VESPER SPARROW
Pooecetes gramineus

Description

The male vesper sparrow's twilight singing—after most other birds have fallen silent—earned it its name (Ryser 1985).

P. g. confinis, the western vesper sparrow, occurs in Colorado

The vesper sparrow is a relatively large sparrow, with a narrowly streaked breast (rarely with a breast spot), white belly, a notched brown tail with distinct white edges to the outer tail feathers, a rusty or rufous shoulder (lesser coverts), a thin, distinct eye-ring and brown iris, and a conspicuously streaked back. The legs are pinkish and the bill is dusky brown with a pinkish lower mandible (Rising 1996). The sexes are similar in coloration (Beadle and Rising 2003).

Three subspecies are generally recognized: *gramineus, confinis*, and *affinis*. The subspecies *P. g. confinis* (western vesper sparrow) occurs in Colorado (Rising 1996), and is slightly larger than the other subspecies, with a narrower bill, paler back coloration, and fainter and thinner breast streaking. Vesper sparrows cannot be reliably identified to the subspecies in the field (Rising 1996).

Life history & behavior

Pooecetes gramineus: "grass dweller" or "fond of grass."

The vesper sparrow is primarily a ground forager and ground nester.

Vesper sparrows arrive on breeding grounds in Colorado in mid-April (Andrews and Righter 1992) and are generally seasonally monogamous (Jones and Cornely 2002).

During the breeding season vesper sparrows feed primarily on a wide range of available invertebrates such as beetles, grasshoppers, caterpillars, pseudoscorpions, and spiders, but also forage for seeds of forbs and grasses, and crop waste grains. Adults provide nestlings with invertebrates, rarely seeds. Adults also eat grit, and have low free-water requirements. The vesper sparrow is primarily a ground forager, but will hop and hover to capture invertebrate prey. Vesper sparrow winter feeding habits are unknown (Jones and Cornely 2002).

Vesper sparrows nest on the ground, often in a slight depression dug near a clump of bunchgrass, under a shrub, beside some type of woody debris, or even near a dirt clod. Nests are usually constructed by the female, and are a shallow cup of woven grasses and other plant material, lined with soft grasses or animal hair. Nest diameter averages about 7 cm (Jones and Cornely 2002).

Clutch size is 3 to 5 eggs (sometimes 6), apparently decreasing as the breeding season advances. Eggs hatch over a period of 1 to 3 days after 10 to 14 days of incubation. Young open their eyes by day 5 and fledge in 7 to 12 days (Rising 1996). Brooding is performed by the female, and occasionally by the male. The male may take primary responsibility for feeding the first brood while the female re-nests (Jones and Cornely 2002). Females may display broken wing behavior if flushed from their nests (Rising 1996), or may even attack intruders (Jones and Cornely 2002). Dust bathing is a common activity (Lambeth 1998) both among juveniles and adults (Ryser 1985). Dust bathing sites include dirt roads and bare spots under vegetation. The birds frequent regular sites with friable soil,

fashioning body-sized hollows in the ground (Ryser 1985).

Vesper sparrows migrate nocturnally in small flocks. After nesting season, the birds congregate along roadways and fencelines until mid-September, when the majority move south (Bailey and Niedrach 1965). Based on limited data, vesper sparrows exhibit relatively low natal site fidelity and relatively high breeding territory fidelity (Best and Rodenhouse 1984).

Population trends

In decline in the eastern United States (Sauer et al. 2004)

Colorado trends tracked by MCB are as yet uncertain (T. Leukering, pers. comm.).

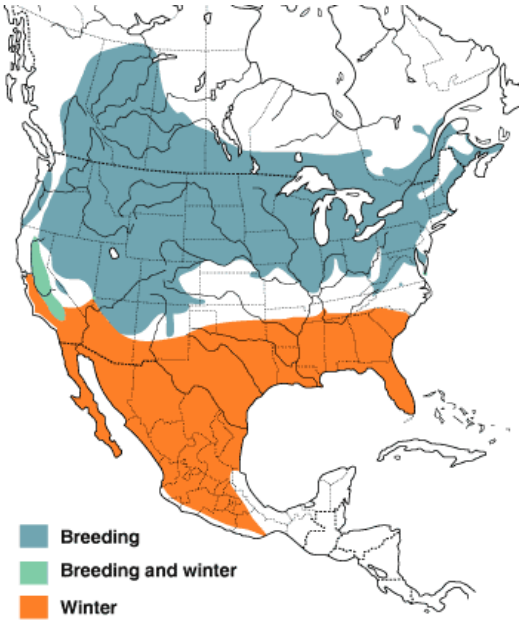
Vesper sparrows appear to be declining in the eastern and midwestern U.S. as farmlands revert to forests or other uses, but they remain relatively common in the western U.S. (Jones and Cornely 2002). The following are selected standard BBS trend estimates (Sauer et al. 2004) from 1966 – 2003:

