

SPECIES ASSESSMENT FOR SAGE SPARROW (*AMPHISPIZA BELLI*) IN WYOMING

prepared by

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Introduction

The Sage Sparrow (*Amphispiza belli*) is a common breeding bird in landscapes dominated by big sagebrush (*Artemisia* spp.) in western North America. The species prefers large, undisturbed tracts of tall and dense sagebrush. Such habitat is declining across large areas, and many sagebrush obligates such as the Sage Sparrow are showing corresponding declines in distribution and abundance. For example, in Washington over half the native shrubsteppe has been converted to agriculture in the last 150 years (Vander Haegen et al. 2000). In this report, shrubsteppe is defined as an environment with a “...co-dominance of sagebrush and native bunch grass and moderate shrub cover” (B. Walker, personal communication). Shrubsteppe habitat is relatively homogenous in vegetation compared to other ecosystems (Kitchen et al. 1999), which can make it more sensitive to disturbance (Rotenberry 1998).

The Sage Sparrow is an inconspicuous bird that is often overlooked because it forages while well-hidden on the ground, and when perched tends to remain motionless. Five subspecies are recognized (American Ornithologists’ Union 1983), with 4 restricted to the Pacific coast and portions of the Southwest and 1 (*Amphispiza belli nevadensis*) occupying the intermountain west, including Wyoming (Martin and Carlson 1998). This report reviews key published literature, focusing on *A. b. nevadensis*, and presents existing information on the distribution, biology, ecological niche, and conservation planning being conducted for the Sage Sparrow on state and rangewide scales.

Natural History

Morphological Description

The Sage Sparrow is a medium-sized sparrow (12.0-15.0 cm long); the sexes are similar in appearance (Figure 1). Head is gray with a distinct white spot in front of the eye, a thin eye-ring, dark and narrow moustache marks, a broad white sub-moustache stripe, a white throat, and black malar stripes at the sides of the throat and above the wing. The gray head contrasts with a brown, streaked back. A dark spot stands out on the center of the whitish chest; flanks are buff with dark streaks. A yellowish patch is present at the bend of the wing near two white wing bars. The tail is blackish brown and square at the end. In contrast to the other subspecies, *A. b. nevadensis* has thin white edges on its outer tail feathers. Juvenile birds have heavy brown streaks on their breasts (Miller 1968, Rising and Beadle 1996, Martin and Carlson 1998, Sibley 2000).

Diagnostic field marks

Distinct markings on the head, dark spot in the center of the breast, and white on edges of the tail (outermost rectrices) are key identification features.

Similar Species

The juvenile Sage Sparrow is similar to the juvenile Black-throated Sparrow (*Amphispiza bilineata*), but the Sage Sparrow lacks a white supercilium and has slightly heavier streaking on its breast (Rising and Beadle 1996). The Lark Sparrow (*Chondestes grammacus*) is somewhat larger, also has a dark breast spot, and large white tail spots.

Vocalization

Very little was known about the Sage Sparrow's song prior to 1970 (Tuckfield 1985). It has been described as weak series of high-pitched tinkling notes lasting 3-4 seconds (Rising and Beadle 1996); a series of short, musical buzzes on different frequencies (Martin and Carlson 1998); and a rather hoarse series of notes on the same pitch with a mechanical quality (Sibley 2000). The songs of the Pacific races are longer, more rapid, and the notes are slurred. Songs are often incomplete (Rich 1983). The call is a bell-like "chink" or "tink," which is used to maintain pair contact. Only the male sings.

Unmated males sing more often than mated males; birds sing throughout the breeding season and sing less frequently after the young fledge (Best and Petersen 1982). Birds sing from or just below the top of tall shrubs in their territories, and rarely sing while foraging. Simple songs of low frequency are favored where shrubs are tall. Tall bushes have a dampening affect on avian acoustics, because they scatter sound more than small ones (Tuckfield 1979); interference from wind has the same effect. As a result, songs of sagebrush species like the Sage Sparrow tend to be rather simple.

Taxonomy and Distribution

Taxonomy

The Sage Sparrow occurs in 2 geographically separate complexes: one on the Pacific coast and portions of the Southwest, and the other extending across the intermountain west (American Ornithologists' Union 1983, Martin and Carlson 1998, Sibley 2000). Rising and Beadle (1996) classified the complexes as separate species: Bell's Sparrow (Pacific) and Sage Sparrow

(Intermountain). They further divided Bell's Sparrow into 3 subspecies, and Sage Sparrow into 2 subspecies.

It is now generally accepted that Sage Sparrows occur as only one species in North America (*A. belli*), with 5 subspecies; 4 subspecies form the Pacific - Southwest complex (*A. b. belli*, *A. b. canescens*, *A. b. cinerea*, *A. b. clementeae*), and only 1 subspecies occupies the intermountain west (*A. b. nevadensis*) (Martin and Carlson 1998). Johnson and Marten (1992), among others (see Martin and Carlson 1998), explored the morphological, genetic, and ecological differences among these groups. *Amphispiza belli nevadensis* is well differentiated from the other subspecies, and does not interbreed with them in areas of range overlap in California. Although species- and subspecies-level taxonomy may undergo further revision, it is likely that *A. b. nevadensis* will retain its current status as a discrete taxon (Martin and Carlson 1998).

This assessment will follow the currently accepted taxonomy of the American Ornithologists' Union: all five groups will be considered one species, the Sage Sparrow (*Amphispiza belli*). Furthermore, this assessment will focus primarily on the intermountain subspecies, *A. b. nevadensis*, which is the only one that occurs in Wyoming and adjacent states.

Distribution and Range

Breeding Range

Amphispiza belli nevadensis breeds from eastern Washington south to central Nevada, and east to north-central New Mexico and eastern Wyoming. The western boundary is generally along the California - Nevada border, with a few areas of overlap with the Pacific subspecies. Utah, southern Idaho, and western Colorado support major breeding centers (Martin and Carlson 1998).

