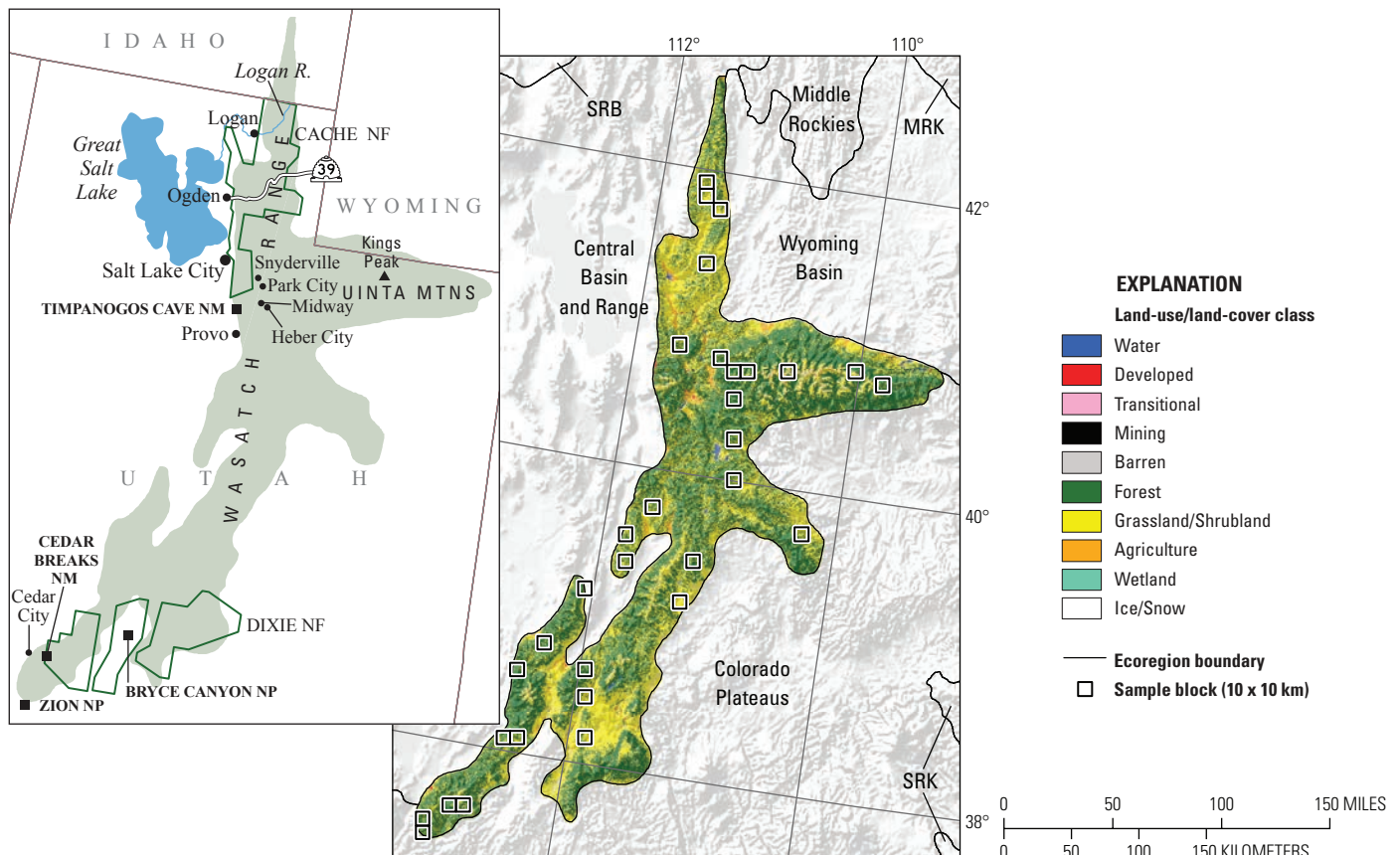
# Wasatch and Uinta Mountains Ecoregion

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## Ecoregion Description

The Wasatch and Uinta Mountains Ecoregion covers approximately 44,176 km<sup>2</sup> (17,057 mi<sup>2</sup>) (fig. 1) (Omernik, 1987; U.S. Environmental Protection Agency, 1997). With the exception of a small part of the ecoregion extending into southern Wyoming and southern Idaho, the vast majority of the ecoregion is located along the eastern mountain ranges of Utah. The ecoregion is situated between the Wyoming Basin and Colorado Plateaus Ecoregions to the east and south and the