- 1.1% survey-wide (*P*<0.01, n=1,658, RA=8.04)
- 3.2% in eastern region (*P*<0.01, n=735, RA=1.68)
- 1.0% in central region (*P*=0.12, n=310, RA=13.18)
- 0.4% in western region (*P*=0.13, n=613, RA=11.44)
+1.0% in Colorado (*P*=0.59, n=72, RA=6.90)

A recent spatial analysis of BBS data by Dobkin and Sauder (2004) suggests that vesper sparrows have increased in abundance in the western U.S.; areas predicted to have >5 birds per route expanded by 17% in the shrubsteppe ecoregions. However, comparison of detection frequencies on BBS routes during the same periods suggests mixed trends; for example, vesper sparrow detection frequencies declined in southwestern Colorado and increased elsewhere in the state.

Range

The species likely expanded its range significantly in the eastern U.S. and Canada during European settlement as forests were converted to croplands. Since the 1940s, however, its range in the eastern U.S. has been contracting, presumably due to land use changes (Jones and Cornely 2002).



Overall range map reproduced from Jones and Cornely (2002) with permission.

Colorado distribution patterns & abundance

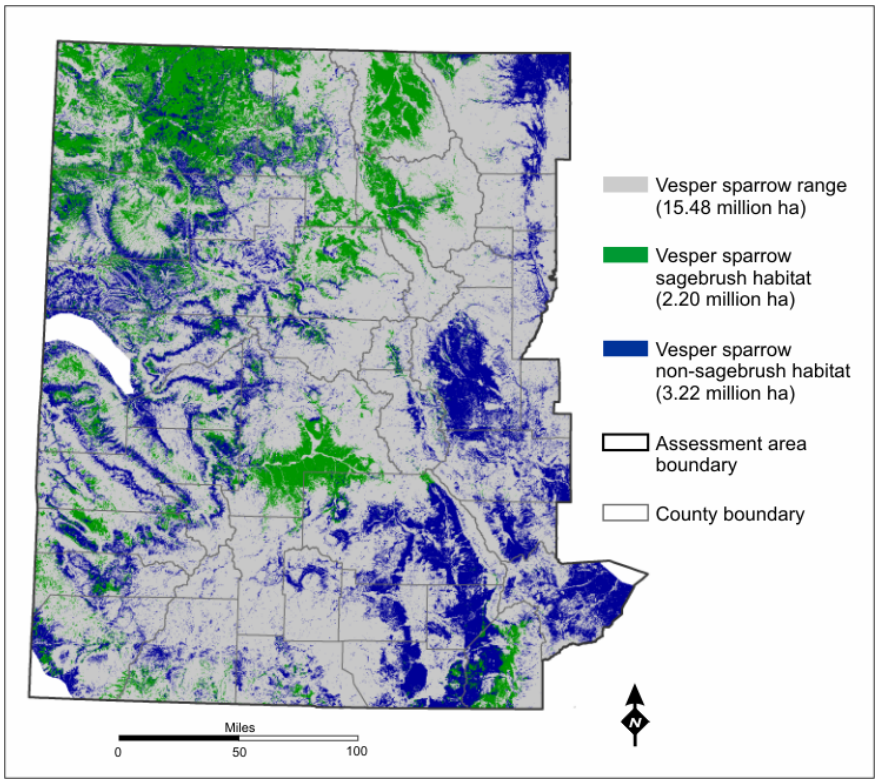
In Colorado, vesper sparrows nest in appropriate habitat between 5,500 and 10,500 feet (Righter et al. 2004).

Breeding vesper sparrows are largely absent from the eastern plains of Colorado.

Distribution of vesper sparrow was positively correlated with the green-tailed towhee in one northwestern Great Basin study (Wiens and Rotenberry 1981).

The total area of the range of the vesper sparrow in the assessment area is 15.48 million ha.

In the eastern and midwestern U.S., the vesper sparrow is found in row crops and adjacent uncultivated lands, while in the west it is primarily associated with shrubsteppe and open rangelands (Jones and Cornely 2002). In their summer range, centers of vesper sparrow abundance recorded by BBS lie in eastern Idaho, central Montana and up into southeastern Alberta; in west-central Saskatchewan; across northern North Dakota; in the Wyoming Basin; and in extreme northwestern Colorado (Sauer et al. 2004).



According to Righter et al. (2004), Colorado's breeding vesper sparrows are most common in the large big sagebrush basins of northwestern Colorado and in the big sagebrush shrublands of west-central and southwestern Colorado. The Colorado BBA found a greater presence of vesper sparrows in central Colorado than expected—particularly South Park and the Gunnison Basin (Lambeth 1998). Breeding birds are also common in open meadows of Grand Mesa, the Flat Tops, Roan Plateau, and the mesas of the San Juan Basin. Andrews and Righter (1992) and the Colorado BBA (Lambeth 1998) show similar summer distribution of this species; however, Andrews and Righter identify extreme northwestern Colorado as "secondary" rather than "primary" range.

