

CHAPTER 2

OVERVIEW OF SAGEBRUSH ECOSYSTEMS

This chapter provides a brief, qualitative overview of sagebrush ecosystems in North America and the Colorado sagebrush assessment area ([Chapter 1](#)). This document is concerned with tall, woody species of sagebrush (*Artemisia*) that dominate the widespread sagebrush shrubsteppe and shrubland communities of North America. “Tall sagebrush” consists principally of various subspecies of big sagebrush (*A. tridentata*), black sagebrush (*A. nova*), and silver sagebrush (*A. cana*), along with hybrids.

Several other *Artemisia* taxa exist in the assessment area, including low sagebrush (*A. arbuscula*), fringed sage (*A. frigida*), and sand sage (*A. filifolia*); we touch on these species briefly in this chapter. The remainder of this document applies only to tall sagebrush species, which we refer to in subsequent chapters as simply “sagebrush” or “big sagebrush.” In [Chapter 3](#), we quantify the amount of sagebrush-dominated lands in the assessment area and estimate the amount of sagebrush that has been lost since Euro-American settlement in the assessment area. In [Chapter 4](#), we model the risk of four widespread threats to sagebrush ecosystems in the assessment area. These models are then applied in [Chapters 6](#) and [7](#) to sagebrush habitat for species of concern identified in [Chapter 5](#).

Terminology and Taxonomy

Ecologists distinguish between two broad sagebrush community types: “sagebrush shrubsteppe” and “sagebrush shrublands.” In undisturbed sagebrush shrubsteppe, tall sagebrush species are typically co-dominant with native perennial bunchgrasses. In undisturbed sagebrush shrublands, tall sagebrush species are typically dominant, native forbs and bunchgrasses are relatively sparse, and patches of bare ground or biological soil crusts are common throughout. Usually, only one species of tall sagebrush is present or dominant in any given sagebrush stand in either community type, but stands can differ extensively in their composition of understory plants.

Tall sagebrush, as described above, is big sagebrush, black sagebrush, and silver sagebrush, and the subspecies, variants, or hybrids thereof. Taxonomic revisions of sagebrush species have occurred relatively frequently during the last century, and are likely to occur in the future. Of the several state and regional treatments currently available, we chose to follow Winward’s (2004) taxonomy and nomenclature, the most recent treatment specific to Colorado (see [Table 2-1](#)).

Although both sagebrush community types occur in Colorado, we mostly generalize across community types in this document by using the term “sagebrush habitats” or “sagebrush shrublands.” Nevertheless, the distinction between shrubsteppe and shrublands is important to managers at the local level who want to manage toward the native plant composition and physiognomic conditions of these communities.

Range and Distribution of Sagebrush in the Western U.S.

Native sagebrush ecosystems encompass an estimated 43 million ha (106 million acres) in the western U. S. [Figure 2-1](#) shows the current estimated range and distribution pattern of sagebrush across the western U.S., depicted in ecoregions with at least 1 percent of their land surface dominated by sagebrush. Sagebrush shrubsteppe is characteristic of the Columbia Plateau, the Middle Rockies, and the Wyoming Basins ecoregions into northwest Colorado, where average precipitation is higher and temperatures are lower than elsewhere in overall

sagebrush range. Sagebrush shrublands predominantly occur in the Great Basin, Utah High Plateaus, Southern Rocky Mountains, and on the Colorado Plateau ecoregions into west-central and southwestern Colorado, where conditions are more arid. About 5 percent of sagebrush shrublands in the western U. S. occur in Colorado.

While [Figure 2-1](#) may give the impression that sagebrush is a dominant feature on the landscape, experts are alerting the conservation community that these systems are becoming increasingly degraded and fragmented (Bock et al. 1993; Welch 2005; Braun et al. 1976; Dobkin and Sauder 2004; Knick 1999; Knick et al. 2003; Knick and Rotenberry 2000; Noss et al. 1995; Paige and Ritter 1999; Saab et al. 1995).

Historically, as many as 63 million ha (156 million acres) supported sagebrush ecosystems in pre-European settlement times (Knick et al. 2003) in western North America. The reduction by nearly 32 percent of one of the west's largest and most distinct ecosystems has been caused largely by the transformative influences of human-caused impacts. Colorado's sagebrush habitats have undergone loss and degradation at a lower rate (see [Chapter 3](#) for distribution maps and discussion).