Central Basin and Range Ecoregion to the west; in addition, the Middle Rockies, Snake River Basin, and Northern Basin and Range Ecoregions are nearby to the north. Considered the western front of the Rocky Mountains, the two major mountain ranges that define the Wasatch and Uinta Mountains Ecoregion include the north-south-trending Wasatch Range and east-west-trending Uinta Mountains. Both mountain ranges have been altered by multiple mountain building and burial cycles since the Precambrian era 2.6 billion years ago, and they have been shaped by glacial processes as early as 1.6 million years ago. The terrain is defined by sharp ridgelines, glacial lakes, and narrow canyons, with elevations ranging from 1,829 m in the lower



**Figure 1.** Map of Wasatch and Uinta Mountains 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.

canyons to 4,123 m at Kings Peak, the highest point in Utah (Milligan, 2010).

The climate is a midlatitude highland climate influenced by Pacific storms moving in from the west. Average temperature and precipitation vary with elevation and latitude. The southern part of the ecoregion is generally 6° to 8°C warmer than northern parts at similar elevations. The average annual precipitation varies between 457 and 1,016 mm (Utah Center for Climate and Weather, 2009).

The ecoregion is largely made up of federally managed lands. Approximately 67 percent (30,000 km<sup>2</sup>) of the ecoregion falls within six National Forests (Wasatch-Cache, Ashley, Uinta, Manti-La Sal, Fishlake, and Dixie), seven Wilderness Areas (Mount Naomi, High Uintas, Twin Peaks, Lone Peak, Mount Timpanogos, Box-Death Hollow, and Ashdown Gorge), two National Monuments (Timpanogos Cave and Cedar Breaks), one National Park (Zion), and a number of Bureau of Land Management Public Domain lands. The Uintah and Ouray Reservation is also located within the ecoregion.

The ecoregion's forest lands, which cover approximately 61 percent of its area, vary according to elevation, soils, precipitation, and temperature. Gambel's oak (*Quercus gambelii*) and canyon maple (*Acer grandidentatum*) live on lower mountain slopes and foothills, giving way to pinyon-juniper forests along the drier foothills. The pinyon-juniper forests include the singleleaf pinyon pine (*Pinus monophylla*), Colorado pinyon (*Pinus edulis*), and two types of juniper, the Utah juniper (*Juniperus osteosperma*) and Rocky Mountain juniper (*Juniperus scopulorum*). The middle elevations support Douglas-fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), ponderosa pine (*Pinus ponderosa*), and lodgepole pine (*Pinus contorta*). The higher elevations support quaking aspen (*Populus tremuloides*), Engelmann spruce (*Picea engelmannii*), and balsam fir (*Abies lasiocarpa*) (Utah Department of Natural Resources, Division of Forestry, Fire and State Lands, 2003).