Vesper sparrows are notably absent from the eastern plains of Colorado, from the Grand Valley (Righter et al. 2004), and from the conifer-dominated forests of the San Juans, Elks, and the Sawatch, Gore, and Front Ranges (Lambeth 1998). The absence of breeding vesper sparrows in Colorado's eastern plains may be partly explained by a missing structural component in the predominantly grassland vegetation, but Lambeth (1998e) suggested

that vesper sparrows prefer cooler summer temperatures, noting that birds abandoned nests in North Dakota during the particularly hot summer of 1988.

Breeding densities are highly variable. In Colorado between 1999 and 2003, estimates varied from 0.155 to 0.260 birds/ha in sagebrush, 0.026 to 0.080 birds/ha in semi-desert shrubland, 0.010 to 0.160 birds/ha in pinyon-juniper, and 0.010 to 0.020 birds/ha in grasslands (Leukering 2004).

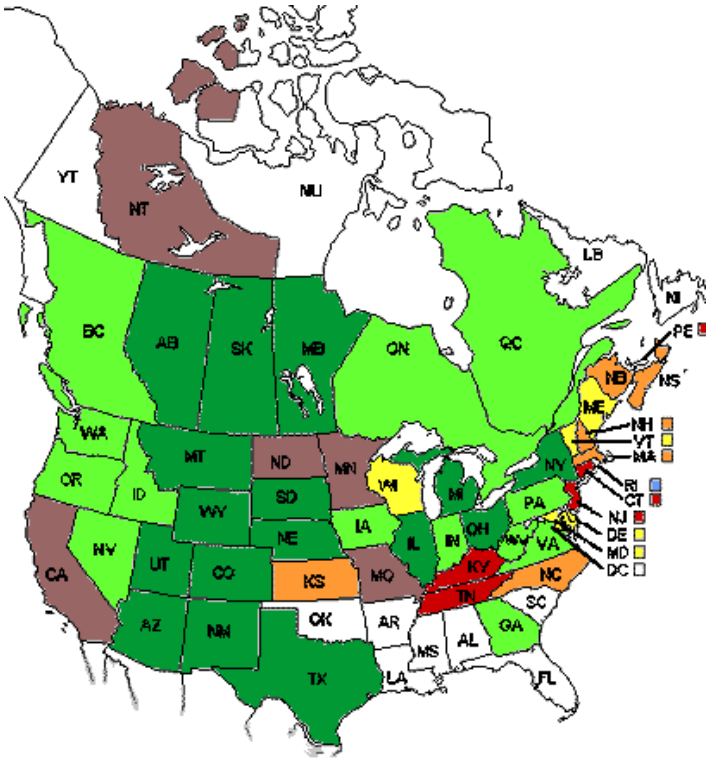
During migrations, vesper sparrows are found throughout Colorado, and migrant birds are quite abundant on the eastern plains, especially in fall (Andrews and Righter 1992). In winter, vesper sparrows retreat to the southern U.S. and Mexico (Dillon 1998). Only rarely do individuals winter in Colorado (Andrews and Righter 1992).

Conservation status

SX: Presumed extirpated
SH: Possibly extirpated
S1: Critically imperiled
S2: Imperiled
S3: Vulnerable
S4: Apparently secure
S5: Secure
Not ranked / Under review

S1, S2, and S3 rankings in eastern U.S. due to population declines and habitat loss; S2 ranking in Kansas attributable to edge-of-range effects.

Colorado's subspecies (*P. g. confinis*) is secure or apparently secure throughout its range, but *P. g. affinis* and *P. g. gramineus* have legal status in other states.



Map courtesy of NatureServe (2004)

- State-listed as endangered in New Jersey (breeding population), Rhode Island, Connecticut, and Kentucky
- State-listed as threatened in New Jersey (non-breeding population) and Massachusetts
- Species of special concern in New York
- Designated "sensitive" in Oregon
- Candidate for state listing in Washington
- Presumed extirpated in Rhode Island (last record was in 1984)

Habitat

In their overall range, the vesper sparrow is a “moderate habitat generalist.” In breeding range, it requires dry, open habitat with short, sparse, patchy herbaceous vegetation, some bare ground, and low to moderate shrub cover (Jones and Cornely 2002). In the western North America, breeding habitat includes montane meadows, grasslands, and prairie—but the species favors grasslands with a shrub component, particularly big sagebrush (Rotenberry and Wiens 1980).

In the Colorado sagebrush assessment area, about 5.42 million ha of suitable habitat exists for vesper sparrow, 2.2 million ha of which is sagebrush shrublands (see figure in Colorado Distribution and Abundance Patterns).

