

## Chapter 3 : VEGETATION

The sagebrush ecosystem occupies 43 million ha of semi-arid, sagebrush-dominated lands throughout the western United States (Fig. 1.1). Nineteen of the western ecoregions defined by The Nature Conservancy (Nachlinger et al. 2002) contain sagebrush; 3 of these ecoregions—Columbia Plateau, Great Basin, and Wyoming Basins—support the majority (70%) of area in these cover types. Across the sagebrush ecosystem, sagebrush habitats range from semi-arid grasslands with limited cover of sagebrush to arid, sagebrush-dominated shrublands to sagebrush-dominated subalpine meadows. Approximately 20 taxa of sagebrush grow in the western United States, from semi-desert lowlands to subalpine meadows (McArthur et al. 1981, Shultz 1986, Meyer 2003). The 8 major sagebrush taxa of the Great Basin Ecoregion (Great Basin) occur in a variety of environmental conditions (Table 3.1).

Sagebrush in the Great Basin encompasses a dynamic landscape shaped by variations in soils, topography, climate, and fire frequency. These dynamics resulted in the evolution of numerous sagebrush species that have strikingly different responses to fire (e.g., Wyoming big sagebrush vs. mountain big sagebrush; Bunting et al. 2002). Natural fire regimes in the sagebrush ecosystem range in frequency from 20 – 150 years (Young and Evans 1978, West and Hassan 1985, Whisenant 1990).

Vegetation structure and composition in the sagebrush ecosystem has undergone major changes since European settlement (Knick 1999, Miller and Tausch 2001). These changes are due, in part, to changes in frequency, size, and severity of wildfires. Examination of recent data on wildfires reveals a dramatic increase in number of fires and area burned during the last 20 yrs (Fig. 3.1).

Greater frequency of fire has altered ecological relationships in portions of the sagebrush ecosystem (e.g., Wyoming-basin big sagebrush land cover type [cover type]). Inappropriate livestock grazing and shorter fire return intervals in these areas have led to the replacement of perennial grasses and shrubs by non-native annual grasses (West and Hassan 1985). Recent inventories have indicated that cheatgrass is dominant on >6.8 million ha of the sagebrush ecosystem (Pellant and Hall 1994) and >40 million ha throughout the Intermountain West (Whisenant 1990). Conversely, ecological relationships in other portions of the sagebrush ecosystem (e.g., mountain big sagebrush cover type) have been altered by decreased frequency of fire (Miller and Tausch 2001). Fire suppression, shifts in climate, inappropriate grazing by livestock and wild horses, and increases in atmospheric CO<sub>2</sub> in these areas have led to the replacement of shrubs by pinyon and juniper woodlands (Miller and Rose 1999). As a result, it is important to consider the distribution and extent of recent fires when describing vegetation in the Great Basin.

In this chapter, we describe the spatial data used to map habitats for sagebrush-associated species for our assessment. We then present results of estimates of the amount, distribution, and patterns of recent fire history for the major land cover types that occur in Nevada and the Great Basin, based on these spatial data. Our specific objectives were to (1) describe the recently completed sagestitch map (Comer et al. 2002), which provides continuous coverage of all sagebrush and other major cover types in the Great Basin; (2) provide estimates of amount and distribution of these major cover types, to be used as background context for chapters that follow, all of which rely on these estimates; and (3) describe changes in amount of wildfire in the major cover types over the past 25 yrs, and discuss implications for management.

## Methods

We used a recently completed map of cover types (Comer et al. 2002; “sagestitch” map available at <http://sagemap.wr.usgs.gov/>) for our regional assessment. This map was developed explicitly for regional assessment of sagebrush habitats across the western United States. The map includes the current distribution of 10 sagebrush cover types from eastern Washington, Oregon, Nevada, and California, eastward through central Colorado and eastern Wyoming and Montana. Eight of these 10 sagebrush cover types occur in the Great Basin and in Nevada. Primary data sources for the map included GAP analysis land cover data from several states (e.g., Colorado, California) and regional land cover characterizations developed by the USDA Forest Service (Comer et al. 2002). Source map completion dates ranged from 1996 through 2001.

Map developers also used additional data on vegetation, elevation, and soil characteristics to better depict regional vegetative patterns (Comer et al. 2002). Emphasis was placed on describing the distribution of sagebrush vegetation, but 38 other land cover type also were included in our assessment area (Table 3.2). Thematic consistency among source maps was established through a “crosswalk” of land cover categories from each map source. In several instances, existing knowledge of sagebrush habitat characteristics was combined with elevation and soil characteristics to provide greater thematic precision for sagebrush vegetation than was included in source material. In other instances, minor edits of source material were completed, based on local expert knowledge. A 90-m grid was established for the map, but source material included 30 – 90-m grids and 1:24,000 or 1:100,000 polygon coverages.

The vegetation types used in this map were based on the National Vegetation Classification System (FGDC 1997) and included vegetation alliances for the sagebrush species (Table 3.2). Additional sagebrush vegetation alliances occurred throughout the Intermountain West, but were not distinguishable with existing data for this assessment. Some occurred in patches smaller than minimum mapping units; others were difficult to distinguish using remotely sensed data (see Chapter 9). As a result, the basin big sagebrush and Wyoming big sagebrush cover types were combined to form a Wyoming-basin big sagebrush cover type.

As part of our estimation of the amount and distribution of cover types from the sagestitch map, areas in the Great Basin and Nevada that experienced large-scale fires since 1994 were updated on the cover type map as “recently burned.” This designation replaced the original cover types present before the fires. Fire history data from 1980 – 2001 were compiled from several sources (e.g., existing historical data, digitized hard copy maps, aerial photographs, satellite images) (USDA Forest Service unpublished data, USDI Bureau of Land Management unpublished data). We used fire data from 1994 – 2001 for our habitat analyses because the cover type map included areas burned prior to 1994. Also, the amount of habitat burned in this region, especially sagebrush, increased dramatically beginning in 1994. Any area in a polygon that depicted a fire that burned from 1994 – 2001, regardless of the previous cover type, was recoded as “recently burned” and reported as such in our summaries.

## Results

Eight cover types of sagebrush compose 36%, or >10.1 million ha, of the State of Nevada and 28%, or >8.3 million ha, of the Great Basin (Table 3.3). Beyond the combination of sagebrush cover types, the next most abundant cover type in both areas was salt desert scrub, covering 22%, or 6.2 million ha, of the State of Nevada and 25%, or >7.3 million ha, of the Great

Basin. Pinyon-juniper cover types were also common, totaling 10% of the State of Nevada and 13% of the Great Basin (Table 3.3). Wyoming-basin big sagebrush was the most abundant sagebrush cover type in both assessment areas, followed by black sagebrush and mountain big sagebrush.

Many of the major cover types varied widely in their distribution (Fig. 3.2). Cover types of sagebrush were especially concentrated in northern Nevada. By contrast, salt desert shrub cover types were sparse in northern Nevada, and concentrated in the western and eastern portions of the Great Basin. Pinyon and juniper woodlands were most evident in central and southern parts of the Great Basin and east-central Nevada (Fig. 3.2).