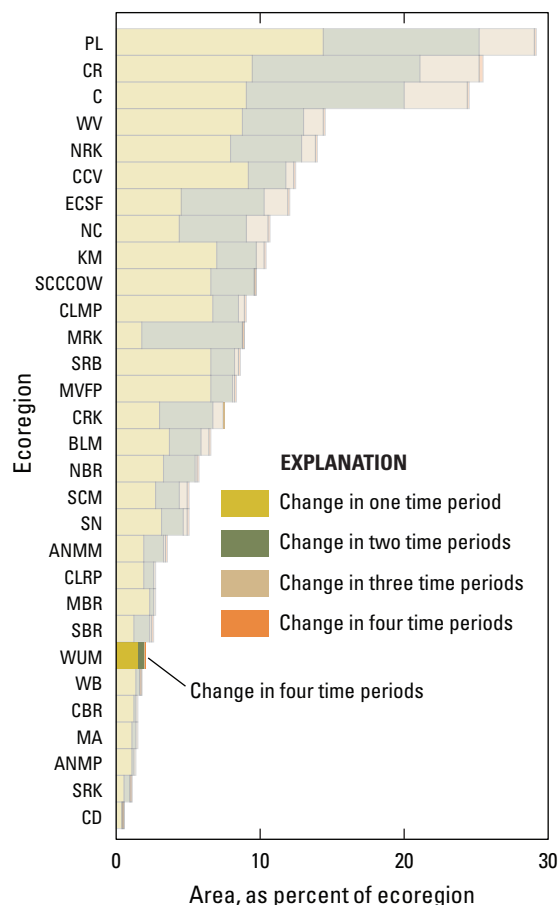
Grassland/shrubland land cover accounts for approximately 34 percent of the ecoregion. Similar to forest land cover, grassland/shrubland in the ecoregion also varies according to elevation, soils, precipitation, and temperature. Big sagebrush (*Artemisia tridentata*) is commonly found along the drier foothills, whereas perennial bunchgrasses and mixed forbs can be found at the middle elevations. Herbaceous plants, grasses, sedges, and rushes are found in upland meadows (Grahame and Sisk, 2002).

Owing to the steep terrain and rugged landscape of the ecoregion, most developed land is located in the fertile valleys and the unincorporated area surrounding Snyderville, known informally as "Snyderville Basin," situated between the Wasatch Range and Uinta Mountains just east of Salt Lake City, Utah. The Wasatch and Uinta Mountains Ecoregion is sparsely populated with only one town of over 20,000 people recorded in the 2000 Census (Cedar City, Utah, population 20,527); the next three largest towns were Park City, Utah (population 7,371), Heber City, Utah (population 7,291), and Midway, Utah (population 2,121) (U.S. Census Bureau, 2010). However, an estimated 1.7 million people live just west of

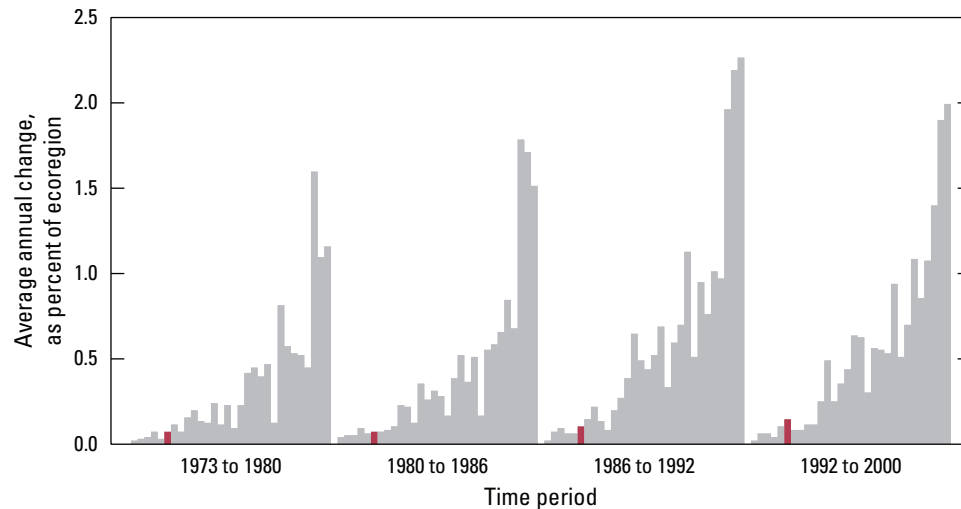
the ecoregion boundary along the Wasatch Front (extending roughly 129 km from Ogden, Utah, to Provo, Utah) (Economic Development Corporation of Utah, 2008). Agriculture, which is not a significant land cover within the ecoregion, is limited to irrigated pasture and hay in fertile lowland stream valleys.