One of the greatest densities of breeding *A. b. nevadensis* is in southwestern Wyoming (Sauer et al. 2003; Figure 2).

Winter Range

The Sage Sparrow winters from southern Nevada and southwestern Utah to most of Arizona and southern New Mexico, east to west Texas and south to southeastern California, Baja California, and central Mexico (Martin and Carlson 1998).

Casual Records

A Sage Sparrow was seen on Brier Island, Nova Scotia in November 1994 (Forsythe 1995).

Historical Records

Urbanization and conversion of lands to agriculture have extirpated local populations in southern California (Martin and Carlson 1998). Fossils of the Sage Sparrow have been found in McKittrick and Rancho La Brea, California (Sibley 1939).

Habitat Requirements

There is a positive correlation between the density of Sage Sparrows and horizontal heterogeneity and density of big sagebrush (Figure 3) (Wiens and Rotenberry 1981). These sparrows prefer large and contiguous areas of tall and dense sagebrush, rather than the seral mosaics and patchy shrublands preferred by other sagebrush obligates such as Sage Grouse (*Centrocercus urophasianus*) and Brewer's Sparrow (*Spizella breweri*). Sage Sparrow occurrence is negatively correlated with the abundance of greasewood (*Sarcobatus vermiculatus*). Sage Sparrows are an "edge-sensitive species" in that they prefer to nest in the interior of sagebrush stands, likely to avoid detrimental edge effects such as brood parasitism (Gates and Gysel 1978, Bolger et al. 1997, Misenhelter and Rotenberry 2000).

Breeding

The Sage Sparrow breeds across a wide elevation range, with a strong affinity for large stands of tall and dense sagebrush (Miller 1968). Throughout the intermountain west *A. b. nevadensis* breeds in shrubsteppe dominated by big sagebrush and bunchgrass, or sagebrush-saltbush with lesser amounts of other shrubs (Figure 3).

Sage Sparrow distribution and abundance in Wyoming generally reflects this vegetation association; both sagebrush and Sage Sparrows are rather abundant and widespread in the state. Sagebrush constitutes 9,568,981 ha (38%) of the total area of Wyoming (Knick et al. 2003; Figure 4). Sage Sparrow occurrence is positively correlated with the presence of big sagebrush, amount of shrub cover, amount of bare ground, and shrub height; it is negatively correlated with grass cover (Rotenberry and Wiens 1980, Wiens and Rotenberry 1981). The Pacific subspecies are associated with chaparral and saltbush (*Atriplex* spp.) as well as sagebrush (Martin and Carlson 1998).

Sage Sparrows prefer to nest in tall, live shrubs in the densest stands within a breeding territory (Rich 1980a). Where sagebrush is sparse and patchy nests are deliberately and preferentially placed in the largest sagebrush stands available.

Migration

Although migrating Sage Sparrows may retain some preference for shrub-dominated habitats in general, and sagebrush habitats in particular, like most passerines they become more general in habitat use during this period (Rich 1980b).

Winter

Conditions in wintering areas may play a primary role in population regulation of this and other migratory species (Fretwell 1972). In winter the Sage Sparrow is found in arid, open plains with sparse brush, mesquite, and riparian habitat; they prefer to feed near woody cover (Meents et al. 1982, Repasky and Schluter 1994, Martin and Carlson 1998). Flocks in the Mojave Desert are associated with riparian areas (Eichinger and Moriarty 1985). Wintering birds in honey mesquite (*Prosopis glandulosa*) of the lower Colorado River select areas that have higher inkweed (*Suaeda torreyana*) density, but the reason for this preference is unclear (Meents et al. 1982). Some Sage Sparrows winter in the Sonoran desert of southern California where the ground is hard packed and sparsely vegetated (Repasky 1996).

Area Requirements

Shrub stands must be at least 30 acres in size to attract Sage Sparrows (Knick and Rotenberry 1995). Breeding pairs require at least 2 ha per territory (Vander Haegen et al. 2000). Larger territories are favored in Nevada, Oregon, and Washington. Territory size varies more strongly for Sage Sparrows than for Brewer's Sparrows, and is related to body mass of individuals, mating status, habitat quality, and defensibility. Territory size was also positively correlated with densities of spinescent shrub species, such as saltbush, and was smaller in areas with more grass and sagebrush. Once an area is saturated with Sage Sparrows territory sizes remain constant, indicating a minimum threshold of territory size (Wiens et al. 1985).

Landscape Pattern

Based on current literature breeding Sage Sparrows generally occupy dry interior basins dominated by big sagebrush, with a significant proportion of that sagebrush occurring in large and dense stands with rather tall shrubs. Sage Sparrows often occur in areas with rather hard, clay-

derived soils. Unlike the Brewer's Sparrow, Sage Sparrows tolerate relatively high levels of livestock grazing before abandoning a site. It appears that the stand-level characteristics of amount, density, and height of shrub cover are more important than landscape patterns in determining site selection by breeding Sage Sparrows (Vander Haegen et al. 2000).

Movement and Activity Patterns

Dispersal

Little is known about post-natal dispersal. Sage Sparrows congregate in mixed flocks after breeding; fledglings assemble in loose flocks as early as July. Wintering flocks of 3-10 juvenile *A. b. nevadensis* have been documented (Miller 1968).

Migration

Migrating Sage Sparrows are apparently not restricted to sagebrush environments; they will cross a variety of open habitats (Rich 1980b). They migrate in flocks and usually return in pairs (unusual for a migrating passerine) to Colorado in mid-April (Andrews and Righter 1992), Washington in late February to mid-March (Jewett et al. 1953), eastern Oregon in March, and Utah from mid-March to early April (Miller 1968). Nest sites at higher elevations are not occupied until late April or early May.

Daily Activity

The Sage Sparrow is inconspicuous and difficult to observe in the field, mostly due to its habit of running along the ground and foraging under shrubs in dense stands. All Sage Sparrow subspecies are ground dwellers, and perch in the top of shrubs only to sing. An eight-year study in Oregon suggested the following daily activity budget: 51% singing, 35% foraging, 12% inactive, 4% moving, and 3% aggressive behavior (Wiens et al. 1986, 1987).