More than 4% of the area occupied by fire-susceptible cover types burned in the Great Basin from 1994 – 2001 (~1.2 million ha, Table 3.4). Nearly 5% of these cover types burned in Nevada (~1.3 million ha) during this same period. Approximately 45% of the total area burned in the Great Basin was formerly occupied by 1 of the 8 sagebrush cover types. Almost 30% of the total area burned was in the Wyoming-basin big sagebrush cover type. Over 6% of the total area of sagebrush cover types burned during this period, including >20% of the low sagebrush-mountain big sagebrush cover type and nearly 26% of the low sagebrush-Wyoming big sagebrush cover type. The salt desert scrub cover type also was susceptible to burning in the Great Basin, making up 22% of the total area burned.

In Nevada, 55% of the total area burned was in a sagebrush cover type (Table 3.4). Almost 30% of the total area burned was in the Wyoming-basin big sagebrush cover type and 11% was in the mountain big sagebrush cover type. Nearly 7% of the total area of sagebrush cover types burned in Nevada during this period, including almost 16% of the low sagebrush-mountain big sagebrush and >19% of the low sagebrush-Wyoming big sagebrush cover types. As in the Great Basin, the salt desert scrub cover type was also vulnerable, making up >14% of the total area burned.

## Discussion

Despite the accelerating loss and degradation of native habitats in the sagebrush ecosystem, the Great Basin encompasses 1 of the largest remaining areas of sagebrush in the western United States. Sagebrush cover types occur on 8.3 million ha or 28% of the Great Basin. This area of sagebrush comprises >20% of all the sagebrush in the sagebrush ecosystem (Wisdom et al. 2003). Only the Columbia Plateau Ecoregion contains more sagebrush, with >32% of the remaining sagebrush in the United States. In Nevada, cover types of sagebrush occupy 10.2 million ha, or 36% of the state. As a result, management of these sagebrush habitats is likely to have strong influence on the future of many species associated with the sagebrush ecosystem in western North America.

The changing composition and structure of vegetation communities in the Great Basin and Nevada from invasion and dominance by cheatgrass threatens much of the remaining native shrublands (see Chapter 4). Importantly, these native shrublands provide major habitats for species of conservation concern (see Chapter 5). One of the notable changes in many of these native shrublands, particularly salt desert scrub, is the dramatic increase in the number and intensity of wildfires. Black sagebrush and low sagebrush rarely burned under natural conditions because these species are sparsely distributed, and low site productivity resulted in low fuel loads on these sites (Tisdale and Hironaka 1981). When these sagebrush species burned, the plants were easily killed and they did not sprout (Wright et al. 1979).

Natural fire return intervals in basin big sagebrush is intermittent between mountain big sagebrush (5 – 15 yrs) and Wyoming big sagebrush (10 – 150 yrs) (see review by Tirmenstein 1999). Fires typically produced a mosaic of burned and unburned stands. Sagebrush plants generally reseeded in burned stands from adjacent unburned stands because patch size of burned areas was small, allowing for adequate dispersal of sagebrush seeds from unburned stands. Under current, altered fire regimes, natural re-establishment of sagebrush after burning (especially basin big sagebrush and Wyoming big sagebrush) is unlikely. As a result, fire management (i.e., prescribed fire and wildfire suppression) must be carefully planned and implemented. Active management (e.g., seeding, protection from ungulate grazing) is often required to facilitate reestablishment of sagebrush after wildfires.

Before the mid-1980s, fire was not a major component of salt desert shrub communities (West 1983, Blaisdell and Holmgren 1984). However, the recent and expansive invasion by cheatgrass into this ecosystem, and the subsequent increase in fire frequency, area, and intensity, has caused managers to reconsider the role of fire and its management in salt desert shrub communities (West 1988, West 1994). Limited knowledge of the response of salt desert shrub communities to fire makes management under current conditions very difficult (West 1994).

### **Assumptions and Limitations**

Land cover maps are the most convenient and universally understood means to graphically represent the spatial arrangement and relationships among features on the earth's surface, and they greatly facilitate assessment of regional landscape conditions (Mosby 1980). However, maps are simplified representations of environmental conditions and are subject to limitations of the technology used to create them. Consequently, the following points need to be considered in use of the sagestitch map. See [Chapter 9](#) for additional details.

- Our estimates of the amount and distribution of cover types were based on the dominant plant species present in the overstory of each 90-m pixel used for mapping in the sagestitch map (Comer et al. 2002). Consequently, we were unable to provide descriptions of understory vegetation.
- The mapping process used to describe the land cover types in our assessment was unable to distinguish between homogeneous areas of basin big sagebrush versus areas co-dominated by basin big sagebrush and Wyoming big sagebrush. As a result, areas dominated by basin big sagebrush were included in a more general Wyoming-basin big sagebrush cover type.
- Linear features such as narrow riparian strips are generally not mapped accurately at the 90- x 90-m pixel size (0.81 ha) used in our assessment. Consequently, estimates of the area of cover types that occur in small or linear patches were of lower accuracy, and may have been substantially underestimated in relation to their true amount.
- The sagestitch map was developed by combining the results of several different vegetation mapping efforts that were implemented differently across administrative boundaries. The development process resolved the problem of

abrupt cover type changes across administrative boundaries for the sagebrush cover types, but the woodland cover types were not rectified for these mapping differences. Consequently, some abrupt changes in woodland cover types exist at state boundaries, especially along the California-Nevada border. Additional rectification of these woodland cover type differences is needed as part of future mapping efforts.

- In developing the sagestitch map, Comer et al. (2002) emphasized production of an ecosystem-wide map of sagebrush cover types in the western United States. Other cover types also were mapped to provide a complete coverage, but less effort was put into ensuring their accuracy (e.g., pinyon and juniper woodlands, as mentioned in point above).

### Key Findings

- Sagebrush, salt desert scrub, and pinyon-juniper cover types dominate the State of Nevada and the Great Basin.
- The number, size, and total area burned across the Great Basin and State of Nevada have increased dramatically in the last 20 yrs; these trends appear to be accelerating, in association with extensive establishment of cheatgrass.
- Large portions of the areas burned since the early 1990s previously supported sagebrush or salt desert shrub communities; many of these cover types were not adapted to frequent, high-intensity fires and have converted to cheatgrass (Knick 1999).
- Management of all cover types of sagebrush and salt desert shrub needs to consider and address the changing role of wildfire. Reducing the spread of cheatgrass in these native shrublands, through mitigation of the pervasive human disturbances that facilitate its spread, are probably the most important consideration in reducing the frequency, intensity, and area of the associated and undesirable wildfires (see [Chapter 10](#)).

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Table 3.1. Ecological characteristics of sagebrush taxa in the Great Basin Ecoregion and Nevada.