Unique Functions & Values of Sagebrush Ecosystems

The long-standing attitude in the west toward sagebrush has been to consider it little more than a hindrance to agricultural uses of the land, or a nuisance to be removed so that livestock range could be manipulated to produce more forage (Frisina and Wambolt 2004; Welch 2005; Welch and Criddle 2003).

Petitions to the federal government to list the sage-grouse under the U. S. Endangered Species Act have sparked conservation planning efforts for this important game species, and for a suite of other less well-known wildlife species that depend on sagebrush. Consequently, conservation of sagebrush habitats is now a priority of many federal and state resource management agencies, and recognition of the intrinsic value of sagebrush habitats is growing.

Sagebrush habitats support a unique biodiversity. Several bird and mammal species are almost entirely dependent on sagebrush for survival: greater sage-grouse, Gunnison sage-grouse, sage sparrow, Brewer's sparrow, sage thrasher, pygmy rabbit, and sagebrush vole. An additional 100 species of birds, 90 mammals, and 60 herptiles have a facultative association with sagebrush. At least one bird, 18 small mammals and 3 native ungulates consume sagebrush in their diets. Over 240 insects and 70 spiders and other arachnid species are associated with sagebrush (Welch 2005).

At least 133 plants and 24 species of lichens are associated with sagebrush (Welch 2005; Wisdom et al. 2003a), varying with geographic location, topography, soil, elevation, and climate. Sagebrush hosts 16 species of paintbrushes and 7 species of owl-clovers—all facultative root hemiparasites (Welch 2005). Biological soil crusts are an important component of healthy semi-arid sagebrush ecosystems. Made up of lichens, fungi, bacteria, cyanobacteria, algae, and moss, these fragile micro-communities bind and stabilize surface soil, recycle nutrients and make them available to plants, and provide micro-topography and moisture retention to aid seed germination (Belnap 1994).

Not only does sagebrush provide forage directly to many vertebrates and invertebrates, it functions as a nurse plant for other plant species (including important livestock forage plants) in its understory. The following information was synthesized from literature reviewed by Welch (2005): 1) the number of plant species found directly under or near the canopy of sagebrush plants exceeds that found in the canopy interspaces; 2) the sagebrush canopy reduces solar radiation to the ground, positively influencing soil moisture retention, and extending conditions

for forb and grass seedling establishment for up to 28 days longer than conditions in the canopy interspaces; 3) and soil nutrient content is higher directly under the canopies of sagebrush shrubs than in the canopy interspaces.

Colorado has 21 sagebrush taxa (Winward 2004). [Table 2-2](#) lists the Colorado sagebrush taxa, and describes their wildlife use and value, their distribution, and management considerations. Sagebrush communities have not been mapped reliably to the species level at the regional spatial scale in Colorado. The percent cover of the sagebrush canopy and composition and cover of understory vegetation in either sagebrush shrubsteppe or sagebrush shrublands varies locally depending on the seral stage of the stand, the effects of management actions, the effects of drought or grazing, or the cumulative impacts of a combination of factors.

Threats to Sagebrush Ecosystems

Threats to sagebrush ecosystems are myriad and widespread, including urban and suburban development, energy development, agricultural conversions, livestock grazing and range treatments to improve range conditions for livestock, invasion of non-native vegetation and altered fire regimes, and encroachment by successional vegetation types.

The loss and degradation of sagebrush ecosystems is significant and well-documented in western North America (Bock et al 1993, Saab et al. 1995, Knick and Rotenberry 2002). At least 10 percent of sagebrush shrubsteppe has been lost to agriculture in the overall region, and in some subregions, much more has been lost to agriculture and other types of development. Eastern Washington has lost an estimated 60 percent of its sagebrush shrubsteppe (Paige and Ritter 1999), and southern Idaho has lost up to 99 percent (Knick and Rotenberry 2002). Much remaining sagebrush shrubsteppe is highly fragmented, leading to deleterious edge effects on area-sensitive species, including increased predation and songbird brood parasitism by brown-headed cowbirds (Knick and Rotenberry 2002; Misenhelter and Rotenberry 2000).