Reproduction and Survivorship

Breeding Behavior

Due a lack of sexual dimorphism it is difficult to observe all aspects of breeding behavior. Sage Sparrows are monogamous; *A. b. nevadensis* arrives on breeding territories already paired, an unusual behavior among passerines (Rich 1980b). Both males and females appear to select the nest site. The female constructs the nest while the male sings from a nearby perch. Nests may be placed quite near (<5m) those of other passerines. Nests are usually 3 – 40” above the ground, typically near the center of a large, live shrub with a large canopy that provides maximum cover (Miller 1968, Green 1981). Nest placement appears to be related to the density of vegetative cover over the nest; nests are higher in tall shrubs (Rich 1980a). Birds occasionally nest on the ground under a shrub. According to Winter and Best (1985) Sage Sparrows nest on the ground only after “devastation” of shrubs. Sage Sparrows avoid building nests on the south side of shrubs, presumably to avoid overheating in the afternoon sun (Petersen and Best 1985).

Males defend territories by walking boundary lines and occasionally flying to the edge of a neighbor’s territory and engaging in head-bobbing displays (Rich 1983).

Breeding Phenology

Singing territorial males have been observed in late March near Bonneville, Utah (Martin and Carlson 1998), and males have been heard singing by April 1 in east-central Nevada (Medin 1992). The more sedentary subspecies in California start to sing in January or February.

Nests with eggs have been observed from early April to mid-June; the female lays three to four eggs, rarely five. Incubation lasts 10-16 days, and the female tends the clutch with only occasional help from the male. Young remain in the nest for about 10 days before fledging.

Adults may continue to feed fledglings for 2 weeks after leaving the nest (Martin and Carlson 1998).

Fecundity and Survivorship

Sage sparrows typically live for 2-3 years, although one six-year-old individual has been documented (Wiens 1985). Individuals breed at one year old. Most *A. b. nevadensis* raise two broods per year; some raise three. Severe weather during the breeding season lowers reproductive rates. Also, fewer fledglings survive when daytime temperatures are unusually high (Martin and Carlson 1998). Larger territories tend to produce more fledglings. This may be related to a larger food base (Tuckfield 1979) and more potential nest sites (important for a species that produces multiple broods).

There are very few data on lifetime reproductive success or survivorship in Sage Sparrow populations. In general, survivorship is highly variable from year to year and is most affected by predation and weather. Loggerhead Shrikes (*Lanius ludovicianus*) can be devastating nest predators (Reynolds 1981). Nest parasitism by Brown-headed Cowbirds (*Molothrus ater*) is an important impact in some areas.

Population Demographics

Limiting Factors

Processes regulating Sage Sparrow populations are largely unknown. It is reasonable to assume that predation is a major impact; Rotenberry and Wiens (1989) describe nest predation as a major influence on all birds nesting in shrubsteppe habitat.

It is also reasonable to assume that reproductive success is at least generally correlated with climatic variation. Severe spring weather can directly kill nestlings, fledglings, and adults, and fledglings are known to be sensitive to high summer temperatures (Martin and Carlson 1998). Furthermore, cold weather during the breeding season may severely reduce availability of insect prey. As detailed below, Sage Sparrows are insectivorous during the breeding season when hatchlings and fledglings depend strongly on insect protein for growth and development. Unusually cold weather could reduce survival of young by reducing or delaying insect production in sagebrush systems. This could be a major constraint on populations of many other sagebrush obligates such as Sage Grouse, Sage Thrasher (*Oreoscoptes montanus*), and Brewer's Sparrows, and requires more research. Very little is known about insect ecology in the sagebrush of western North America.

Metapopulation Dynamics

Sage Sparrows may develop formal metapopulations in areas of especially fragmented habitat (Misenhelter and Rotenberry 2000), but in most situations their populations are better described as simply patchy or discontinuous. Sagebrush-dominated habitats are still well-distributed throughout the breeding range, and Sage Sparrows are mobile enough to suggest that major breeding centers are linked through occasional, if not regular, exchange of individuals.

Genetic Concerns

Current knowledge does not suggest that *A. b. nevadensis* is subdivided into genetically distinct populations, or is threatened by inbreeding or significant genetic homogeneity, in the western U.S. Populations of some of the Pacific subspecies, where habitat is more fragmented, may be at higher risk of the deleterious genetic effects associated with small and isolated

populations. Hybridization between *A. b. nevadensis* and the Pacific complex of subspecies is thought to be very rare.

Food Habits

Food Items

Primary food items include insects, spiders, seeds, small fruits, and succulent vegetation (Martin and Carlson 1998). Nestlings are fed a wide variety of arthropods (Petersen and Best 1986). Sage Sparrows are more insectivorous than most other sparrows. It is generally assumed that food is not limiting in shrubsteppe habitat, but the availability of important insect prey during the nestling and fledgling stages has not been well-studied and may be an important constraint on population growth. As with many birds inhabiting semiarid climates, water is primarily acquired from vegetation and insect prey.

Foraging Strategy

The Sage Sparrow feeds on the ground, eating insects from under the edges of shrubs and searching for miscellaneous seeds and other items. Birds hop or walk on the ground, running across open areas between shrubs with their tails held vertically. Tails are frequently jerked upward while perched in a shrub or standing on the ground.

Rotenberry (1980) studied the Western Meadowlark (*Sturnella neglecta*), Horned Lark (*Eremophila alpestris*), and Sage Sparrow in eastern Washington to assess interspecific competition for food. All fed extensively on the ground between bunchgrass clumps and sagebrush, and their territories broadly overlapped. Their diets consisted of at least 70% arthropods during the breeding season, but Sage Sparrows ate more grasshoppers in August. Prey

size was related to bill and body size: Sage Sparrows and Horned Larks took similar-sized arthropods, whereas Western Meadowlarks ate slightly larger prey.