Species	Growth form	Elevation	Land form	Soils	Sources
Basin big sagebrush	Erect, rounded or somewhat spreading; 0.4 – 4.5 m tall	500 – 3,400 m	Arid plains, valleys, foothills, mountain slopes	Deep, fertile	Beetle 1960, McArthur et al. 1979, Barker and McKell 1983, Welch 2003
Wyoming big sagebrush	Rounded, uneven crowns; 0.5 – 0.8 m tall	760 – 2,100 m	Foothill, undulating terrace, slope, plateau	Shallow, well-drained, hot	Barker and McKell 1983, Tiedemann et al. 1987, Burke et al. 1989, Meyer and Monsen 1993
Mountain big sagebrush	Spreading, even crown; <1 m tall	1,400 – 3,000 m	Warm desert to montane parklands	Deep, wet, cool	Beetle and Johnson 1982, Blaisdell et al. 1982, Young and Evans 1986, Johnson et al. 1994
Black sagebrush	Small, spreading crown; 15 – 45 cm tall	1,500 – 2,400 m	Desert valley, lower slopes of high desert foothill	Dry, stony, shallow	Zamora and Tueller 1973, Blaisdell et al. 1982, McArthur and Taylor 2003a
Low sagebrush	Spreading, irregularly branched crown; ≤50 cm tall	700 – 3,500 m	Low foothills to mountain slopes	Well-drained, shallow root depth, rocky, alkaline clay	Zamora and Tueller 1973, West et al. 1978, McArthur et al. 1979, Tisdale and Hironaka 1981,

Table 3.1. Ecological characteristics of sagebrush taxa in the Great Basin Ecoregion and Nevada.

Species	Growth form	Elevation	Land form	Soils	Sources
					McArthur and Taylor 2003 <i>b</i>
Silver sagebrush	Erect, rounded crown; ≤1 m tall	≤3,050 m	Valleys, plains, foothills, mountain slopes	Moist	Blaisdell et al. 1982
Threetip sagebrush	Rounded crown; ≤1 m tall	900 – 2,750 m	Low foothills to mountain slopes	Dry, well- drained	Blaisdell et al. 1982

Table 3.2. Descriptions of land cover type classes occurring in the Great Basin Ecoregion and Nevada.

Land cover code	Land cover type	Distribution	Land cover characteristics
101	Agriculture	Analysis-area wide	Row crops, irrigated pasture and hay fields, dry farm crops.
102	Ash	Vicinity of Ash Meadows, near Amargosa Valley, Nevada	Woodland dominated by <i>Fraxinus velutina</i> and <i>Prosopis pubescens</i> . Primary associated shrub species include <i>Baccharis emoryi</i> .
104	Aspen	High elevations, cool aspects	Deciduous forest principally dominated by <i>Populus tremuloides</i> . Primary associated conifer species include <i>Picea engelmanni</i> , <i>Picea pungens</i> , <i>Abies lasiocarpa</i> , <i>Abies concolor</i> , <i>Pseudotsuga menziesii</i> , <i>Pinus contorta</i> , and <i>Pinus ponderosa</i> . Primary associated shrub species include <i>Symphoricarpos</i> spp. and <i>Amelanchier alnifolia</i> .
106	Barren/rock/lava	Low elevation barren soil or high elevation rock cliffs and talus slopes	Barren soil, rock, or lava; <5% total vegetative cover.
107 108 160	Wyoming-basin big sagebrush	Flat to steeply sloping sites with southerly aspects; sloping fans, footslopes, rolling hills, and deep, well-drained alluvial bottomlands	<i>Artemisia tridentata wyomingensis</i> shrubland alliance – <i>Artemisia tridentata</i> ssp. <i>wyomingensis</i> -dominated shrub layer that lacks a significant perennial graminoid layer (<20% cover) or has over 40% total cover of shrubs. <i>Artemisia tridentata</i> (ssp. <i>tridentata</i> , <i>xericensis</i> ) shrubland alliance – <i>Artemisia tridentata tridentata</i> - or <i>Artemisia tridentata xericensis</i> -dominated shrub layer that lacks a significant perennial graminoid layer (<20% cover) or has over 40% total cover of shrubs.
109	Bitterbrush	Shrublands and benches on the east slope of the Sierra Mountains	Shrubland principally dominated or co-dominated by <i>Purshia tridentata</i> . Primary associated shrub species include <i>Artemisia</i> spp., <i>Chrysothamnus</i> spp., <i>Arctostaphylos</i> spp., and <i>Ceanothus</i> spp. Primary associated tree species include <i>Juniperus osteosperma</i> , <i>Pinus monophylla</i> , <i>Cercocarpus ledifolius</i> , <i>Pinus jeffreyi</i> , and <i>Pinus ponderosa</i> .
110	Blackbrush	Transition vegetation class between Mojave scrub and	Shrubland principally dominated by <i>Coleogyne ramosissima</i> . Primary associated tree species include <i>Juniperus osteosperma</i> . Primary associated shrub species

Table 3.2. Descriptions of land cover type classes occurring in the Great Basin Ecoregion and Nevada.

Land cover code	Land cover type	Distribution	Land cover characteristics
		Great Basin shrubs; >1,200- <1,500 m elevation	include <i>Grayia spinosa</i> , <i>Ephedra</i> spp., <i>Atriplex confertifolia</i> , <i>Lycium</i> spp., <i>Xanthocephalum</i> spp., and <i>Larrea tridentata</i> . Other associated species include <i>Yucca brevifolia</i> and <i>Yucca</i> spp.
111	Black greasewood	Throughout the analysis area, typically in the salt desert shrub zone; very salt tolerant; usually on flat valley floors	Shrubland principally dominated by <i>Sarcobatus vermiculatus</i> . Primary associated shrub species include <i>Atriplex confertifolia</i> , <i>Allenrolfea occidentalis</i> , <i>Artemisia tridentata tridentata</i> , and <i>Sarcobatus baileyi</i> . Other associated species include <i>Suaeda torreyana</i> , <i>Halogeton glomeratus</i> , and <i>Salsolia iberica</i> .
112	Black sagebrush	Well-drained slopes and ridges at 1500-2500 m elevation	<i>Artemisia nova</i> shrubland alliance – characterized by the dominance of the dwarf-shrub <i>Artemisia nova</i> , which must contribute $\geq 40\%$ of total shrub cover, and by cover of perennial graminoids that is typically $< 20\%$ . Associated shrub species that occur in stands of this alliance include <i>Chrysothamnus viscidiflorus</i> , <i>Atriplex confertifolia</i> , <i>Artemisia tridentata</i> , <i>Artemisia arbuscula</i> , <i>Artemisia cana</i> , <i>Symphoricarpos oreophilus</i> , <i>Grayia spinosa</i> , <i>Purshia tridentata</i> , and <i>Gutierrezia sarothrae</i> .
113	Bunchgrass	Primarily seeded perennial grasslands or fire induced annual grasslands in central and northern Nevada; also valley, foothill and mountain native grasslands	Principal perennial grass species include <i>Agropyron spicatum</i> , <i>Poa secunda</i> , <i>Agropyron cristatum</i> , <i>Elymus cinereus</i> , <i>Hilaria jamesii</i> , <i>Stipa comata</i> <i>Sporobolus cryptandrus</i> , <i>Bouteloua gracilis</i> , <i>Stipa thurberiana</i> , <i>Agropyron smithii</i> , <i>Sitanion hystrix</i> , and <i>Oryzopsis hymenoides</i> . Principal annual grass species include <i>Bromus tectorum</i> . Primary associated shrub species include <i>Artemisia</i> spp., <i>Atriplex confertifolia</i> , <i>Sarcobatus vermiculatus</i> , and <i>Larrea tridentata</i> . Primary associated tree species include <i>Juniperus</i> spp.
115	Chapparral	East slope of the Sierra Mountains	Shrubland principally dominated or co-dominated by foothill and montane chaparral shrub species locally abundant in the Sierra mountains including <i>Arctostaphylos</i> spp., <i>Ceanothus</i> spp., <i>Quercus</i> spp., <i>Ribes</i> spp., <i>Prunus emarginata</i> , and <i>Symphoricarpos</i> spp. Primary associated shrub species include <i>Artemisia</i> spp. and <i>Purshia tridentata</i> . Primary associated tree species include <i>Pinus monophylla</i> , <i>Cercocarpus ledifolius</i> , <i>Pinus jeffreyi</i> , <i>Pinus ponderosa</i> , <i>Abies</i>