Only an estimated 1 percent of sagebrush ecosystems across western North America has been untouched by grazing, and 30 percent of all sagebrush ecosystems have been grazed heavily (West 1996, cited in Paige and Ritter 1999). Overgrazing is a major source of non-native plant incursions into sagebrush habitat, especially cheatgrass (Saab et al. 1995). Grazing is also associated with increased abundances of brood parasitic brown-headed cowbirds, which negatively affect the nesting success of sagebrush-obligate passerine birds (Rich 1978).

Invasions of exotic herbaceous vegetation such as cheatgrass have led to significant shrubland loss by dramatically altering natural fire regimes. Cheatgrass, whose carpet-like cover spreads fire much more easily than native bunchgrasses, was associated with fires that influenced the almost 50 percent loss of shrublands in the 200,000 ha Snake River Birds of Prey National Conservation Area from 1979 to 1996 (Knick and Rotenberry 2002). Ominously, cheatgrass has become the dominant ground cover in possibly 50 percent of sagebrush shrubsteppe (Paige and Ritter 1999). Fire-induced replacement of sagebrush stands with cheatgrass is not advancing in Colorado on the same scale as on the Columbia Plateau or other parts of the sagebrush region (S. Monsen, pers. comm.). Nevertheless, understory encroachment by non-native invasive herbaceous plants is a serious concern (see [Chapter 4](#)).

Drought and sagebrush disease are major concerns in some areas of the sagebrush region, especially where sagebrush habitats are under the pressure of heavy domestic grazing or wild ungulate use and where sagebrush recruitment has been inadequate (Wenger et al. 2003; Winward 2004).

Management Issues

Eradication and treatments of sagebrush on public lands to benefit livestock grazing have decelerated due to concern over the decline of sage-grouse and other sagebrush dependent species, and an increasing awareness of the intrinsic value of sagebrush ecosystems. Questions remain about how to best balance management of sagebrush habitats for livestock grazing and wildlife benefit. Conservation entities have suggested that sagebrush habitats be managed for structure and composition similar to native or undisturbed conditions. Yet, much controversy has surrounded the question of what sagebrush ecosystems under pristine conditions or pre-European settlement times looked like.

For many decades, range managers assumed that the intermountain west had been dominated by grasses in pre-European settlement times, and that sagebrush had increased or invaded as a result of heavy grazing. This assumption drove much of the range treatments aimed at eradicating sagebrush on both public and private rangelands across the west (Knick et al. 2003; Welch 2005; Welch and Criddle 2003). Rangeland scientists now theorize that much of the sagebrush shrublands of western North America evolved without significant grazing pressure from native ungulates, implying that sagebrush canopy cover in situations undisturbed by heavy grazing was significantly higher than the low percentages (e.g., 10 to 15 percent) suggested by early literature (Knick et al. 2003; Paige and Ritter 1999). Welch (2005) and Welch and Criddle (2003) reviewed early and recent literature and concluded that sagebrush-dependent species occupy sagebrush with a range of canopy cover significantly higher than 10 to 15 percent commonly accepted in the literature (e.g. 20 to 50 percent). This conclusion is difficult to test given that so little of the sagebrush habitat in the intermountain west has gone untouched by the influences of livestock grazing, but it carries important implications for the management of sagebrush habitats for the benefit of sagebrush-dependent species.

About 44 percent of sagebrush habitats are under private land ownership ([Chapter 3](#)). The public perception that sagebrush is a junk plant is still pervasive. One of the biggest challenges to conservation and management of this important ecosystem in Colorado will be to change this mindset.

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Table 2-1. Sagebrush taxa in Colorado with common and scientific name synonymy. ^a