## Contemporary Land-Cover Change (1973 to 2000)

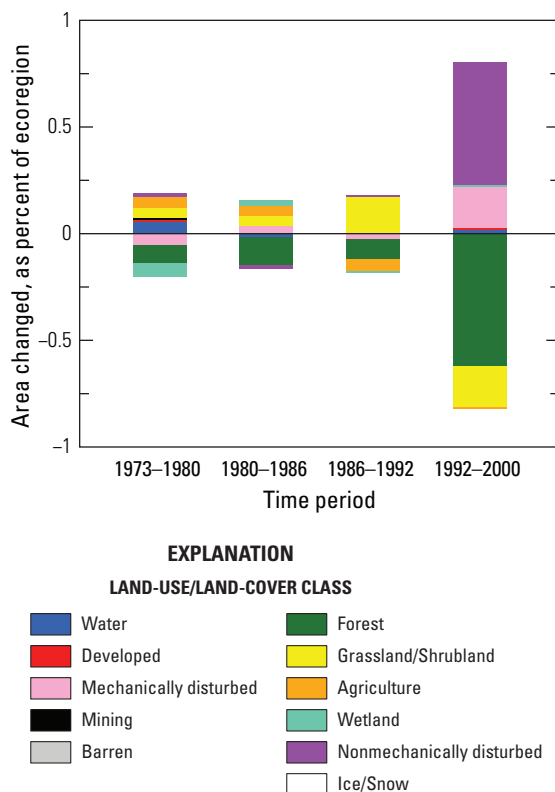
Between 1973 and 2000, the ecoregion's overall spatial change (the percentage of area undergoing at least one land-cover change during the study period) is estimated at approximately 2.0 percent, and an estimated 0.5 percent of the ecoregion area changed in two or more time periods (fig. 2). The vast majority of land, approximately 98 percent, did not change



**Figure 2.** Overall spatial change in Wasatch and Uinta Mountains Ecoregion (WUM; 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 Wasatch and Uinta Mountains 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 3.** 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 Wasatch and Uinta Mountains Ecoregion are represented by red bars in each time period.



**Figure 4.** Normalized average net change in Wasatch and Uinta Mountains 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.

during the study period (table 1). This level of change is among the lowest of the western United States ecoregions (fig. 2).

The total land-cover change estimated within the four time periods varied only slightly between 1973 and 2000. The first three time periods showed similar amounts of change, but the last time period, between 1992 and 2000, had the greatest amount of change at 1.1 percent of the ecoregion (table 2). When time periods are normalized to an average annual rate of change to adjust for uneven time periods, all four time periods had a minimal change rate of approximately 0.1 percent per year (table 2; fig. 3).

The land-use/land-cover composition of the ecoregion experienced little change during the study period. In 2000, forest was the dominant land cover at approximately 60.8 percent of the ecoregion, followed by grassland/shrubland (33.7 percent), barren (2.9 percent), and agriculture (0.9 percent); the remaining land-cover classes combined for approximately 1 percent of the ecoregion (table 3).

The most significant net gain and net loss identified between 1973 and 2000 was the net loss of approximately 1.4 percent (408 km<sup>2</sup>) of forest and a net gain of approximately 261 km<sup>2</sup> of nonmechanically disturbed lands, which did not occupy any area in 1973 (table 3; fig. 4). The association between the loss of forest and the increase in nonmechanical disturbance is likely the result of beetle infestation and wildfire (fig. 5). Increased beetle infestation, which is a natural process, is believed to be caused by warmer winters, extended drought, and the practice of fire suppression over several decades. Forest-management activities that include prescribed burns and mechanical thinning have been implemented in recent years to improve forest health and reduce the likelihood of large-scale natural fires (Utah Department of Natural Resources, Division of Forestry and State Lands, 2003) (fig. 6).



**Figure 5.** Stand of Engelmann spruce showing impact of spruce beetle infestation in Dixie National Forest, Utah (elevation, 2,970 m).



**Figure 6.** Mechanical thinning of stand of Engelmann spruce devastated by spruce beetle infestation near Cedar Breaks National Monument in Dixie National Forest, Utah.