Table 3.2. Descriptions of land cover type classes occurring in the Great Basin Ecoregion and Nevada.

Land cover code	Land cover type	Distribution	Land cover characteristics
			<i>magnifica</i> , <i>Pinus monticola</i> , <i>Pinus contorta</i> , <i>Tsuga mertensiana</i> , and <i>Pinus albicaulis</i> .
116	Creosote-bursage	Mojave Desert <1,200 m elevation; valley bottoms, lowlands and flatlands	Scrubland principally dominated by <i>Larrea tridentata</i> and <i>Ambrosia dumosa</i> . Primary associated shrub species include <i>Coleogyne ramosissima</i> , <i>Ephedra</i> spp., <i>Dalea fremonti</i> , <i>Atriplex confertifolia</i> , <i>Grayia spinosa</i> , <i>Lycium</i> spp., <i>Krameriaceae parvifolia</i> , <i>Hymenoclea salsola</i> , <i>Prosopis glandulosa</i> , and <i>Encelia farinosa</i> . Other associated species include <i>Yucca brevifolia</i> , <i>Yucca</i> spp., <i>Opuntia engelmannii</i> , and other <i>Opuntia</i> spp.
117	Desert grassland	Analysis-area wide	Principal grassland species include <i>Hilaria jamesii</i> , <i>Oryzopsis hymenoides</i> , <i>Aristida glauca</i> , and <i>Sporobolus airoides</i> . Principal shrub species include <i>Atriplex confertifolia</i> , <i>Chrysothamnus</i> spp., <i>Ephedra</i> spp., and <i>Ceratoides lanata</i> . Principal forb species include <i>Eriogonum inflatum</i> .
118	Dunes	Analysis-area wide	Sand dunes with <5% total vegetative cover.
119	Low sagebrush	Poorly drained soils on a variety of landforms; from flats and depressions to slopes and ridges	<i>Artemisia arbuscula arbuscula</i> shrubland alliance – <i>Artemisia arbuscula arbuscula</i> -dominated low-shrub layer (or codominated with >40% relative shrub cover) that lacks a significant graminoid layer (<20% cover perennial graminoids) or has >40% total shrub cover. <i>Artemisia arbuscula longiloba</i> shrubland alliance – <i>Artemisia arbuscula longicaulis</i> -dominated shrub layer that has >5% cover of the nominal species that contributes ≥40% of the total shrub cover.
120	Exotic	Analysis-area wide	Introduced grasses and forbs.
121	Forbland	Analysis-area wide	Primary associated forb species include <i>Halogeton glomeratus</i> , <i>Eriogonum inflatum</i> , <i>Achillea millefolium</i> , <i>Taraxacum officinale</i> , <i>Penstemon</i> spp., <i>Wyethia amplexicaulis</i> , <i>Chrysopsis villosa</i> , <i>Balsamorhiza sagittata</i> , <i>Agoseris pumila</i> , <i>Delphinium</i> spp., and <i>Gilia aggregata</i> .

Table 3.2. Descriptions of land cover type classes occurring in the Great Basin Ecoregion and Nevada.

Land cover code	Land cover type	Distribution	Land cover characteristics
122	Forest	High elevations, analysis-area wide	A mix of forest types including <i>Abies lasiocarpa</i> , spruce-fir, alpine fir/ <i>Pseudotsuga menziesii</i> , alpine fir/ <i>Pinus contorta</i> , mountain fir/mountain shrub, <i>Pinus aristata</i> , <i>Abies concolor</i> , Great Basin subalpine pine, and <i>Pinus ponderosa</i> .
126	Low sagebrush–mountain big sagebrush		See descriptions for these alliances under the individual entries for low sagebrush (119) and mountain big sagebrush (136).
127	Low sagebrush–Wyoming big sagebrush		See descriptions for these alliances under the individual entries for low sagebrush (119) and Wyoming-basin big sagebrush (108).
128	Marsh/wetland	Low elevation basins around a permanent water source	Principal species include <i>Typha latifolia</i> , <i>Scirpus</i> spp., <i>Sparganium</i> spp., <i>Phragmites australis</i> , <i>Potamogeton</i> spp., and <i>Carex</i> spp.
129	Mesic shrubs	Analysis-area wide	Upland shrublands, naturally occurring or initiated by fire or timber harvest. Principal species include <i>Alnus</i> spp., <i>Amelanchier</i> spp., <i>Berberis aquifolium</i> , <i>Symphoricarpos</i> spp., <i>Ceanothus</i> spp., <i>Physocarpus</i> spp., <i>Aronia</i> spp., <i>Rosa</i> spp., <i>Ribes</i> spp., <i>Salix</i> spp., <i>Sambucus</i> spp., and <i>Spiraea</i> spp.
130	Mesquite	Scattered clumps on the west side of the Mojave desert	Shrubland dominated by <i>Prosopis glandulosa</i> . Primary associated shrub species include <i>Tamarix pentandra</i> , <i>Atriplex torreyi</i> , and <i>Larrea tridentata</i> .
133	Mojave mixed scrub	Slopes, washes, and upland areas within the Mojave desert	Mojave desert mixed scrublands are usually characterized by the occurrence of <i>Larrea tridentata</i> in association with <i>Ambrosia dumosa</i> , <i>Psoralea fremontii</i> , <i>Lycium</i> spp., <i>Atriplex confertifolia</i> , <i>Grayia spinosa</i> , <i>Krameriaceae parvifolia</i> , or <i>Ephedra</i> spp. Primary associated shrub species include <i>Coleogyne ramosissima</i> , <i>Encelia farinosa</i> , <i>Hymenoclea salsola</i> , <i>Bebbia juncea</i> , <i>Atriplex polycarpa</i> , and <i>Atriplex hymenelytra</i> . Other associated species include <i>Yucca brevifolia</i> , <i>Yucca</i> spp., <i>Echinocereus</i> spp., and <i>Opuntia biglovii</i> .