Common Name	Species	Synonymy	
	Scientific Name	Common Name	Scientific Name
Low sagebrush	<i>Artemisia arbuscula</i> subsp. <i>arbuscula</i>	Dwarf sagebrush Little sagebrush	<i>A. tridentata</i> subsp. <i>arbuscula</i> <i>A. tridentata</i> . var. <i>arbuscula</i>
Coaltown sagebrush	<i>A. argilosa</i>	None	None
Bigelow sagebrush	<i>A. bigelovii</i>	Bigelow sage	None
Plains silver sagebrush	<i>A. cana</i> subsp. <i>cana</i>	Silver wormwood	<i>A. columbiensis</i>
Mountain silver sagebrush	<i>A. cana</i> subsp. <i>viscidula</i>	None	<i>A. cana</i> var. <i>viscidula</i> <i>A. viscidula</i>
Sand sagebrush	<i>A. filifolia</i>	Sand sage	<i>A. plattensis</i>
Fringed sagebrush	<i>A. frigida</i>	Fringed sage Prairie sagewort	None
Early sagebrush	<i>A. longiloba</i>	Alkali sagebrush	<i>A. tridentata</i> subsp. <i>arbuscula</i> var. <i>longiloba</i> <i>A. spiciformis</i> var. <i>longiloba</i>
Black sagebrush	<i>A. nova</i>	Black sage	<i>A. tridentata</i> subsp. <i>nova</i> <i>A. arbuscula</i> subsp. <i>nova</i> <i>A. arbuscula</i> var. <i>nova</i>
Tall black sagebrush (tentative)	<i>A. nova</i> (hybrid) Hybrid potentially between black sagebrush and Wyoming big sagebrush	None	None
Birdfoot sagebrush	<i>A. pedatifida</i>	Matted sagewort	<i>Oligosporus pedatifidus</i>
Pygmy sagebrush	<i>A. pygmae</i>	Pygmy sage	<i>Seriphidium pygmaeum</i>
Spiked sagebrush	<i>A. spiciformis</i>	Snowfield sagebrush	<i>A. tridentata</i> . subsp. <i>vaseyana</i> form <i>spiciformis</i> <i>A. tridentata</i> . subsp. <i>spiciformis</i>
Mountain big sagebrush	<i>A. tridentata</i> var. <i>pauciflora</i>	None	<i>A. tridentata</i> subsp. <i>vaseyana</i> <i>A. vaseyana</i>

Table 2-1. Sagebrush taxa in Colorado with common and scientific name synonymy. ^a

Common Name	Species	Common Name	Synonymy
	Scientific Name		Scientific Name
Basin big sagebrush	<i>A. tridentata</i> subsp. <i>tridentata</i>	None	<i>A. angustifolia</i> <i>A. tridentata</i> var. <i>tridentata</i>
Subalpine big sagebrush	<i>A. tridentata</i> var. <i>vaseyana</i>	Vasey's sagebrush	<i>A. vaseyana</i> <i>A. tridentata</i> subsp. <i>vaseyana</i>
Wyoming big sagebrush	<i>A. tridentata</i> subsp. <i>wyomingensis</i>	None	<i>A. tridentata</i> var. <i>wyomingensis</i>
Bonneville big sagebrush (tentative)	<i>A. tridentata</i> (hybrid "B") Hybrid potentially between mountain and Wyoming big sagebrush	None	None
Three-tip sagebrush	<i>A. tripartita</i> subsp. <i>tripartita</i>	None	<i>A. trifida</i> <i>A. tridentata</i> subsp. <i>trifida</i>
Wyoming three-tip sagebrush	<i>A. tripartita</i> subsp. <i>rupicola</i>	None	None
Bud sagebrush	<i>Picrothamnus desertorum</i>	Bud sage Spring sage	<i>A. spinescens</i>

^a Nomenclature from Winward (2004).

Table 2-2. Key ecological characteristics of sagebrush taxa in Colorado. ^a

Species ^b	Distribution	Habitat Characteristics	Wildlife Use/Value	Management Considerations
Basin big sagebrush	Common in western counties touching Utah, but only scattered patches occur in counties touching the western side of the Continental Divide. Not found in North Park, and found only sporadically between North Park and Salida.	Very deep, well-drained, often alluvial soils, where soil moisture is retained through August (occurs in roughly 10 to 14-inch annual precipitation zone). Requires more moisture than Wyoming big sagebrush. Associated grasses and forbs more diverse than on Wyoming big sagebrush sites.	May be less palatable than other <i>Artemisia</i> species, but its tall stature provides valuable hiding and thermal cover for native ungulates and perching and nesting sites for passerine birds. Critical game forage source during severe winters when other foliage is buried under snow.	Low fire tolerance; regenerates from seed only. Generally the tallest shrub in the <i>Artemisia</i> genus.
Bigelow sagebrush	Known from western Delta, Montrose, and San Miguel counties; likely in all counties touching Utah and northwest New Mexico. From 3,280 to 7,800 feet.	In or near rimrock areas, in pinyon-juniper or mixed desert shrub communities; relatively xeric soils.	Moderately palatable and occurs in winter-range situations.	Monitor to measure age-class ratios to provide information on the long-term health of the species. Winward (2004) observed significant die-offs in vast stands west of Delta attributable to drought and heavy browsing.
Birdfoot sagebrush	North-central Colorado. 5,200 to 5,900 feet.	Gentle hills in clay soils.	No information.	No information.
Black sagebrush	Widespread; found in all counties touching Wyoming and Utah, and Delta County. Also in North Park and counties along west side of Continental Divide. 4,000 to 8,500 feet.	Shallow argillic soils or clay pan soils. Tolerates saturated springtime soils and droughty summer-fall periods.	Heavily browsed by ungulates; cover for small mammals and birds.	Restore associated forb and grass species decimated by overgrazing; monitor stands to assure young plants are establishing so that stands affected by drought and heavy browsing will stabilize.