Colorado BBA (Lambeth 1998) reported about 41 percent of vesper sparrow occurrences in a range of grassland habitats and 37 percent in big sagebrush shrublands. Breakdowns of occurrences are as follows:

24% - mountain big sagebrush shrubland
21% - montane grasslands
20% - other grasslands (6 types, from disturbed to native)
13% - lowland sagebrush
14% - other shrublands (mountain shrub, tall desert shrub)
8% - woodlands (pinyon-juniper, ponderosa pine, montane)

Despite their association with grasslands, vesper sparrows require specific habitat conditions for nesting (Lambeth 1998).

MCB found vesper sparrows most often in sagebrush shrublands (Leukering and Levad 2002). They occasionally breed in pinyon-juniper woodland openings with small shrubs (Sedgwick 1987), early seral stage shrublands or forests, or croplands (Jones and Cornely 2002). MCB found consistently higher densities of vesper sparrows in sagebrush-dominated shrublands than semi-desert shrublands or pinyon-juniper woodlands (second highest densities), or grasslands (third highest densities) from 1999 through 2003 (Leukering 2004).

Vesper sparrows tolerate a wide range of shrub, grass, and forb cover in their habitat.

In general, vesper sparrows prefer short, patchy herbaceous vegetation and scattered shrub cover, and typically avoid mesic areas or plant communities with tall, dense herbaceous vegetation (Dobkin and Sauder 2004). In Maine "grassland-barrens," breeding bird densities were positively correlated with vegetation patchiness and bare ground (Vickery et al. 1994). Rotenberry and Wiens (1980a) found that vesper sparrow abundance was positively correlated with forb cover and extent of variation in height of the nearest forb or shrub. In sagebrush shrubsteppe, this ground-nester requires scattered shrubs for singing; bunchgrasses or sagebrush for nest cover (Best and Rodenhouse 1984; Castrale 1982); and patches of bare ground for dust bathing (Jones and Cornely 2002).

Vesper sparrows have high tolerance for diverse shrub species in their habitat. Their abundances in Oregon shrubsteppe positively correlated with green rabbitbrush and bitterbrush (Wiens and Rotenberry 1981).

Breeding vesper sparrows tolerate a wide range in shrub canopy cover, but probably prefer less shrub canopy coverage than sage sparrow, sage thrasher or Brewer's sparrow. On sites where sagebrush canopy cover was reduced (but not eliminated) by herbicide or prescribed burns to approximately 5 to 15 percent, vesper sparrows remained abundant or began colonizing sites within a few years where they had previously been absent. They were also present in untreated control plots where sagebrush canopy cover was about 36 percent (see discussion under “Threats & Sensitivities.”) Rotenberry and Wiens (1980) found no significant correlation

between bird abundance and shrub canopy cover in a multivariate analysis of physiognomic habitat characteristics at the regional scale.

Vesper sparrows seem to tolerate a broad range of herbaceous cover, but likely prefer more herbaceous cover than sage sparrow, sage thrasher, or Brewer's sparrow. Jones and Cornely (2002) summarize herbaceous cover across a variety of habitats, with grass cover ranging from 6.25 to 74 percent, and forb cover ranging from 1.5 to 52 percent. Vesper sparrows were present in big sagebrush habitat with bare ground ranging between 16 to 48 percent. Vesper sparrows forage in relatively short (about 5 cm) understory (Wiens 1969), and nest on the ground under native bunchgrass clumps (Jones and Cornely 2002) or under sagebrush shrubs averaging 32 cm in height (Dechant et al. 2000).

Breeding territory size ranges from 0.29 to 8.19 ha, although no published data are available regarding territory sizes in Colorado sagebrush habitats (synthesis by Jones and Cornely 2002).

Minimum patch size for vesper sparrows is unknown. In Maine "grassland-barrens," incidence of vesper sparrows increased with area of site, reaching 50 percent when site size reached 20 ha (Vickery et al. 1994). These authors suggest area requirements are consistent across the species' range. A Colorado grassland study suggests vesper sparrows are more abundant in interior rather than edge habitats (Miller et al. 1998).

Recent work in northern Utah by Wilson et al. (In prep) showed that small patches of sagebrush may be suitable for vesper sparrows if sufficient resources are available in patches less than 200 m away. Increasing patch size was correlated with increasing likelihood of vesper sparrow occupancy. The authors caution that the occupancy of small sagebrush patches by vesper sparrow may be the result of source-sink and/or meta-population phenomena, however.

During spring and fall migrations the vesper sparrow is found primarily in pastures and the weedy margins of cultivated fields or roads, hedgerows, fencerows, and barren or overgrown fields (Jones and Cornely 2002). The Colorado BBA reported “legions” of migrating vesper sparrows on the eastern plains during spring (Lambeth 1998).