Table 3.2. Descriptions of land cover type classes occurring in the Great Basin Ecoregion and Nevada.

Land cover code	Land cover type	Distribution	Land cover characteristics
136	Mountain big sagebrush	Mid-elevation mountain slopes and foothills to above the lower treeline	<i>Artemisia tridentata vaseyana</i> shrubland alliance – <i>Artemisia tridentata vaseyana</i> dominates the shrub layer or with >40% relative cover; total perennial graminoid cover is typically <20%.
137	Mountain mahogany	Above pinyon and juniper on steep, rocky, dry slopes	Woodland principally dominated by <i>Cercocarpus ledifolius</i> . Primary associated species include <i>Quercus gambelii</i> , <i>Pinus monophylla</i> , <i>Juniperus</i> spp., and <i>Artemisia</i> spp.
138	Mountain shrub	Wide-spread in foothills and mountains	Deciduous shrubland principally dominated by <i>Cercocarpus montanus</i> , <i>Cowania mexicana</i> , <i>Purshia tridentata</i> , <i>Amelanchier utahensis</i> , <i>Amelanchier alnifolia</i> , <i>Ceanothus</i> spp., <i>Prunus virginiana</i> , <i>Symphoricarpos</i> spp., <i>Arctostaphylos pungens</i> , and <i>Arctostaphylos uva-ursi</i> . Primary associated shrub species include <i>Artemisia</i> spp., <i>Chrysothamnus</i> spp., <i>Quercus</i> spp., and <i>Acer</i> spp. Primary associated tree species include <i>Pinus monophylla</i> , <i>Juniperus osteosperma</i> , <i>Cercocarpus ledifolius</i> , <i>Populus tremuloides</i> , <i>Abies concolor</i> , <i>Pinus flexilis</i> , <i>Pinus ponderosa</i> , <i>Abies lasiocarpa</i> , and <i>Picea engelmannii</i> .
139	Pinyon pine	Widely distributed throughout eastern, central, and western portions of the analysis area above the pinyon-juniper zone. It is absent from northern portions of the analysis area.	Conifer woodland principally dominated by <i>Pinus monophylla</i> at canopies <30%. Primary associated tree species include <i>Juniperus osteosperma</i> , <i>Pinus ponderosa</i> , <i>Abies concolor</i> , <i>Cercocarpus ledifolius</i> and <i>Pinus jeffreyi</i> . Primary associated shrub species include <i>Artemisia</i> spp., <i>Quercus gambelii</i> , <i>Cercocarpus montanus</i> , <i>Cercocarpus intricatus</i> , <i>Cowania mexicana</i> , <i>Arctostaphylos</i> spp., <i>Quercus turbinella</i> , and <i>Purshia tridentata</i> .
140	Pinyon-juniper	Distributed above the juniper zone and below the pinyon zone throughout all but northern portions of the analysis area. It is most abundant in eastern and	Conifer woodland principally co-dominated by <i>Pinus monophylla</i> and <i>Juniperus osteosperma</i> . Primary associated tree species include <i>Cercocarpus ledifolius</i> . Primary associated shrub species include <i>Artemisia</i> spp., <i>Chrysothamnus</i> spp., <i>Quercus gambelii</i> , <i>Cercocarpus montanus</i> , <i>Purshia tridentata</i> , <i>Cercocarpus intricatus</i> , and <i>Cowania mexicana</i> .

Table 3.2. Descriptions of land cover type classes occurring in the Great Basin Ecoregion and Nevada.

Land cover code	Land cover type	Distribution	Land cover characteristics
		central portions.	
141	Playa	Analysis-area wide on flat, low elevation valley floors	Barren internal basin floors which may occasionally be covered by water.
142	Rabbitbrush	Green rabbitbrush generally occurs at low elevations on dry plains, valleys, and foothills; Rubber rabbitbrush occurs on open plains, valleys, drainage ways, foothills, and mountains.	<i>Chrysothamnus viscidiflorus puberulus</i> is most commonly found in <i>Artemisia</i> spp. communities with other subspecies of <i>Chrysothamnus viscidiflorus</i> , as well as with salt-tolerant species such as <i>Halogeton glomeratus</i> , <i>Atriplex confertifolia</i> , and <i>Krascheninnikova lanata</i> . It is occasionally found with <i>Pinus</i> spp. and <i>Juniperus</i> spp.
144	Riparian	Analysis-area wide	Localized vegetation influenced by the presence of abundant water in contrast to surrounding areas. Principal tree species include <i>Populus fremonti</i> , <i>Populus angustifolia</i> , <i>Populus trichocarpa</i> , <i>Alnus tenuifolia</i> , <i>Populus tremuloides</i> , <i>Betula occidentalis</i> , <i>Crataegus douglasii</i> , and <i>Acer glabrum</i> . Principal shrub species include <i>Tamarix pentandra</i> , <i>Fraxinus velutina</i> , <i>Chilopsis linearis</i> , <i>Prosopis glandulosa</i> , <i>Salix</i> spp., <i>Cornus stolonifera</i> , and <i>Rosa woodsii</i> .
145	Salt desert scrub	This class occurs in a variety of physiographic areas typically <1,500 m elevation	Shrublands principally dominated by $\geq 1$ of the following: <i>Atriplex confertifolia</i> , <i>Atriplex hymenelytra</i> , <i>Sarcobatus baileyi</i> , <i>Lycium</i> spp., <i>Atriplex torreyi</i> , <i>Ceratoides lanata</i> , <i>Artemisia spinescens</i> , <i>Atriplex canescens</i> , <i>Ephedra</i> spp., <i>Sarcobatus baileyi</i> , <i>Tetradymia canescens</i> , or <i>Gutierrezia sarothrae</i> . Primary associated shrub species include <i>Sarcobatus vermiculatus</i> , <i>Artemisia</i> spp. <i>Coleogyne ramosissima</i> , <i>Allenrolfea occidentalis</i> , and <i>Larrea tridentata</i> . Primary associated forb species includes <i>Halogeton glomeratus</i> . Primary associated grass species include <i>Distichlis spicata</i> and <i>Bromus tectorum</i> .
146	Saltbush	Saltbush occurs in northern and southern desert	Saltbush shrublands are principally dominated by $\geq 1$ of the following: <i>Atriplex canescens</i> , <i>Atriplex torreyi</i> , or <i>Atriplex polycarpa</i> . Common codominants or



Table 3.2. Descriptions of land cover type classes occurring in the Great Basin Ecoregion and Nevada.