Table 2-2. Key ecological characteristics of sagebrush taxa in Colorado. ^a

Species ^b	Distribution	Habitat Characteristics	Wildlife Use/Value	Management Considerations
Bonneville big sagebrush (tentative)	A few-hundred acre patch of this hybrid is known from near the head of Long Gulch near Gunnison—between Wyoming big sagebrush at its lower limits and mountain big sagebrush at its upper limits. Probably occurs in similar situations in general area. Approximate elevation: 8,000 feet.	Shorelines and bottomlands sediments of ancient lakebeds (e.g., Lake Bonneville).	Considered highly selected by native ungulates and sage-grouse in Nevada.	A weak seed producer. Reseeding could be required in management of some stands.
Bud sagebrush	Remnant small patches in far western counties.	Ecotonal situations between salt desert shrub communities and lower elevation sagebrush species.	Early growth of fresh stems and leaves results in considerable spring browsing by native ungulates and livestock.	Absence of seedlings from many stands suggests extirpation is a risk. Winward (2004) recommends special protection be designated for this species.
Coaltown sagebrush	Known only from North Park in Jackson County. 7,900 to 8,500+ feet.	Intermixed with mountain silver sagebrush, early sagebrush, and greasewood, on poorly drained alkaline soils.	Presumed less palatable than other sagebrush species, but valuable as ground cover and low hiding cover for sage-grouse.	No information.
Early sagebrush	North Park to southern Colorado.	Clayey, often alkaline soils with argillic layer in the first 30 cm. Tolerates saturated springtime soils and droughty summer-fall periods.	Heavy winter browsing is apparent in areas where snow cover is light.	Maintain multi-aged stands; where overgrazing has eliminated young plants, seeding may be a viable option.
Fringed sagebrush	Widespread, up to 11,000 feet.	Variable soil types; poor competitor where associated vegetation can overtop it.	Winter browse and ground cover.	Extensive stands indicate range deterioration.

Table 2-2. Key ecological characteristics of sagebrush taxa in Colorado. ^a

Species ^b	Distribution	Habitat Characteristics	Wildlife Use/Value	Management Considerations
Low sagebrush	Considered rare in Colorado; known from Moffat County (between Craig and Meeker on private lands) and Saguache County (3 to 4 miles south of Poncha Pass).	Occurs on argillic soils on windswept ridge lines within patches of basin big sagebrush or mountain big sagebrush.	Selected as food plant by greater sage-grouse in Oregon and elsewhere.	Gear grazing and browsing management toward maintaining semi-open canopies with diversity of interspersed grasses and forbs.
Mountain big sagebrush	In appropriate settings from 6,800 to 8,500 feet.	Well-drained, mid- to upper elevation side slopes and ridges. Soils range from sandy through silty and clayey and may often be cobbly. Occurs where annual precipitation >14 inches.	Moderately palatable to domestic and native ungulates; canopy structure and productive and diverse understory provide seasonal habitat and spring and summer forage for mammals and birds.	Die-offs in older stands appear to be tied to natural stem and root pathogens. Postpone treatments until die-off has run its course. Thinning project design must consider needs of sagebrush-dependent species.
Mountain silver sagebrush	Primarily west of the Continental Divide, but also in North Park. Found in most Colorado counties, but seldom found in large acreages. Elevations range between 6,000 and 10,000 feet, mostly above 7,500 feet.	Stream edges, meadow edges, snow bank areas; areas with poorly drained soils and suitable summer moisture.	Hiding and forage for birds and small mammals; moderately browsed in winter by ungulates.	Mechanical treatments are precluded generally due to moist soils and ability to rapidly resprout; manage grazing and browsing to maintain species diversity and appropriate understory vegetation.
Plains silver sagebrush	Found primarily east of the Continental Divide with outlier populations in Moffat and Mesa Counties. Usually below 7,000 feet.	Well-drained sandy soils.	Cover and forage for small mammals and birds; although majority of leaves fall from plants before winter season. Not heavily browsed by ungulates.	Rapidly resprouts after fire or mowing.