The three leading conversions during the 1973 to 2000 study period involved the disturbance of forest either by mechanical means (timber harvesting or mechanical thinning) or by nonmechanical means (beetle infestation or fire) and the subsequent recovery of disturbed land to grassland/shrubland. An estimated 58 percent of all change is explained by this cyclical pattern of land-cover conversion. The fourth and fifth leading conversions identified are fluctuations between agriculture and grassland/shrubland, with an estimated 92 km<sup>2</sup> of grassland/shrubland converting to agriculture, and an estimated 70 km<sup>2</sup> of agriculture converting back to grassland/shrubland during the study period (table 4).

The Wasatch and Uinta Mountains Ecoregion experienced little change during the study period. The low level of change can be largely explained by the remote and rugged terrain characterized by its sharp ridgelines and narrow canyons (fig. 7). In addition, the presence of federal lands may also inhibit change within the ecoregion (fig. 8). The change that did occur resulted from either natural processes (beetle infestation and natural fire) or anthropogenic disturbance (prescribed burns,

timber harvesting, and mechanical thinning). Combined, these processes accounted for an estimated net loss of 408 km<sup>2</sup> of forest. Given probable increases in temperature and prolonged periods of drought, future changes are likely to involve a higher incidence of nonmechanical disturbance including natural fires and insect infestations (Utah Department of Natural Resources, Division of Forestry and State Lands, 2003).



**Figure 7.** Logan River rushing through steep, narrow canyon in Cache National Forest, Utah.



**Figure 8.** Aspen, pine, spruce, and fir along State Route 39 in Cache National Forest, Utah, with towering Wasatch Range in distance (elevation, 2,650 m).

**Table 1.** Percentage of Wasatch and Uinta Mountains Ecoregion land cover that changed at least one time during study period (1973–2000) and associated statistical error.

[Most sample pixels remained unchanged (98.0 percent), whereas 2.0 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	1.5	0.6	0.8	2.1	0.4	29.2
2	0.5	0.3	0.2	0.7	0.2	38.4
3	0.0	0.0	0.0	0.1	0.0	35.6
4	0.0	0.0	0.0	0.0	0.0	96.3
Overall spatial change	2.0	0.8	1.2	2.8	0.5	26.3

**Table 2.** Raw estimates of change in Wasatch and Uinta Mountains 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	0.5	0.4	0.1	0.8	0.2	49.9	0.1
1980–1986	0.4	0.2	0.2	0.6	0.1	34.4	0.1
1986–1992	0.6	0.3	0.3	0.9	0.2	32.4	0.1
1992–2000	1.1	0.5	0.6	1.6	0.4	32.8	0.1
Estimate of change, in square kilometers							
1973–1980	216	159	57	375	108	49.9	31
1980–1986	184	93	91	277	63	34.4	31
1986–1992	255	122	133	377	83	32.4	42
1992–2000	485	234	250	719	159	32.8	61