Land cover code	Land cover type	Distribution	Land cover characteristics
		shrublands and in Mohave and Sonoran desert scrub communities	associates include <i>Bouteloua gracilis</i> , <i>Bouteloua eriopoda</i> , <i>Hilaria jamesii</i> , <i>Sporobolus</i> spp., <i>Elymus elymoides</i> , <i>Pascopyrum smithii</i> , <i>Oryzopsis hymenoides</i> , <i>Chrysothamnus nauseosus</i> , <i>Sarcobatus vermiculatus</i> , <i>Artemisia nova</i> , and <i>Gutierrezia sarothrae</i> .
147	Shadscale	Shadscale communities form a vegetative zone below <i>Artemisia</i> spp. communities and above <i>Sarcobatus</i> spp. communities	Shadscale inhabits both warm and cold deserts and is indicative of salt-desert shrub communities. Little understory is usually present, and overstory shrubs are widely spaced. Shadscale forms almost pure stands in valley bottoms and is mixed with other shrubs and grasses on higher slopes. Common components of shadscale communities include <i>Artemisia spinescens</i> , <i>Eurotia lanata</i> , <i>Chrysothamnus nauseosus</i> , <i>Chrysothamnus viscidiflorus</i> , <i>Artemisia tridentate</i> spp., <i>Atriplex spinosa</i> , and <i>Sarcobatus vermiculatus</i> . Common grass associates include <i>Bromus tectorum</i> , <i>Elymus elymoides</i> , <i>Poa secunda</i> , and <i>Oryzopsis hymenoides</i> . Common forbs include <i>Halogeton glomeratus</i> , <i>Sphaeralcea coccinea</i> , <i>Sphaeralcea grossularifolia</i> , <i>Mentzelia multiflora</i> , and <i>Stanleya pinnata</i> . <i>Kochia americana</i> and <i>Ambrosia dumosa</i> are also common associates.
148	Silver sagebrush	Relatively moist environments, including alkaline or saline playa lakes	<i>Artemisia cana</i> (ssp. <i>viscidula/bolanderi</i> ) shrubland alliance – Stands are characterized by an open to closed, medium-tall shrub canopy of <i>Artemisia cana viscidula</i> or <i>Artemisia cana bolanderi</i> . Herbaceous cover can be abundant to very sparse, but perennial graminoids generally total <20% cover. Species include <i>Festuca idahoensis</i> , <i>Festuca thurberi</i> , <i>Festuca ovina</i> , <i>Elymus elymoides</i> , <i>Deschampsia caespitosa</i> , <i>Poa secunda</i> (= <i>Poa nevadensis</i> ), <i>Poa cusickii</i> , <i>Muhlenbergia richardsonis</i> , <i>Leymus cinereus</i> , <i>Eleocharis palustris</i> , and <i>Danthonia intermedia</i> .
149	Snow/ice	High elevations	
151	Spiny hopsage	This is a transition shrubland that occurs in the northern reaches of the Mojave and the	This shrubland is characterized by the occurrence of <i>Grayia spinosa</i> , typically in concert with <i>Lycium</i> spp, <i>Chrysothamnus</i> spp., <i>Ephedra</i> spp., and <i>Atriplex confertifolia</i> . Primary associated shrub species include <i>Artemisia</i> spp., <i>Coleogyne</i>

Table 3.2. Descriptions of land cover type classes occurring in the Great Basin Ecoregion and Nevada.

Land cover code	Land cover type	Distribution	Land cover characteristics
		southern fringe of the Great Basin	<i>ramosissima</i> , <i>Ceratoides lanata</i> , <i>Krameriaceae parvifolia</i> , <i>Ambrosia dumosa</i> and <i>Larrea tridentata</i> .
152	Threetip sagebrush	The alliance occurs at the northern fringe of the analysis area on flat to steeply sloping upland sites	<i>Artemisia tripartita tripartita</i> shrubland alliance – <i>Artemisia tripartita tripartita</i> typically has 5-15% cover, and contributes $\geq 40\%$ to the total shrub cover. <i>Artemisia frigida</i> , <i>Artemisia tridentata tridentata</i> , <i>Artemisia tridentata wyomingensis</i> , <i>Artemisia tridentata vaseyana</i> , <i>Chrysothamnus viscidiflorus</i> , <i>Purshia tridentata</i> , or <i>Tetradymia canescens</i> may also be common. The herbaceous stratum is typically dominated by graminoids and of moderate to moderately high cover (25-70%). <i>Festuca idahoensis</i> and <i>Pseudoroegneria spicata</i> are the most common associates. Other locally abundant graminoid species include <i>Hesperostipa comata</i> (= <i>Stipa comata</i> ), <i>Festuca campestris</i> , <i>Leymus cinereus</i> , <i>Carex filifolia</i> , and <i>Koeleria macrantha</i> . Forbs form a major and highly variable component of this vegetation type.
154	Urban	Analysis-area wide	
155	Utah juniper	Widely distributed, often occurring below the pinyon-juniper zone	This conifer woodland is principally dominated by <i>Juniperus osteosperma</i> . Primary associated tree species include <i>Juniperus scopulorum</i> , <i>Juniperus occidentalis</i> , and <i>Pinus monophylla</i> . Primary associated shrub species include <i>Artemisia</i> spp., <i>Chrysothamnus</i> spp., and <i>Coleogyne ramosissima</i> .
156	Water	Analysis-area wide	
157	Western juniper	Extreme northwest Nevada	For descriptions of <i>Juniperus occidentalis</i> see descriptions of Pinyon-juniper (140) and Utah juniper (155)
158	Wet meadow	This class is sparsely distributed throughout mountains in the analysis area	This type occurs in mountain meadows where soil moisture is abundant throughout the growing season. Principal species include <i>Carex</i> spp., <i>Juncus</i> spp., <i>Calamagrostis</i> spp., <i>Phleum</i> spp., <i>Poa</i> spp., <i>Deschampsia cespitosa</i> , <i>Epilobium</i> spp., <i>Saxifraga</i> spp. Primary associated species include <i>Salix</i> spp., <i>Lonicera</i> spp.,

Table 3.2. Descriptions of land cover type classes occurring in the Great Basin Ecoregion and Nevada.

Land cover code	Land cover type	Distribution	Land cover characteristics
159	Winterfat	Analysis-area wide	<i>Potentilla</i> spp., and <i>Vaccinium</i> spp. <i>Ceratoides lanata</i> dominated communities exist in almost pure stands over extensive areas. Associated species frequently include <i>Chrysothamnus viscidiflorus</i> , <i>Oryzopsis hymenoides</i> , <i>Hilaria jamesii</i> , and <i>Artemisia nova</i> .
201	Recently burned	Analysis-area wide	Cover types burned in wildfires from 1994 – 2001.