Table 2-2. Key ecological characteristics of sagebrush taxa in Colorado. ^a

Species ^b	Distribution	Habitat Characteristics	Wildlife Use/Value	Management Considerations
Pygmy sagebrush	Uncommon. Known from west-central Colorado, 5,200 to 7,500 feet.	Shale or gravel soils with high levels of calcium or dolomite. Occurs with salt desert shrubs, black sagebrush, pinyon-juniper, and Ponderosa pine communities.	Rarely browsed.	No information.
Sand sagebrush	Southern counties and prairie counties. 3,300 to 6,500 feet.	Sandy, often wind-drifted soils.	Palatability unknown.	No information.
Spiked sagebrush	In appropriate settings statewide. 9,500 to 11,000+ feet.	High-elevation park-like openings in spruce-fir forests.	Stands are valuable for storing and slowly releasing water for late summer/fall flow; ungulates forage on its tall flower stalks, potentially as a means for acclimatizing rumen flora to winter sagebrush diet at lower elevations.	Maintain high live plant cover and high plant litter cover to ensure water storage function.
Subalpine big sagebrush	From Routt County to North Pass in Saguache County, probably mostly west of the Continental Divide. 8,500 to 10,000 feet.	In conifer and aspen forest openings on slightly moister sites than mountain big sagebrush and slightly drier sites than spiked sagebrush. Occurs where annual precipitation exceeds 14 inches.	Receives very little browsing, probably due to high elevation of habitat where large ungulates are absent during winter. Limited browsing of flower stalks in August and September may be a means for ungulates to acclimatize rumen flora to winter sagebrush diet.	Prolific seed producer and can regenerate by root sprouting (vegetative reproduction). Sound grazing and browsing practices will help keep this community healthy. Where high percentage of bare ground is exposed (due to overgrazing) soil erosion can occur.

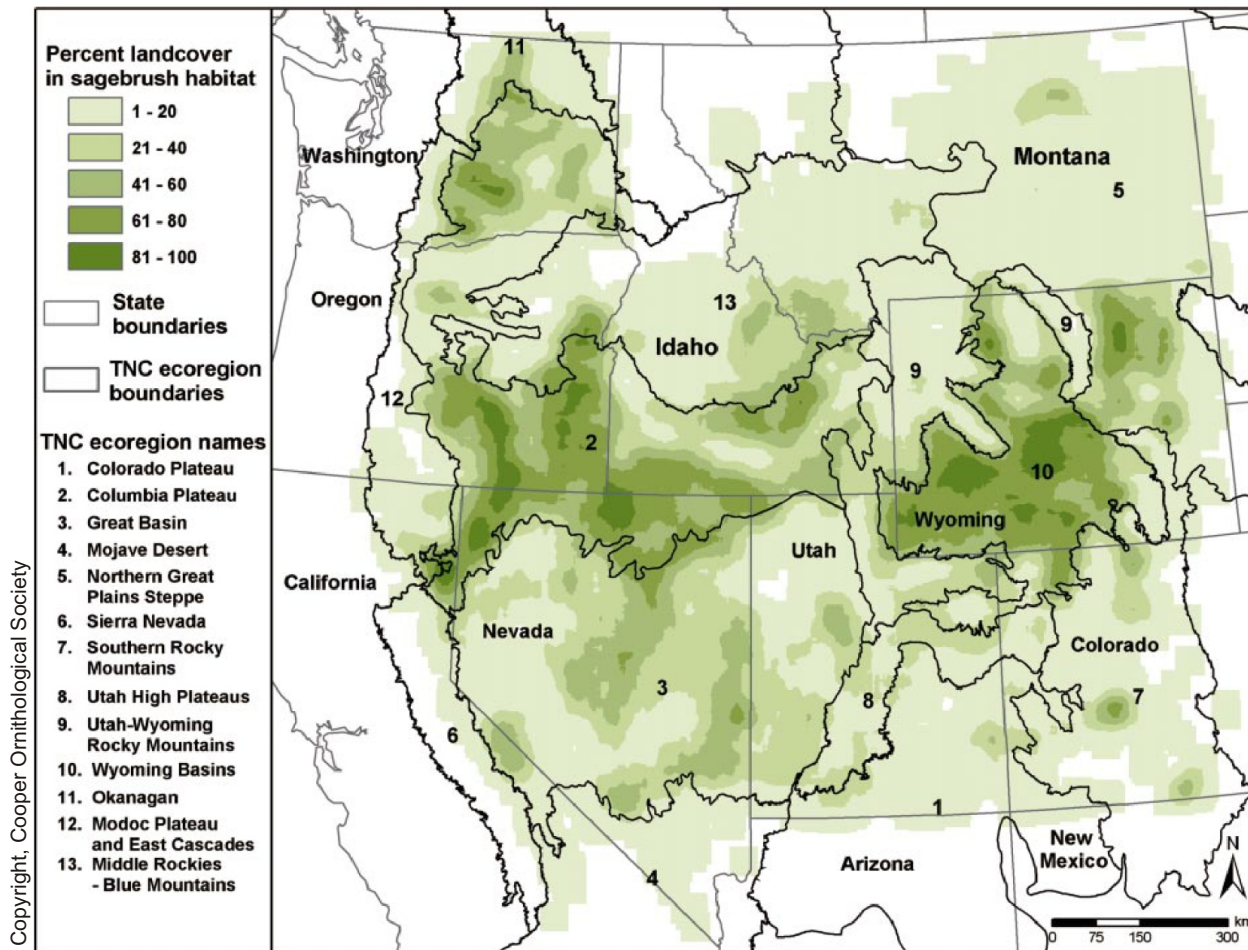
Table 2-2. Key ecological characteristics of sagebrush taxa in Colorado. ^a