**Table 3.** Estimated area (and margin of error) of each land-cover class in Wasatch and Uinta Mountains 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	0.2	0.1	0.1	0.1	0.2	0.2	0.0	0.0	2.9	1.9	61.7	5.2	33.7	5.0	0.9	0.6	0.3	0.2	0.0	0.0
1980	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	2.9	1.9	61.7	5.2	33.7	5.0	0.9	0.6	0.3	0.1	0.0	0.0
1986	0.2	0.1	0.1	0.1	0.2	0.1	0.0	0.0	2.9	1.9	61.5	5.1	33.8	4.9	1.0	0.7	0.3	0.2	0.0	0.0
1992	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	2.9	1.9	61.4	5.1	33.9	4.9	0.9	0.7	0.3	0.2	0.0	0.0
2000	0.2	0.1	0.1	0.1	0.3	0.2	0.0	0.0	2.9	1.9	60.8	5.0	33.7	4.8	0.9	0.7	0.3	0.2	0.6	0.5
Net change	0.1	0.0	0.0	0.0	0.2	0.3	0.0	0.0	0.0	0.0	-0.9	0.5	0.1	0.6	0.0	0.3	0.0	0.0	0.6	0.5
Gross change	0.2	0.1	0.0	0.0	0.8	0.4	0.0	0.0	0.0	0.0	1.1	0.5	1.1	0.5	0.3	0.3	0.1	0.1	0.7	0.5
Area, in square kilometers																				
1973	71	42	47	35	76	86	2	1	1,298	836	27,276	2,286	14,878	2,222	376	257	150	77	0	0
1980	98	50	52	37	53	59	6	5	1,299	836	27,241	2,277	14,895	2,200	401	275	122	62	10	14
1986	92	46	53	38	69	64	6	5	1,299	836	27,182	2,264	14,913	2,184	423	294	136	67	4	5
1992	92	48	54	38	60	43	7	5	1,300	835	27,141	2,256	14,988	2,153	399	302	131	67	6	6
2000	101	52	57	38	144	92	8	6	1,299	836	26,868	2,212	14,903	2,107	398	302	136	71	261	209
Net change	30	19	10	8	68	121	6	6	1	1	-408	234	25	262	22	114	-14	13	261	209
Gross change	86	64	10	8	373	188	6	6	3	3	483	234	474	240	120	114	61	59	292	218

**Table 4.** Principal land-cover conversions in Wasatch and Uinta Mountains 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 <sup>2</sup> )	Margin of error (+/- km <sup>2</sup> )	Standard error (km <sup>2</sup> )	Percent of ecoregion	Percent of all changes
1973–1980	Mechanically disturbed	Grassland/Shrubland	65	82	55	0.1	30.1
	Forest	Mechanically disturbed	47	59	40	0.1	21.8
	Grassland/Shrubland	Agriculture	24	30	20	0.1	11.2
	Wetland	Water	24	32	21	0.1	10.9
	Grassland/Shrubland	Forest	21	27	18	0.0	9.8
	Other	Other	35	n/a	n/a	0.1	16.2
	Totals		216			0.5	100.0
1980–1986	Forest	Mechanically disturbed	66	64	43	0.2	36.1
	Mechanically disturbed	Grassland/Shrubland	47	59	40	0.1	25.6
	Grassland/Shrubland	Agriculture	22	30	21	0.0	11.8
	Water	Wetland	12	17	11	0.0	6.5
	Nonmechanically disturbed	Forest	8	11	7	0.0	4.1
	Other	Other	29	n/a	n/a	0.1	15.8
	Totals		184			0.4	100.0
1986–1992	Mechanically disturbed	Grassland/Shrubland	60	62	42	0.1	23.6
	Agriculture	Grassland/Shrubland	57	67	45	0.1	22.3
	Forest	Mechanically disturbed	50	43	29	0.1	19.7
	Grassland/Shrubland	Agriculture	34	48	32	0.1	13.4
	Grassland/Shrubland	Forest	9	9	6	0.0	3.5
	Other	Other	45	n/a	n/a	0.1	17.5
	Totals		255			0.6	100.0
1992–2000	Forest	Nonmechanically disturbed	193	189	128	0.4	39.9
	Forest	Mechanically disturbed	91	58	39	0.2	18.7
	Grassland/Shrubland	Nonmechanically disturbed	67	91	62	0.2	13.8
	Grassland/Shrubland	Mechanically disturbed	36	50	34	0.1	7.4
	Mechanically disturbed	Grassland/Shrubland	31	32	21	0.1	6.5
	Other	Other	67	n/a	n/a	0.2	13.8
	Totals		485			1.1	100.0
1973–2000 (overall)	Forest	Mechanically disturbed	254	148	101	0.6	22.3
	Forest	Nonmechanically disturbed	211	194	132	0.5	18.5
	Mechanically disturbed	Grassland/Shrubland	203	185	125	0.5	17.9
	Grassland/Shrubland	Agriculture	92	123	83	0.2	8.1
	Agriculture	Grassland/Shrubland	70	74	50	0.2	6.2
	Other	Other	308	n/a	n/a	0.7	27.0
	Totals		1,139			2.6	100.0

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