Table 3.3. Area of land cover types in the Great Basin Ecoregion and Nevada.<sup>a</sup>

Land cover type	Great Basin Ecoregion		Nevada	
	Ha	% total	Ha	% total
Sagebrush				
Black sagebrush	1,499,522.2	5.1	1,627,573.5	5.8
Low sagebrush	318,708.3	1.1	820,336.4	2.9
Low sagebrush- mountain big sagebrush	117,880.9	t <sup>b</sup>	203,833.3	t
Low sagebrush- Wyoming big sagebrush	50,687.4	t	133,644.3	t
Mountain big sagebrush	1,097,565.4	3.7	1,574,906.5	5.6
Silver sagebrush	179.8	t	2,151.4	t
Threetip sagebrush	-- <sup>c</sup>	--	499.8	t
Wyoming-basin big sagebrush	5,232,872.2	17.9	5,822,357.0	20.7
Subtotal	8,317,416.2	28.4	10,185,302.2	36.2
Salt desert shrub				
Salt desert scrub	7,383,104.6	25.2	6,198,035.8	22.0
Saltbush	41,866.5	t	42,306.3	t
Shadscale	834,765.8	2.8	879,254.2	3.1
Spiny hopsage	111,605.0	t	137,773.7	t
Subtotal	8,371,341.9	28.6	7,257,370.0	25.8
Other shrub				
Bitterbrush	146,606.0	t	194,814.7	t
Blackbrush	193,267.6	t	951,157.1	3.4
Black greasewood	1,285,751.9	4.4	1,229,218.7	4.4
Chaparral	68.0	t	2,444.6	t
Creosote-bursage	405.0	t	1,465,085.9	5.2
Mesic shrubs	2,200.0	t	2,209.7	t
Mesquite	--	--	7,312.7	t

Table 3.3. Area of land cover types in the Great Basin Ecoregion and Nevada.<sup>a</sup>

Land cover type	Great Basin Ecoregion		Nevada	
	Ha	% total	Ha	% total
Mojave mixed scrub	38,848.4	t	--	--
Mountain mahogany	21,300.6	t	2,620.4	t
Mountain shrub	324,001.6	1.1	407,774.3	1.4
Rabbitbrush	37,032.4	t	38,616.8	t
Winterfat	85,823.6	t	85,972.6	t
Subtotal	2,135,305.1	7.3	4,387,227.5	15.6
Woodland				
Pinyon pine	1,300,080.0	4.4	1,167,846.7	4.1
Pinyon-juniper	1,779,779.0	6.1	1,390,690.6	4.9
Utah juniper	708,047.7	2.4	240,576.5	t
Western juniper	--	--	607.5	t
Subtotal	3,787,906.7	12.9	2,799,721.3	9.9
Other vegetation				
Ash	--	--	4,319.7	t
Aspen	65,239.8	t	102,972.9	t
Bunchgrass	953,852.8	3.3	529,923.9	1.9
Desert grassland	113,188.6	t	12,698.4	t
Exotic	5,060.1	t	661.0	t
Forbland	8,450.7	t	7,826.2	t
Forest	493,524.1	1.7	244,224.7	t
Marsh/wetland	161,075.0	t	114,826.4	t
Playa	431,841.8	1.5	1.6	t
Riparian	114,307.2	t	79,504.7	t
Wet meadow	11,026.5	t	13,299.4	t
Subtotal	2,357,566.6	8.0	1,110,258.9	3.9
Other land types				
Agriculture	813,645.0	2.8	--	--
Barren/rock/lava	1,189,312.5	4.1	755,331.5	2.7
Dunes	30,020.2	t	19,165.4	t

Table 3.3. Area of land cover types in the Great Basin Ecoregion and Nevada.<sup>a</sup>

Land cover type	Great Basin Ecoregion		Nevada	
	Ha	% total	Ha	% total
Recently burned <sup>d</sup>	1,188,484.7	4.1	1,250,623.8	4.4
Snow/ice	2,696.5	t	2,877.1	t
Unknown	932.3	t	--	--
Urban	248,454.5	t	234,768.8	t
Water	856,596.9	2.9	135,126.6	t
Subtotal	4,330,142.6	14.8	2,397,893.2	8.5
No data <sup>e</sup>	4,405.6	t	4,691.5	t
Total	29,304,084.7	100.0	28,142,464.6	100.0

<sup>a</sup> Land cover types are from the “sagestitch” map of sagebrush and other land cover types in the sagebrush biome (Comer et al. 2002).

<sup>b</sup> t = trace (<1.0%).

<sup>c</sup> “--” denotes cover type absent from analysis area.

<sup>d</sup> Areas burned by wildfire in Nevada during 1994-2001 were recoded as “recently burned,” regardless of land cover type existing prior to the burn.

<sup>e</sup> Land cover type data were not available for small portions of the Great Basin Ecoregion and the State of Nevada that fell outside the boundaries of the “sagestitch” map.

Table 3.4. Area burned in the Great Basin Ecoregion and Nevada from 1994 – 2001 by land cover type.

Land cover type	Great Basin		Nevada	
	Ha	% of cover type	Ha	% of cover type
Sagebrush				
Black sagebrush	34,360.2	2.3	50,907.7	3.1
Low sagebrush	31,649.1	9.9	77,999.0	9.5
Low sagebrush-mountain big sagebrush	23,771.1	20.2	31,914.0	15.7
Low sagebrush-Wyoming big sagebrush	13,109.9	25.9	25,572.5	19.1
Mountain big sagebrush	75,004.4	6.8	131,960.3	8.4
Silver sagebrush	0.0	0.0	0.0	0.0
Threetip sagebrush	0.0	0.0	0.0	0.0
Wyoming-basin big sagebrush	350,504.8	6.7	367,108.2	6.3
Subtotal	528,399.5	6.4	685,461.7	6.7
Salt desert shrub				
Salt desert scrub	189,800.0	2.6	179,769.0	2.9
Saltbush	661.8	1.6	663.4	1.6
Shadescale	71,575.7	8.6	74,991.4	8.5
Spiny hopsage	665.0	0.6	665.0	0.5
Subtotal	262,702.4	3.1	256,088.8	3.5
Other shrub				
Bitterbrush	13,160.1	9.0	18,363.5	9.4
Mountain mahogany	87.5	0.4	5.7	0.2
Mountain shrub	16,903.1	5.2	23,119.0	5.7
Rabbitbrush	1,469.3	4.0	1,530.9	4.0
Subtotal	31,620.0	6.0	43,019.1	6.7
Woodland				
Pinyon pine	45,373.8	3.5	43,953.0	3.8
Pinyon-juniper	86,760.7	4.9	65,853.0	4.7
Utah juniper	64,213.6	9.1	19,401.1	8.1
Western juniper	0.0	0.0	13.0	2.1
Subtotal	196,348.1	5.2	129,220.1	4.6
Other	169,632.6	2.7	136,933.7	2.3
Total	1,188,702.5	4.4	1,250,723.4	4.7