Vesper sparrows migrate south of their breeding range in winter to grasslands, weedy fields, brushy second growth and brushy borders next to grasslands, and arid and semi-arid scrublands with sparse vegetation (Jones and Cornely 2002). Much of the desert grasslands in their winter range have been destroyed or overgrazed (Bock and Bock 1999).

Threats & sensitivities

Reversion of farmlands to forests or conversion to other land uses in the eastern U.S. is the most direct threat to the species (Jones and Cornely 2002). For vesper sparrows in western shrublands of North America, habitat loss, habitat fragmentation,and the effects of grazing and range management are principal concerns.

In Colorado, where sagebrush makes up about 41 percent of vesper

vesper sparrow suitable habitat, threats to sagebrush are a major concern.

sparrow suitable habitat, loss and degradation of sagebrush are major concerns. Vesper sparrow sagebrush habitat in Colorado is at risk of four widespread threats modeled in the Colorado sagebrush conservation assessment and strategy: pinyon-juniper encroachment, understory encroachment by non-native herbaceous vegetation, residential development, and energy development.

See Chapter 6 for more detail about vesper sparrow habitat estimates and predictive threat modeling for its sagebrush habitat in the Colorado assessment area. Chapter 4 presents rule sets for threats modeling in sagebrush habitat.

Residential development probably poses the lowest risk of the four threats, with an estimated 2 percent of vesper sparrow sagebrush habitat at high risk, 2 percent at moderate risk, and 14 percent at low risk. About 82 percent of vesper sparrow sagebrush habitat is at no risk of residential development based on our predictive model. Residential development threats to sagebrush are fairly scattered, with hot spots around Craig, Steamboat Springs, Granby, the Eagle River Valley, Aspen Valley and the Roaring Fork Valley, Hotchkiss and Cedaredge in Delta County, and Cortez, Mancos, and Durango.

Pinyon-juniper encroachment risk is also relatively low. Our predictive model estimated 18 percent of vesper sparrow sagebrush habitat is at high risk of pinyon-juniper encroachment, while 26 percent is at moderate or low risk, and 56 percent is at no risk.

Heavy grazing by cattle in shrubsteppe habitats adversely affects vesper sparrows.

Risk of energy development is broadly moderate. About 58 percent of vesper sparrow sagebrush habitat is at moderate risk of energy development in the Colorado sagebrush assessment area, 35 percent is at low or no risk, and 7 percent is at high risk. Energy development can result in destruction, degradation, and fragmentation of habitat via mechanisms described in Chapter 2. Sagebrush habitat at highest risk of energy development is scattered throughout the western-most counties in the assessment area, with larger hot spots clustered in Rio Blanco, Garfield, and southern La Plata Counties. The effects of habitat fragmentation on the vesper sparrow are unknown.

The vesper sparrow's response to sagebrush treatments are mixed (positive or neutral).

Over 99 percent of vesper sparrow sagebrush habitat is at some degree of risk of understory encroachment by non-native herbaceous vegetation. Our model predicts 23 percent at high risk, 18 percent at moderate risk, and 58 percent at low risk. The effects of non-native herbaceous understory encroachment on vesper sparrow sagebrush habitat quality have not been studied. High percent ground cover and nearly monotypic stands that often characterize non-native herbaceous understories could physically interfere with foraging habits or impact plant or invertebrate food sources of this ground-foraging omnivore. Sagebrush habitat at moderate or high risk of understory encroachment in vesper sparrow range is mostly broadly scattered across the western-most counties at lower elevations. Moffat and Rio Blanco Counties contain the largest contiguous patches of sagebrush habitat at high risk of understory encroachment.

Fire appears to improve vesper sparrow habitat in shrubsteppe when it reduces (but does not eliminate) sagebrush canopy.

Agricultural lands provide attractive nesting habitat for vesper sparrows but may act as habitat

There are no long-term, comprehensive studies comparing avifaunas of ungrazed and grazed sagebrush shrubsteppe habitats in Colorado or elsewhere, but two recent literature reviews (Bock et al. 1993; Saab et al. 1995) tentatively concluded the effects of grazing on the vesper sparrow are adverse. Saab et al. (1995) standardized relative mean abundances of vesper sparrows across studies between grazed and ungrazed shrubsteppe

sinks in some cases.

Vesper sparrows may be sensitive to habitat edge effects.

habitats and determined vesper sparrows were less abundant on ungrazed sites, although not significantly so (P=0.7). However, vesper sparrows responded negatively to heavy grazing during the growing season in big sagebrush/bluebunch wheatgrass and low sagebrush/Idaho fescue habitats in Nevada, and negatively to grazing of unspecified intensity in big sagebrush in Idaho (Saab et al. 1995). Bock et al. (1993) concluded similarly that grazing by cattle (intensity unspecified) in shrubsteppe in the growing season negatively affects the vesper sparrow. In Montana, peak densities of breeders were present at moderate and light grazing levels on sagebrush shrubsteppe and shrubsteppe/grassland transition sites, but heavy grazing appeared to depress numbers (Kantrud and Kologiski 1982).