Species ^b	Distribution	Habitat Characteristics	Wildlife Use/Value	Management Considerations
Tall black sagebrush (tentative)	A hybrid known from near Cowdrey in North Park to at least Saguache County. 7,500 to 9,000 feet.	Where a blending of black sagebrush-preferred soils (with at least a weak argillic horizon) and Wyoming big sagebrush-preferred soils (well-drained) occur.	Heavily browsed by native ungulates.	Monitor to measure age-class ratios to provide information on the long-term health of the species; Winward (2004) is concerned about significant browsing pressure and drought stress.
Three-tip sagebrush	Reported from northwest Colorado, but not common.	Deep, well-drained soils where climate is intermediate between basin and mountain big sagebrush preferences.	Rarely receives significant browsing, but can provide nesting and hiding cover for birds, including sage-grouse.	Strong resprouting ability makes it resistant to mechanical, chemical, or fire treatments. Increases where heavy grazing has removed herbaceous undergrowth.
Wyoming big sagebrush	Most common in far west Colorado counties where precipitation levels and soil types fit its ecological requirements. Found at elevations as high as 8,000 feet, but more typically below 6,000 feet.	Xeric, often coarse textured, very well-drained soils, where precipitation ranges from 7 to 11 inches annually. Can occur on shallow clay, sometimes silt.	Utilization by native wintering ungulates is high where wintering game populations occur. This sagebrush provides a considerable percentage of winter game habitat in Colorado.	Due to high winter game use and drought, thousands of acres of this sagebrush are in poor condition. Monitoring general health and age-class ratios of this species should be a major emphasis in Colorado.
Wyoming three-tip sagebrush	Known only from east of the Continental Divide; expected in northern Colorado but not yet documented.	Shallow, rocky ridges.	Thought to have low palatability to native ungulates and livestock; could provide severe winter forage.	Readily layers and resprouts and is therefore relatively resistant to range treatments.

^a Compiled from Winward (2004) and Frison & Wambolt (2004). Nomenclature from Winward (2004).

^b See Table 3-1 for scientific names.

Figure 2-1. Overview of sagebrush ecosystem distribution in North America.



Notes: Ecoregions listed in the legend have >1% of their land surface dominated by sagebrush (TNC 2001).

Map reprinted with permission from the Cooper Ornithological Society from Knick, S. T., D. S. Dobkin, J. T. Rotenberry, M. A. Schroeder, W. M. Vander Haegen, and C. Van Riper, III. 2003. Teetering on the edge or too late? Conservation and research issues for avifauna of sagebrush habitats. *Condor* 105:611-634.