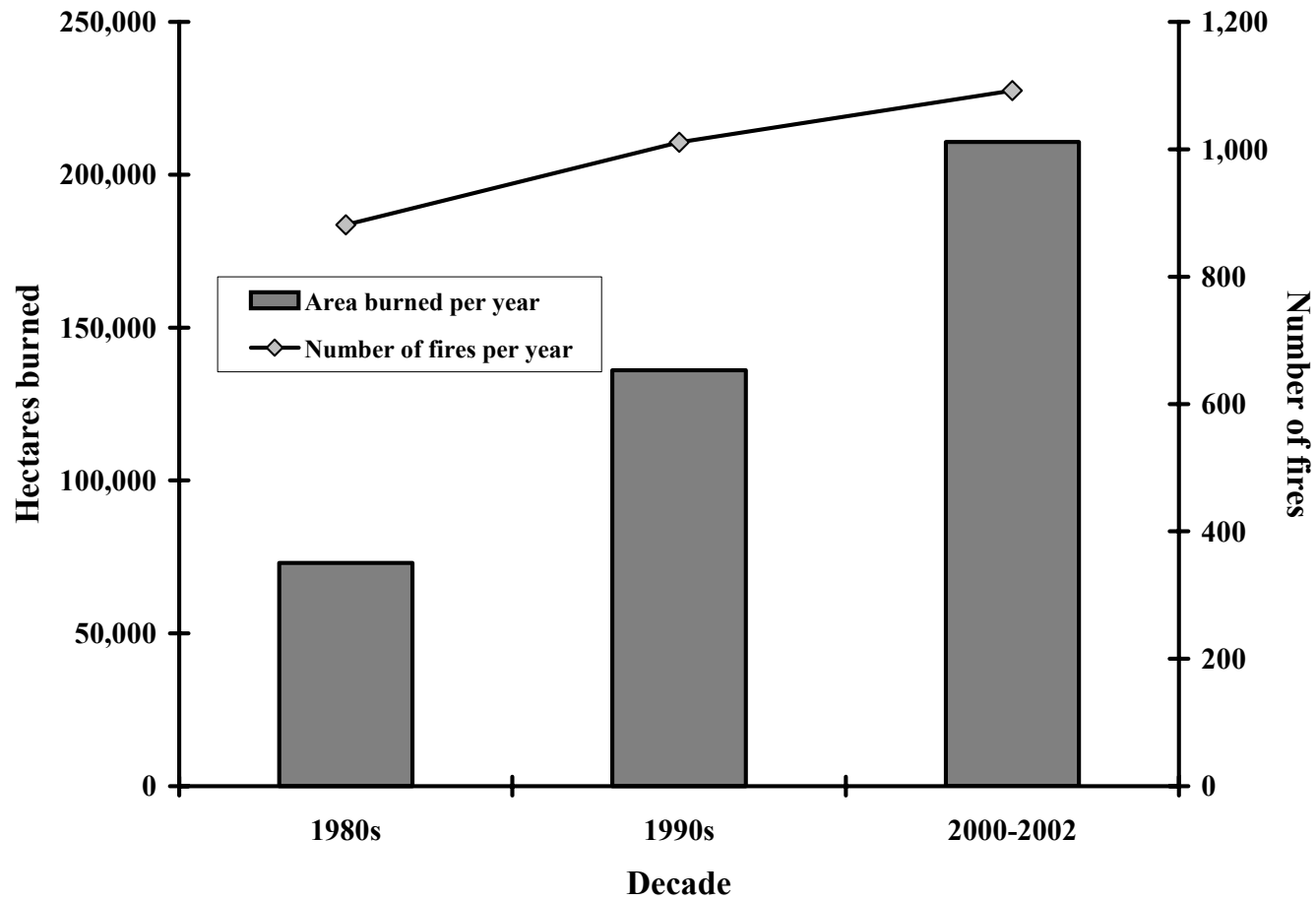


Fig. 3.1. Number of wildland fires and area burned by decade in the State of Nevada (source: USDI Bureau of Land Management; unpublished data, data available online at: <http://www.fire.blm.gov/>).



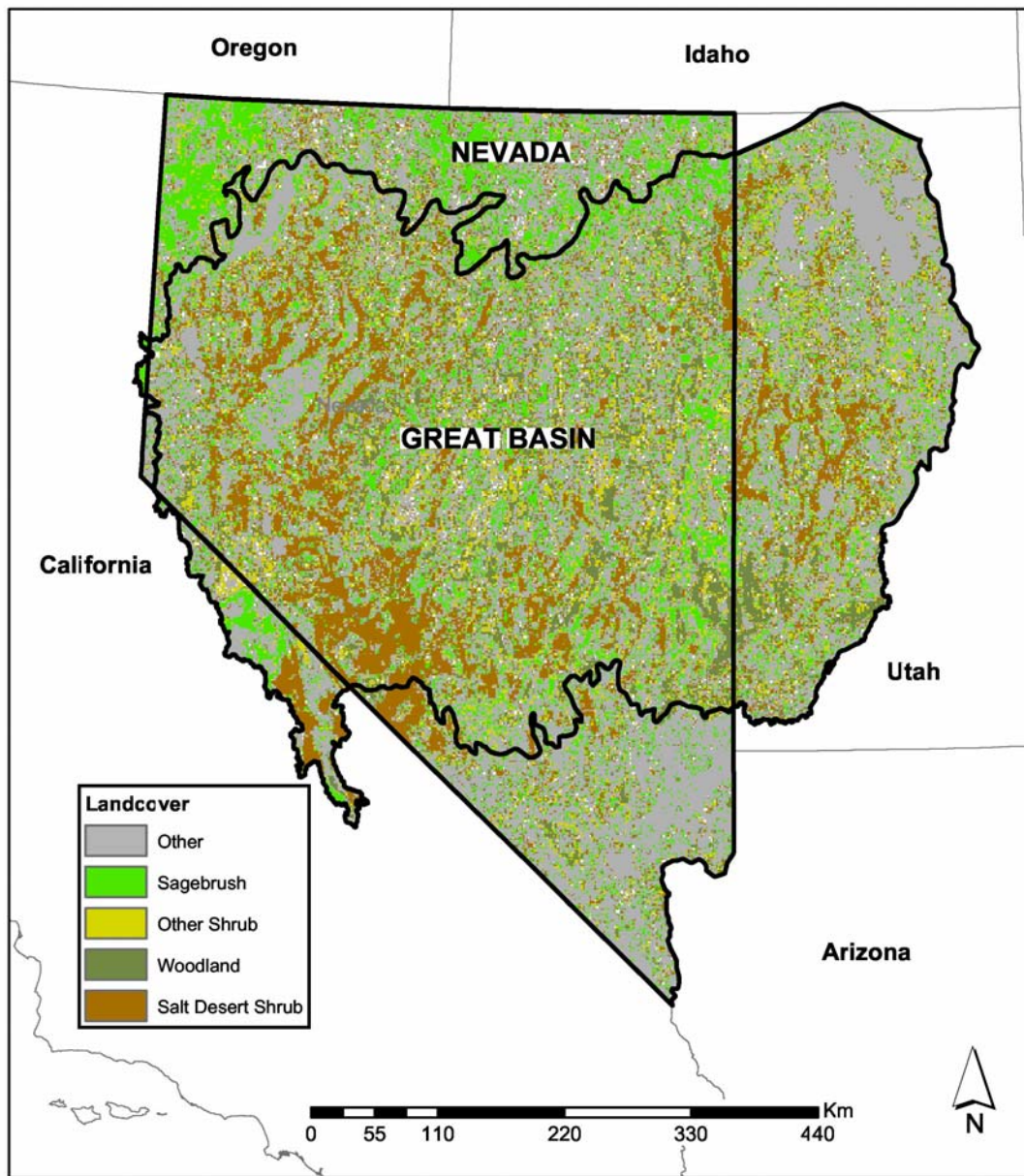


Fig. 3.2. Distributions of major land cover types in the Great Basin and Nevada.