The mechanisms of grazing impacts are uncertain. Impacts can be direct and short-term, such as nest trampling or reduction of bunchgrass nesting cover, or indirect and long-term, influencing structural or floristic shifts in the plant community that make nesting conditions unfavorable for vesper sparrows. Livestock grazing is potentially associated with the introduction of exotic plants and higher densities of brood parasitic brown-headed cowbirds in shrubsteppe habitats. A study in southwestern Colorado showed 6.3 percent of observed nests (n=16) were trampled by cattle, and another 6.3 percent were parasitized by brown-headed cowbirds (C. Ortega, pers. comm.).

Vesper sparrows have shown mixed responses to sagebrush treatments. In Montana, chemically thinned or eradicated sagebrush did not significantly reduce numbers of vesper sparrow breeding pairs, who nested the following year under persistent bunchgrasses (Best 1972). Breeding pairs of Brewer's sparrows (primarily shrub nesters) decreased significantly at the same treated sites. This study did not measure nest success of vesper sparrows and did not take into consideration fidelity of birds to breeding territory. In southern Oregon, vesper sparrows appeared for the first time on a chemically treated site 3 years following chemical treatment when sagebrush canopy had recovered and stabilized at 10 percent and grass cover exceeded 35 percent, while sage sparrows, Brewer's sparrows, and sage thrashers decreased in abundance (Wiens et al. 1985). Vesper sparrows had not been present on the site for 3 years prior to treatment, when the sagebrush canopy cover approached 30 percent and grass and forb covers were less than 10 and 20 percent, respectively. Vesper sparrow abundance did not vary significantly between study sites in Wyoming where sagebrush cover was reduced to 15 percent by herbicide treatment 22 years previously and untreated sites with about 36 percent canopy cover (Kerley and Anderson 1995). In Utah, vesper sparrows avoided areas where sagebrush was removed by chaining followed by seeding to non-native grasses (Castrale 1982). The toxicity to vesper sparrows of herbicides applied to sagebrush and their effects on nesting success are unknown.

Fire potentially improves vesper sparrow habitat in sagebrush, except where it removes the shrub component or replaces the shrubsteppe community with exotic grasslands (Jones and Cornely 2002 synthesized data). Typical dense ground cover associated with invasions of exotic herbs and forbs following fires may negatively affect vesper sparrow nesting and foraging conditions. Vesper sparrow abundances were not significantly different in Wyoming where sagebrush canopy was 5 percent in prescribed fire-treated

plots burned 9 years previously (Kerley and Anderson 1995), compared to untreated sites where sagebrush canopy cover was about 36 percent. In southeastern Idaho, vesper sparrows colonized a study site in the third year following a prescribed fire that burned in a mosaic pattern, leaving an overall sagebrush canopy cover of about 12 percent and significantly increased forb coverage (Petersen and Best 1987, 1999). Control plots supported no vesper sparrows during the 9-year period of the study.

On mine sites in South Dakota and Wyoming, vesper sparrow densities were significantly higher in unmined sagebrush steppe sites than in unreclaimed or reclaimed mine sites (with similar bird densities at both types of mine sites). Frequency of big sagebrush was positively correlated with nesting vesper sparrow densities. Vesper sparrows did not nest on reclaimed sites where sagebrush shrubs were absent (Schaid et al. 1983).

Historically, agriculture facilitated a range expansion of this species in the eastern U.S. When crops and associated physical features provide suitable habitat structure, this species benefits. However, many crop habitats could be environmental sinks due to farming practices (nesting success may be low due to pesticide and harvest effects). Populations in the eastern U.S. have shown vulnerability to pesticide applications to crops (Jones and Cornely 2002).

A study by Miller et al. (1998) on public lands in the urban/suburban matrix of Boulder, Colorado, suggested that recreational trails through grasslands affected distribution, abundance, and nesting success of vesper sparrows. Vesper sparrow nests were significantly more abundant on control transects than on transects placed near trails, whereas the inverse was true for generalists such as the American robin and certain corvids. Whether trail effects are caused by “intense” recreational disturbance, the actual physical presence of a trail, increased rates of nest predation associated with habitat edges, or several mechanisms acting in concert, is undetermined (Miller et al. 1998). Another study found that vesper sparrows were significantly more abundant on interior plots than on edge plots in City of Boulder Open Space grasslands (Bock et al. 1999). These abundances were independent of habitat type. Both male and female vesper sparrows responded to human observers with distraction displays, and in some cases attack (Kruger 1981).