Foraging Variation

Sage Sparrows feed on a wide variety of invertebrates and plants, and therefore are unlikely to be affected by variations in the availability of specific food items. It is assumed that the composition of the diet broadly reflects the local availability of food types. Winter diets appear to be more plant-based than the insect-rich diet in the breeding season (Rotenberry 1980, DeGraaf et al. 1985, Polis 1991, Martin and Carlson 1998).

Community Ecology

Predation

Adult Sage Sparrows chip loudly when predators approach the nest, and females will feign injury to distract predators (J. Rotenberry, personal observation, cited in Martin and Carlson 1998). Predation, especially of nestlings and nest-tending adults, is likely rather heavy. A southern California study documented 80-90% of unsuccessful nests being lost to predation (Misenhelter and Rotenberry 2000). Predators include ground squirrels (Rotenberry and Wiens 1989), Common Ravens (*Corvus corax*), Loggerhead Shrikes (Reynolds 1979, 1981), Merlins (*Falco columbarious*), and Great Horned Owls (*Bubo virginianus*) (Bond 1940). The Greater Roadrunner (*Geococcyx californianus*) may prey on nests of the Pacific subspecies.

When a nest is victimized by predation, the pair will quickly build another. Predation is higher in areas where nests are more closely spaced, which may cause some pairs to preferentially defend larger territories (Petersen 1986).

Competition

Interspecific competition is generally thought to be minimal, but it may become important under certain situations. Sage and Brewer's Sparrows nest in similar niches and occupy overlapping territories, but almost never interact (Wiens 1985). Brewer's Sparrows spend more time in shrubs; Sage Sparrows, on the ground. Reynolds (1981) suggested that Sage Sparrows can suppress numbers of Brewer's Sparrows. Densities of Sage Sparrows vary inversely with those of Black-throated Sparrows in the southwest, suggesting possible interspecific competition. The extent to which invertebrates are competed for during the spring and early summer (when invertebrate use by many sagebrush obligate vertebrates is high) is an area of potentially valuable research.

Parasites and Disease

Sage Sparrow nests are parasitized by the Brown-headed Cowbird throughout breeding range (Rich 1978, Reynolds 1981). Some nests are abandoned, but Sage Sparrows attempt to rear cowbird fledglings in others. Influx of cowbirds is positively correlated with human disturbance, such as removal of sagebrush to increase acreage for livestock grazing.

Sage Sparrows are occasionally affected by body parasites such as chewing lice (Mallophaga), mites, botflies (Oestridae), flesh flies (Sarcophagidae), and fly larvae. Avian pox has rarely been found on the feet of Sage Sparrows (Martin and Carlson 1998).

In Nevada a Sage Sparrow parasitized a Black-throated Sparrow nest (Moldenhauer and Wiens 1970).

Symbiotic and mutualistic interactions

No significant symbiotic or mutualistic interactions are known for Sage Sparrows.

Conservation

Conservation Status

The Sage Sparrow *A. b. nevadensis* is not on any official state or federal endangered species list in the U.S. (*A. b. clementae* is listed as Threatened by the state of California). Sage Sparrows receive some protection via the Migratory Bird Treaty Act (1918) in the U.S., Migratory Bird Conservation Act (1916) in Canada, and the Convention for the Protection of Migratory Birds and Game Mammals (1936) in Mexico.

Despite the fact that it is currently rather abundant and widespread, several factors suggest that the Sage Sparrow is quickly becoming a species of major conservation concern throughout its range. North American Breeding Bird Survey (BBS) data suggest rangewide declines in distribution and abundance, there is solid evidence of widespread reduction in the amount and quality of breeding habitat, and indications of deleterious processes occurring on winter ranges (Knick and Rotenberry 1995, Sauer et al. 2003). This is supported by the clearly increasing concern over other sagebrush obligates (e.g., Sage Grouse, Sage Thrasher, Brewer's Sparrow, pygmy rabbit [*Brachylagus idahoensis*]) whose ranges overlap that of the Sage Sparrow. Conservation of Sage Sparrows may be very cost effective now, when populations are still relatively healthy, rather than waiting until large declines in abundance and distribution force more costly "crisis" management actions.

USDI Fish and Wildlife Service

The USDI Fish and Wildlife Service (USFWS) confers no special status to *A. b. nevadensis* at this time, although it considers the taxon "of conservation concern" in USFWS Region 2

(Oklahoma, New Mexico, Texas, and Arizona; USDI Fish and Wildlife Service 2002).

Amphispiza belli belli receives similar USFWS concern in California.

USDI Bureau of Land Management

The Sage Sparrow is listed by the Wyoming State Office of the USDI Bureau of Land Management as a Sensitive Species.

USDA Forest Service

The Rocky Mountain Region (Region 2) of the USDA Forest Service (USFS), which includes USFS units in most of Wyoming, considers the Sage Sparrow a “Sensitive Species”. At this time the USFS Intermountain Region (Region 4), which includes USFS units in southwest Wyoming, confers no special status to the species (see

http://www.fs.fed.us/biology/resources/pubs/tes/fs_ss_2sept04.pdf).

State Wildlife Agencies

The Wyoming Game and Fish Department confers no special status to the Sage Sparrow at this time.

State Natural Heritage Program

The Wyoming Natural Diversity Database (WYNDD; University of Wyoming) ranks the Sage Sparrow as **G5 / S3** with a Wyoming Contribution Rank of **High**. The “G5” indicates that the full species *A. belli* is demonstrably secure at the continental scale; “S3” indicates a moderate level of security at the state scale. The Wyoming Contribution Rank indicates that because Wyoming forms a large part of the core of Sage Sparrow breeding range Wyoming populations contribute highly to the persistence of the species as a whole in North America (Keinath et al. 2003).

Other

The Sage Sparrow is on the Red List of threatened animals of the world (International Union for the Conservation of Nature and Natural Resources). It is also a Partners in Flight priority avian species for conservation, and a Nature Conservancy “species of concern” (USDI Fish and Wildlife Service 2004).