Vesper sparrows apparently do not readily reject cowbirds eggs (Peer et al. 2000) and are known to raise brown-headed cowbird young (Chace and Cruz 1996; Friedmann 1963). Colorado BBA observers reported vesper sparrow nests with cowbird young in Gunnison County, and adult vesper sparrows feeding cowbird fledglings in Park and Rio Blanco Counties (Chace and Cruz 1996). Cowbirds likely have a minor early hatching advantage, but vesper sparrow nestlings may have a size advantage over cowbird nestlings and, therefore, may not significantly harmed by cowbird parasitism (Rothstein 1975). However, an Illinois study reported parasitized nests hatched fewer host young than unparasitized nests (unpublished data cited in Jones and Cornely 2000). Jones and Cornely (2002) reviewed cowbird parasitism rates in the midwestern U.S. and Canada, and found rates ranged from 0 percent to as high as 61 percent where cowbirds were present. A Saskatchewan study found that parasitized nests were significantly closer to field edges than unparasitized nests (McMaster et al.

2000). The frequency of abandonment of parasitized nests is not well understood.

Common predators of vesper sparrow eggs and young are crows, snakes, and small mammals, including red fox, skunk, and thirteen-lined ground squirrel. Ortega found rock squirrels to be a major predator on nests in southwestern Colorado (pers. comm.) Raptors may take adults (Jones and Cornely 2002).

Research needs

Research on vesper sparrows should focus on nest success (including brood parasitism and predation) under alternate sagebrush rangeland management regimes, over a range of habitat conditions and geographic areas.

More study is needed to determine the effects of habitat fragmentation, estimate minimum patch size requirements, and gain better understanding of wintering ecology and degree of breeding territory fidelity of vesper sparrows.

Alternative methods for estimating long-term population trends of vesper sparrows with statistical confidence are needed for sagebrush shrubsteppe in western North America.

Management issues

A significant amount (about 59 percent) of the vesper sparrow's habitat in the assessment area consists of non-sagebrush habitat types (see Chapter 6). Ideally, conservation planning and management of species of concern should consider all significant habitat types. Such an approach is beyond the scope of this document. About 44 percent of vesper sparrow sagebrush habitat in the Colorado sagebrush assessment area is controlled by private landowners, posing a challenge for effective, integrated habitat management for the species. Nevertheless, about 73 percent of the sagebrush habitat managed by non-private entities is managed by the BLM, making it the public entity best-positioned to have a positive impact on the species.

Literature Cited

Andrews, R. and R. Righter. 1992. *Colorado birds: a reference to their distribution and habitat*. Denver: Denver Museum of Natural History.

Bailey, A. M. and R. J. Niedrach. 1965. *Birds of Colorado, Volumes I & II*. Denver: Denver Museum of Natural History.

Beadle, D. and J. D. Rising. 2003. *Sparrows of the United States and Canada: the photographic guide*. Princeton: Princeton University Press.

Best, Louis. B. 1972. First-year effects of sagebrush control on two sparrows. *Journal of Wildlife Management* 36:534-544.

Best, Louis. B. and Nicholas L. Rodenhouse. 1984. Territory preference of vesper sparrows in cropland. *The Wilson Bulletin* 96:72-82.

Bock, C. E. and J. H. Bock. 1999. Response of winter birds to drought and short-duration grazing in southeastern Arizona. *Conservation Biology* 15:1117-1123.

Bock, C. E., J. H. Bock, and B. C. Bennett. 1999. Songbird abundance in grasslands at a

suburban interface on the Colorado high plains. *Studies in Avian Biology* 19:131-136.

Bock, C. E., V. A. Saab, T. D. Rich, and D. S. Dobkin. 1993. Effects of livestock grazing on neotropical migratory landbirds in western North America. In *Status and management of neotropical migratory birds*, edited by D. M. Finch and P. W. Stangel: USDA Forest Service, General Technical Report RM-229.

Castrale, J. S. 1982. Effects of two sagebrush control methods on nongame birds. *Journal of Wildlife Management* 46:945-952.

Chace, J. F. and A. Cruz. 1996. Knowledge of the Colorado host relations of the parasitic brown-headed cowbird (*Molothorus ater*). *Journal of Colorado Field Ornithology* 30:67-81.

Dechant, J. A., M. F. Dinkins, D. H. Johnson, L. D. Igl, C. M. Goldade, and B. R. Euliss. 2000. *Effects of management practices on grassland birds: vesper sparrow (revised 2002)*. Jamestown, North Dakota: Northern Prairie Wildlife Research Center.

Dillon, M. B. 1998. Sage thrasher (Oreoscoptes montanus). In *Colorado Breeding Bird Atlas*, edited by H. E. Kingery. Denver: Colorado Bird Atlas Partnership & Colorado Div. of Wildlife.

Dobkin, D. S. and J. D. Sauder. 2004. Shrubsteppe landscapes in jeopardy: distributions, abundances, and the uncertain future of birds and small mammals in the intermountain west. Bend, Oregon: High Desert Ecological Research Institute.

Friedmann, H. 1963. *Host relations of the parasitic cowbirds*. Washington DC: Smithsonian Institute Press.

Jones, S. L. and J. E. Cornely. 2002. Vesper sparrow (*Pooecetes gramineus*). In *The Birds of North America, No. 624*, edited by A. Poole and F. Gill. Philadelphia: The Birds of North America, Inc.

Kerley, L. L and S. H. Anderson. 1995. Songbird responses to sagebrush removal in a high elevation sagebrush steppe ecosystem. *Prairie Naturalist* 27:129-146.

Kruger, H. O. 1981. Breeding adaptations of the vesper sparrow (*Poocetes gramineus*) in a fire-altered ecosystem, Central Michigan University, Mt. Pleasant.

Lambeth, R. 1998. Vesper sparrow (*Pooecetes gramineus*). In *Colorado Breeding Bird Atlas*, edited by H. E. Kingery. Denver: Colorado Bird Atlas Partnership & Colorado Div. of Wildlife.

Leukering, T. and R. Levad. 2002. *Monitoring Colorado's Birds, 1998-2001*. Brighton: Rocky Mountain Bird Observatory.

McMaster, D. G., J. H. Devries, M. Gendron, and S. K. Davis. 2000. An integrated evaluation of cropland conversion in the Missouri Coteau of Saskatchewan, unpublished annotated report. Regina: Saskatchewan Wetland Conserv. Corp.

Miller, S. G., R. L. Knight, and C. K. Miller. 1998. Influence of recreational trails on breeding bird communities. *Ecological Applications* 8:162-169.

NatureServe. 2004. NatureServe Explorer: An online encyclopedia of life [web application]. Arlington, Virginia: NatureServe.

Peer, B. D., S. K. Robinson, and J. R. Herkert. 2000. Egg rejection by cowbird hosts in grasslands. *Auk* 117:892-901.

Petersen, K. L. and L. B. Best. 1987. Effects of prescribed burning on nongame birds in a sagebrush community. *Wildlife Society Bulletin* 15:317-329.

———. 1999. Design and duration of perturbation experiments: implications for data interpretation. *Studies in Avian Biology* 19:230-236.

Righter, R., R. Levad, C. Dexter, and K. Potter. 2004. *Birds of western Colorado plateau and mesa country*. Grand Junction: Grand Valley Audubon Society.

Rising, J. D. 1996. *A guide to the identification and natural history of the sparrows of the United States and Canada*. San Diego: Academic Press.

Rotenberry, J. T. and J. A. Wiens. 1980. Habitat structure, patchiness, and avian communities in North American steppe vegetation: a multivariate analysis. *Ecology* 61:1228-1250.

Rothstein, S. I. 1975. An experimental and teleonomic investigation of avian brood parasitism. *Condor* 77:250-271.

Ryser, F. A. 1985. *Birds of the Great Basin: a natural history*. Reno: University of Nevada Press.

Saab, V. A., C. E. Bock, T. D. Rich, and D. S. Dobkin. 1995. Livestock grazing effects in western North America. In *Ecology and management of neotropical migratory birds*, edited by T. E. Martin and D. M. Finch. New York: Oxford University Press.

Sauer, J. R., J. E. Hines, and J. Fallon. 2004. The North American Breeding Bird Survey, Results and Analysis 1966 - 2003: USGS Patuxent Wildlife Research Center.

Schaid, T. A., D. W. Uresk, W. L. Tucker, and R. L. Linder. 1983. Effects of surface mining on the vesper sparrow in the northern Great Plains. *Journal of Range Management* 36:500-503.

Sedgwick, James A. 1987. Avian habitat relationships in pinyon-juniper woodland, northwest Colorado. *The Wilson Bulletin* 99:413-431.

Vickery, P. D., M. L. Jr. Hunter, and S. M. Melvin. 1994. Effects of habitat area on the distribution of grassland birds of Maine. *Conservation Biology* 8:1087-1097.

Wiens, J. A. 1969. An approach to the study of ecological relationships among grassland birds. *Ornithological Monographs* 8.

Wiens, J. A. and J. T. Rotenberry. 1981. Habitat associations and community structure of birds in shrubsteppe environments. *Ecological Monographs* 51:21-41.

Wiens, J. A., J. T. Rotenberry, and B. Van Horne. 1985. Territory size variation in shrubsteppe birds. *Auk* 102:500-505.

Wilson, T. L., E. J. Johnson, and J. A. Bissonette. In prep. Landscape supplementation and shrub-steppe associated bird species in a patchy, mountainous landscape.