Biological Conservation Issues

Abundance

The Sage Sparrow is currently relatively widespread and abundant in appropriate habitat throughout its breeding range, but BBS data suggest that it may be in the initial stages of a rangewide decline (Knick and Rotenberry 2002, Sauer et al. 2003). The highest densities of breeding Sage Sparrows appear to be in Idaho, west-central Nevada, northeastern Utah, and southwestern Wyoming (Sauer et al. 2003; Figure 2).

Trends

Abundance Trends

At one time *A. b. nevadensis* was probably one of the most common birds in the intermountain west. It is now generally accepted as less abundant than historically. BBS data suggest that the Sage Sparrow has declined 1.0 - 2.3% from 1966 to 1991 throughout its breeding range (Sauer et al. 2003), but the numbers are not statistically significant (Knick and Rotenberry 2002). Populations in Arizona, Idaho, and Washington have seen the largest declines; however, in many areas, too few BBS transects sample Sage Sparrow habitat to adequately assess population trends.

The long-term decline of Sage Sparrows essentially mirrors the long-term decline in abundance and quality of sagebrush habitat in western North America. The Sage Sparrow is still

locally common in sagebrush habitat throughout Wyoming and is easily found in most portions of the state.

Extent and Connectivity Trends

Sage Sparrow populations generally follow the distribution of big sagebrush in western North America. Although still relatively widespread, over the past 100 years such habitat has been reduced, fragmented, and degraded in many areas (see Extrinsic Threats). As large areas of contiguous sagebrush become fragmented it is reasonable to assume that populations of *A. b. nevadensis* are becoming similarly fragmented (Braun et al. 1976, Rotenberry and Wiens 1980) and subjected to a host of deleterious processes such as increased nest predation, nest parasitism, and reduced pairing success (Vander Haegen et al. 2000, Knick and Rotenberry 2002).

The overall geographic range (as defined as the area encompassed by the outermost points of regular occurrence) of the subspecies has not changed appreciably, but local extirpations are known from many areas of especially intense sagebrush alteration (e.g., exotic grassland invasions, urban centers, surface mines, intense wildfire). Sage Sparrows have essentially disappeared from many areas where sagebrush systems have been converted to cultivated agriculture (i.e., eastern Washington, eastern Oregon, southern Idaho).

It is assumed that Sage Sparrow distribution in Wyoming is close to historic levels, with only localized extirpations in major urban centers, surface mines, and other highly disturbed sites.

Habitat Trends

As mentioned above and discussed in more detail under Extrinsic Threats, sagebrush-dominated landscapes in western North America have undergone a general trend of reduction, fragmentation, and degradation over the past 100 years which has led to corresponding declines

in the distribution and abundance of Sage Sparrows. Processes responsible for this trend, especially surface disturbances that lead to cheatgrass (*Bromus tectorum*) invasion, are not expected to abate substantially in the near future. This holds on a rangewide scale as well as for the state of Wyoming.

Range Context

Wyoming forms a large part of the core of *A. b. nevadensis* range, with the southwestern corner of the state (Green River and Bear River basins) supporting especially high numbers of the species (Sauer et al. 2003; Figure 2).

Extrinsic Threats and Reasons for Decline

Anthropogenic Impacts

The primary threat to Sage Sparrows is from anthropogenic activities that alter, both deliberately and inadvertently, the structure and composition of sagebrush-dominated ecosystems in western North America. In many areas human actions have replaced sagebrush systems with other land cover types, fragmenting both native sagebrush habitat and dependent populations of Sage Sparrows and other taxa of concern (Braun et al. 1976, Rotenberry and Wiens 1980, Reynolds 1981).

In portions of Washington, Idaho, Oregon, and the western Great Plains much former sagebrush is now under cultivation (e.g., Dobler 1994). In the mid-1970's 10% of native sagebrush in the U.S. was converted to agriculture (Braun et al. 1976). Since that time the rate of disappearance has accelerated (Knick and Rotenberry 1995). Cultivation is not a major concern in Wyoming basins, affecting only a small amount of range in the state. Similarly, in some states

urbanization has eliminated significant areas of former sagebrush, but this has not occurred to any large degree in Wyoming.

Several techniques have been used across North America to convert sagebrush into grassland for agricultural purposes. Discing, chaining, and herbicides have been employed to this end. Some Wyoming sagebrush range has undergone these treatments, probably to the detriment of Sage Sparrows and other sagebrush obligates. The effects of discing and chaining probably depend on exactly how these operations are carried out; specifically, the size of sagebrush patches treated.

Pesticide and herbicide application have the potential to affect Sage Sparrows via reduction in important food items, but more research into this issue is needed. Herbicide application in Oregon reduced the density of Brewer's Sparrow but not Sage Sparrows, possibly because Sage Sparrows have stronger fidelity to breeding territories (Wiens 1985). Schroeder and Sturges (1975) and Best (1979) demonstrated a lag effect following herbicidal spray of shrubsteppe habitats, such that Sage Sparrow populations did not decline until several years after spraying.

Resource managers often re-seed areas of disturbed sagebrush with exotic grasses, commonly crested wheatgrass (*Agropyron cristatum*), which degrades habitat quality for Sage Sparrows. Regions of southeastern Idaho which had been totally converted from sagebrush to crested wheatgrass showed significantly reduced bird species richness (Bradford et al. 1998). Sage Sparrows are rare or absent on reclaimed strip mines planted to crested wheatgrass (Krementz and Sauer 1982).

Moderate levels of livestock grazing typically impact birds only slightly. West of the Rocky Mountains, in the Great Basin and interior Columbia Basin, there is concern that livestock grazing

can damage soil, specifically the delicate cryptogamic layer, to the extent that vegetative succession is altered and recovery is hampered (Saab et al. 1995). This is not of as much concern in the sagebrush basins of Wyoming where, in contrast to more western regions, vegetation evolved with the influence of large grazing mammals. Bock et al. (1993) concluded that the Sage Sparrows respond positively to grazing, because they prefer sparse understory vegetation in stands of sagebrush.

Probably the largest threat to sagebrush ecosystems in western North America, and by extension to Sage Sparrows and other sagebrush obligates, is the complex interaction between invasion by the Asian annual cheatgrass and alteration of native fire regimes. Cheatgrass is steadily invading sagebrush-dominated basins from west-to-east, having already saturated many portions of the Great Basin and replacing native sagebrush steppe with an exotic grassland. Cheatgrass can apparently colonize sites that are disturbed by almost any process, including wildfire, road building, off-road motorized use, heavy livestock grazing, chaining or discing, and surface mining.

Once stands of the highly-flammable cheatgrass become established in an area, the probability of fire increases. Fire reduces sagebrush coverage and reproduction, but encourages cheatgrass spread, thus beginning a conversion cycle that is difficult to stop (Young et al. 1979, Knick and Rotenberry 1995, 2000, 2002). In southeastern Idaho from 1950 to 1979, the cheatgrass/ fire cycle reduced shrubsteppe from 51% to 30% of the total area, and also reduced intervals between wildfires from 80.5 to 27.5 years (U.S. Department of the Interior 1996). Large areas of Nevada and Utah have also been affected, with an almost complete replacement of native shrubs in some areas. The relationship of this process to Sage Sparrows is clear: Sage Sparrow populations decline as fire frequencies increase and favor grasses, especially alien grasses, over sagebrush and

other native shrubs (Rotenberry and Wiens 1978, Wright and Bailey 1982, Brandt and Rickard 1994, Welch 2002). Patchy burns that result in relatively fine-grained mosaics of native shrubs interspersed with patches of grass have little effect on Sage Sparrows (Petersen and Best 1985, Petersen 1986), but such burns are unlikely under high fuel loads, especially when cheatgrass is prevalent.

Cheatgrass is present throughout Wyoming and is generally considered to be increasing in both distribution and abundance in the state. It has not yet established to the point where it dominates large areas, and there is speculation that much of Wyoming may have too short of a growing season and receive too much summer moisture to allow cheatgrass to dominate as it has in portions of the Great Basin. However, cheatgrass is an annual that can evolve very quickly to novel environments, and human disturbance of vegetation and soil are pervasive enough in Wyoming to greatly assist cheatgrass increase and colonization. Wildfires and prescribed burns occur regularly, off-road motorized use appears to be increasing, and road development continues in rather unabated fashion throughout much of the state, especially as a function of increased petroleum exploration and development.

Stochastic Factors (e.g., weather events)

The effects of weather on Sage Sparrows are not well understood, but there is probably a straightforward relationship between precipitation, temperature, and Sage Sparrow reproductive success that may be mediated through food productivity. High winter and spring precipitation can lead to higher grass and forb productivity, which in turn leads to higher invertebrate production and, finally, increased Sage Sparrow clutch size and survival. In contrast, cold snaps late in the spring may reduce and delay the production of plant and animal food sources and, depending on

timing and duration, reduce Sage Sparrow nesting success. Fledglings can be killed by unusually high daytime temperatures (Martin and Carlson 1998).

Natural Predation

In general, nest predation is regarded as a threat to most passerines nesting in shrub habitats (Rotenberry and Wiens 1989).

Protected Areas

Most shrubsteppe habitat in Wyoming does not receive any special protection (Knick et al. 2003) from the threats discussed above. Local exceptions would include scattered BLM Areas of Critical Environmental Concern, National Wildlife Refuges (e.g., Seedskaadee NWR), and small USDI National Park Service units (e.g., Fossil Butte National Monument, Devils Tower National Monument).

Intrinsic Vulnerability

Habitat Specificity and Fidelity

Sage Sparrows have a strong tendency to return to the same breeding and wintering sites year after year. One banded male *A. b. nevadensis* in Oregon returned to within 150m of the same breeding area for six years in a row. In another study 55% of 46 males, and 25% of 82 females, returned to previous breeding sites. Local territory shifts are common, usually involving retention of at least some portion of the old territory. Territory shifting within a seemingly homogeneous sagebrush community may be related to fine-grained patterns of food availability (Petersen and Best 1987).

Territoriality and Area Requirements

Sage Sparrows have the largest area requirements of any sparrow (Rich 1980b). Territories for *A. b. nevadensis* range from 0.1 ha in South Dakota (Green 1981) to 5.3 ha in Nevada and Oregon (Wiens and Rotenberry 1985). Sage Sparrows probably have enough mobility to discover and occupy relatively isolated patches of suitable habitat.

Susceptibility to Disease

There is no information to suggest that disease is a significant impact to Sage Sparrows.

Dispersal Capability

Sage Sparrows are long distance migrators, and as such are quite mobile.

Reproductive Capacity

There are few data on Sage Sparrow reproductive output. Double-clutching is common, with triple-clutching known under especially favorable conditions (Martin and Carlson 1998).

Sensitivity to Disturbance

Sage Sparrows can tolerate a variety of environmental disturbances as long as sagebrush coverage is not substantially reduced. Disturbances that completely remove shrubs (e.g., cultivation, urbanization, surface mining, intense fire) and increase the likelihood of cheatgrass establishment are especially detrimental

Genetic Factors

No current information suggests that genetic factors are reducing the persistence of *A. b. nevadensis* populations. Because of more intense habitat fragmentation along the Pacific coast, some of the more western subspecies may be experiencing increased inbreeding and other detrimental genetic processes.

Population Viability Analyses (PVAs)

At this time there are no formal population viability analyses for Sage Sparrows in the literature.

Conservation Action

Beyond those management actions aimed at conserving native sagebrush habitats in general, there are no conservation actions specifically directed towards Sage Sparrows.

Existing or Future Conservation Plans

Sage Sparrows receive some general protection via the U.S. Migratory Bird Treaty Act (1918), Canadian Migratory Bird Conservation Act (1916), and the Mexican Convention for the Protection of Migratory Birds and Game Mammals (1936). It is assumed that most state wildlife agencies also prohibit the take and collection of native songbirds like Sage Sparrows. In Wyoming the designation of Sage Sparrows as Sensitive Species by the BLM - Wyoming State Office and USFS - Region 2 provides some additional protection, as such designation requires these agencies to formally consider the effect of management actions on the health and persistence of Brewer's Sparrow populations.

Beyond the instruments outlined above there are no conservation or management plans specifically targeting Sage Sparrows. Currently there is much interest in the proper management of sagebrush in western North America, due in part to concern over downward trends in sagebrush obligates such as pygmy rabbit, Sage Grouse, Sage Thrasher, Brewer's Sparrow, and Sage Sparrow, as well as big game species that depend on sagebrush for winter and year-round habitat. Many agencies, including the Wyoming Game and Fish Department, anticipate the opportunity to formulate and implement management plans for sagebrush ecosystems as a whole, rather than

relying on the traditional single-species management approach (R. Rothwell, personal communication). Current knowledge of Sage Sparrow ecology suggests that such plans need to center on (1) maintaining large areas of tall and dense sagebrush, (2) the effects of fire on sagebrush regeneration, especially in the context of the complicating and potentially devastating effects of cheatgrass and the processes that encourage cheatgrass invasion, and (3) the critical role played by insects in providing a forage base, especially during the nestling stage.

Conservation Elements

Inventory and Monitoring

Existing bird-monitoring programs such as BBS and the Christmas Bird Count (not applicable to Sage Sparrows in Wyoming) may not adequately sample species' abundances and trends in sagebrush habitats (Knick et al. 2003). The BBS survey routes generally follow roads, and thus BBS data may be biased towards particular species. Also, only 27 of 117 total Wyoming BBS routes include sagebrush habitat, resulting in only 6,871 ha (3% of the statewide total) of sagebrush being sampled (Knick et al. 2003). Nevertheless, BBS data streams represent the best available information from which to derive regional and rangewide trend estimates, and this sampling should continue.

In 2003 the Rocky Mountain Bird Observatory (RMBO) began a systematic survey of breeding birds throughout Wyoming, with sampling transects stratified by habitat type. Similar sampling is being pursued by RMBO in adjacent states, and has the potential to produce powerful data on abundance, distribution, and trends of Sage Sparrows and many other species. However, probably at least 3 more years of sampling will be needed before reliable estimates can be made. The large scale, multi-species sampling approach taken by RMBO appears to have great potential

for informing conservation and management of many native birds, and should be considered an example to follow for field inventory of other taxa.

Habitat Preservation and Restoration

As discussed above there are no habitat preservation or management plans specifically targeting Sage Sparrows at this time, but there is much interest in the management of sagebrush systems in western North America in general. The Wyoming Game and Fish Department anticipates formulating and implementing a holistic sagebrush ecosystem management plan in the next few years (R. Rothwell, personal communication).

Captive Propagation and Reintroduction

There are no captive propagation or reintroduction efforts for Sage Sparrows at this time, nor are such crisis efforts anticipated to be necessary in the near future.

Information Needs

Rangewide

Studies of invertebrate production in sagebrush-dominated landscapes, especially during the nesting and fledging periods, could identify very important relationships between Sage Sparrow reproductive fitness and food availability, vegetation, and climate. Such research will have important implications for many other sagebrush obligate birds.

Fretwell (1972) suggested that Sage Sparrow populations may be limited by processes occurring on winter range; clearly, this issue needs to be explored further. If population persistence is determined mostly by winter dynamics, managers may want to allocate most resources to countering those effects.

Nest predation has been identified as an important limit on populations of many shrubsteppe passerines (Rotenberry and Wiens 1989). The extent to which this affects Sage Sparrows, and the habitat conditions that encourage/ discourage such predation, should be researched in the field.

Continued research into cheatgrass ecology and the dynamics of the cheatgrass/ fire cycle will provide information important to habitat conservation and restoration efforts.

Although large patches of tall and dense sagebrush are generally identified as good habitat for Sage Sparrows, the quantitative parameters (e.g., stand size, stand shape, thresholds of height and density) of suitable stands are not well-known and are required by habitat managers in order to effectively manage for this species.

Wyoming

All research priorities identified above are pertinent to and important for management of Sage Sparrows in Wyoming. Despite the current situation of relatively low cheatgrass prevalence in Wyoming, research into its ecology and management here is still rather important. It is generally accepted that cheatgrass will increase in distribution and abundance in the state, and climatic and biogeographic differences may reduce the applicability of research results from the Great Basin and Interior Columbia Basin to Wyoming.

Figures

Figure 1. Painting of the Sage Sparrow (*Amphispiza belli*) by R. M. Mengel (Bailey and Niedrach 1965, plate 119). Reprinted here with permission.

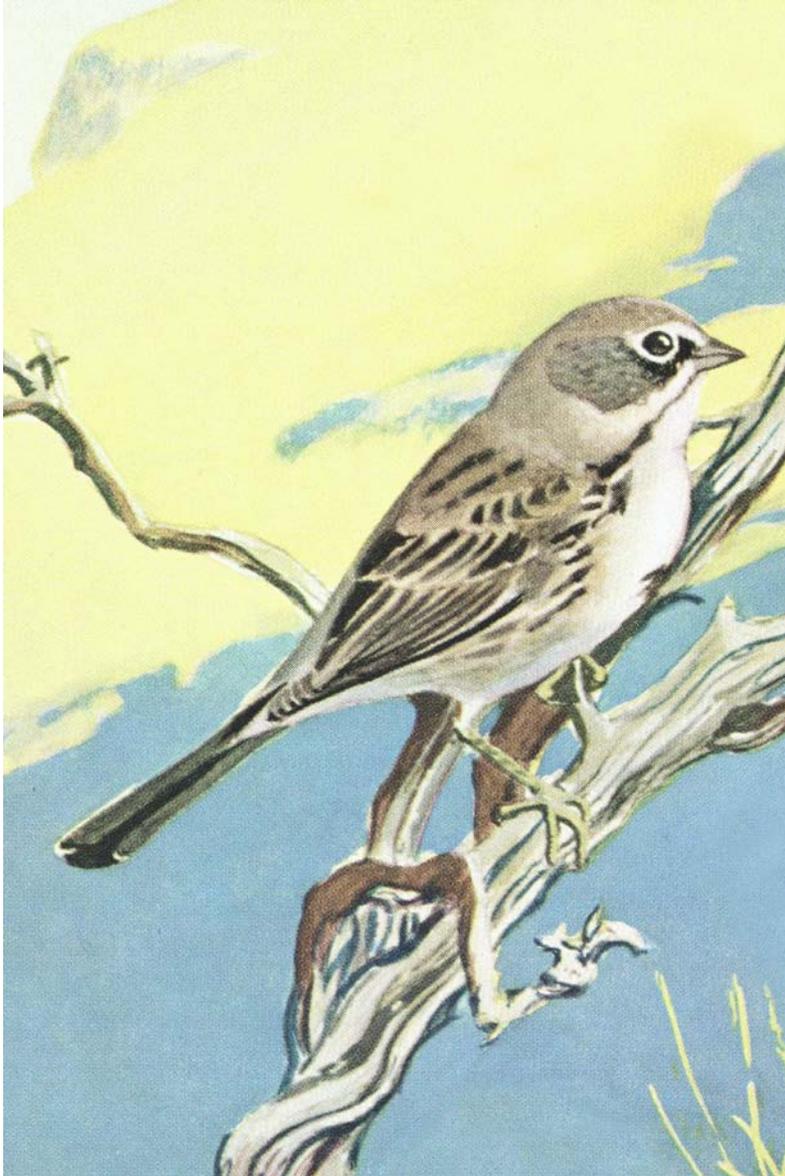


Figure 2. Breeding distribution of the Sage Sparrow as delineated by North American Breeding Bird Survey data. Darkest red indicates highest breeding densities, as summarized from 30 years of BBS data (Sauer et al. 2003).

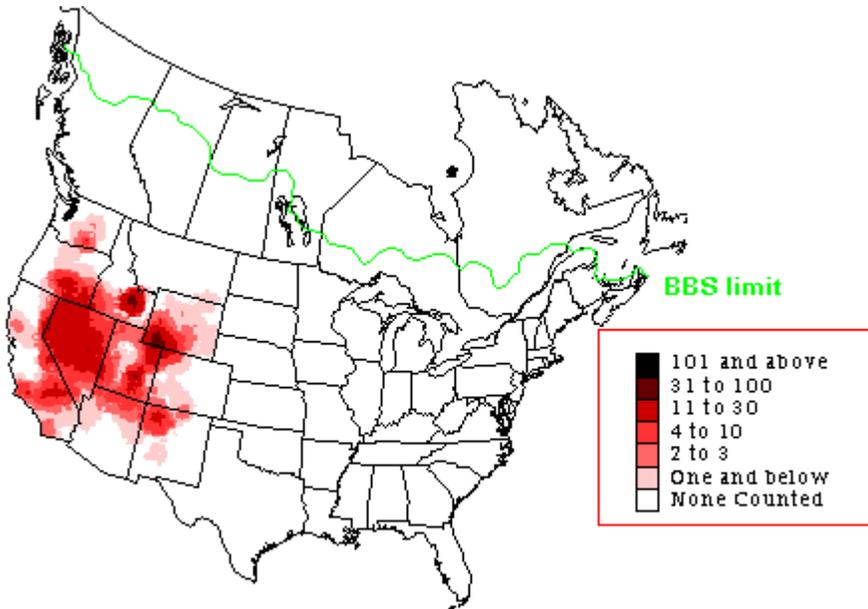
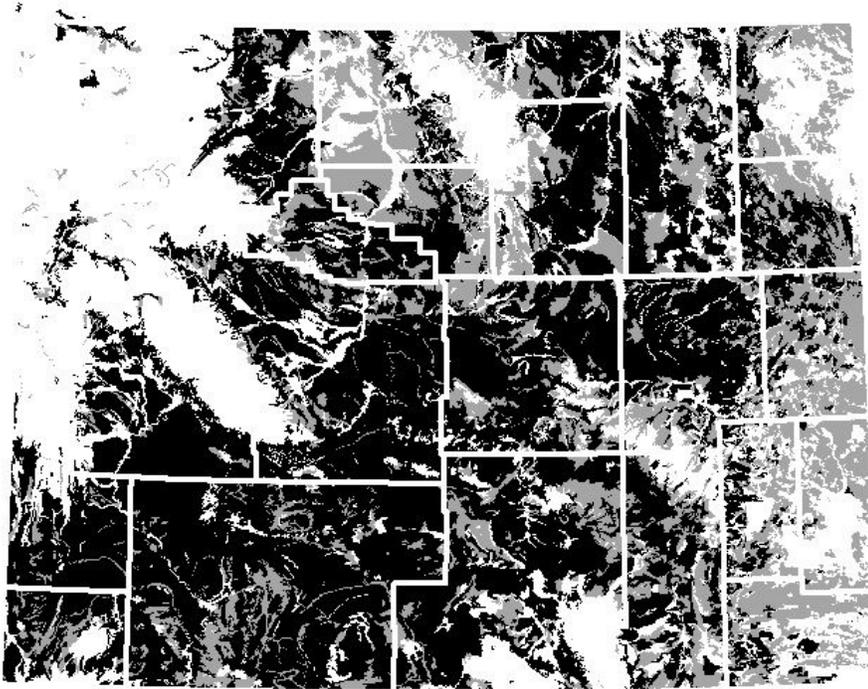


Figure 3. Typical Sage Sparrow (*Amphispiza belli nevadensis*) habitat in eastern Oregon. Photo by USDI Bureau of Land Management; reprinted here with permission.



Figure 4. Map of sagebrush habitat in Wyoming. Darkest areas are dominated by sagebrush; lighter areas have decreasing amounts of sagebrush. Generated by the Wyoming Natural Diversity Database (University of Wyoming) based on Merrill et al. (1996).



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