

Cassin's Sparrow Status Assessment and Conservation Plan

Biological Technical Publication
BTP-R6002-2000



Janet M. Ruth
U.S. Geological Survey
Midcontinent Ecological Science Center
Fort Collins, CO 80525

March 2000

Cassin's Sparrow

(Aimophila cassinii)

Status Assessment and Conservation Plan

Biological Technical Publication
BTP-R6002-2000

Janet M. Ruth
Research Ecologist
U.S. Geological Survey
Midcontinent Ecological Science Center
4512 Mc Murry Avenue
Fort Collins, CO 80525-3400
970-226-9487
FAX 970-226-9230
janet_ruth@usgs.gov

For additional copies or further information, contact:
Nongame Migratory Bird Coordinator, Region 6
U.S. Fish & Wildlife Service
P.O. Box 25486
Denver Federal Center
Denver, CO 80225

March 2000

Recommended citation:

Ruth, J.M. 2000. Cassin's Sparrow (*Aimophila cassinii*) status assessment and conservation plan. Biological Technical Publication BTP-R6002-1999. U.S. Department of the Interior, Fish and Wildlife Service, Denver, CO.

TABLE OF CONTENTS

TABLE OF CONTENTS	iii
LIST OF TABLES AND FIGURES	vii
EXECUTIVE SUMMARY	1
ACKNOWLEDGMENTS	2
TAXONOMY	3
LEGAL STATUS	3
United States	3
Mexico	4
DESCRIPTION	4
Plumage	4
<i>Adult</i>	4
<i>Juvenile</i>	5
NATURAL HISTORY	5
Song	5
Diet	6
Territory and Site Fidelity	6
Breeding Ecology	8
Migratory Behavior	10
RANGE	10
Breeding	11
Migration	12
Wintering	13
Distribution Changes in Response to Precipitation	14
Theory Regarding Unusual “Migration”	
Patterns in Cassin’s Sparrows	17
MONITORING ACTIVITIES	18
Breeding Bird Survey (BBS)	18
Christmas Bird Count (CBC)	19
Breeding Bird Atlases	19
POPULATION ESTIMATES AND TRENDS	19
Population Estimates	19
Trends	19
Possible Explanation of Trends	22
HABITAT	24
Breeding season habitat requirements	25
Winter habitat requirements	27
MANAGEMENT	28
Grazing	28
Burning	31
Conservation Reserve Program (CRP)	33
Tamarisk	33
THREATS	34
Habitat	34
Overutilization for Commercial, Recreational, Scientific, or Educational Purposes	34
Disease or Predation	34
Inadequacy of Existing Regulatory Mechanisms	35
Other natural or Manmade Factors	35
<i>Pesticides</i>	35
<i>Population size</i>	35
<i>Nest Parasitism</i>	35

<i>Suburban Development</i>	35
<i>Exotic Grasses</i>	36
<i>Grazing</i>	37
<i>Brush Control</i>	37
<i>Tamarisk</i>	38
ASSESSMENT AND RECOMMENDATION	38
Recommendation on current status	38
CONSERVATION	39
Research Priorities	40
LITERATURE CITED	42
APPENDIX A	
STATE SUMMARIES	51
Natural Heritage Program State Ranks Defined	51
UNITED STATES	52
ARIZONA	52
Summary.....	52
BBS	52
CBC	52
Atlas	52
Research / Monitoring	53
Major Populations	55
State Status	55
Natural Heritage Rank	55
Habitat Condition	55
Threats	55
Literature Cited.....	55
NEW MEXICO	58
Summary.....	58
BBS	59
CBC	60
Atlas	60
Research / Monitoring	60
Major Populations	62
State Status	62
Natural Heritage Rank	62
Habitat Condition	62
Threats	63
Literature Cited.....	63
TEXAS 65	
Summary.....	65
BBS	65
CBC	66
Atlas	67
Research / Monitoring	67
Major Populations	67
State Status	68
Natural Heritage Rank	68
Habitat Condition	68
Threats	68
Literature Cited.....	69

OKLAHOMA	72
Summary.....	72
BBS	73
CBC	73
Atlas	73
Research / Monitoring.....	73
Major Populations	73
State Status	73
Natural Heritage Rank	73
Habitat Condition	73
Threats	73
Literature Cited.....	74
COLORADO.....	75
Summary.....	75
BBS	75
CBC	76
Atlas	76
Research / Monitoring.....	76
Major Populations	77
State Status	77
Natural Heritage Rank	78
Habitat Condition	78
Threats	78
Literature Cited.....	78
KANSAS	80
Summary.....	80
BBS	80
CBC	80
Atlas	80
Research / Monitoring.....	80
Major Populations	81
State Status	81
Natural Heritage Rank	81
Habitat Condition	81
Threats	82
Literature Cited.....	82
WYOMING.....	83
Summary.....	83
BBS	83
CBC	83
Atlas	83
Research / Monitoring.....	83
Major Populations	83
State Status	83
Natural Heritage Rank	83
Habitat Condition	83
Threats	83
Literature Cited.....	84

NEBRASKA	85
Summary.....	85
BBS	85
CBC	85
Atlas	85
Research / Monitoring.....	85
Major Populations	85
State Status	85
Natural Heritage Rank	85
Habitat Condition	85
Threats	85
Literature Cited.....	86
MEXICO	87
Summary.....	87
BBS	87
CBC	87
Atlas	87
Research / Monitoring.....	88
Major Populations	90
State Status	90
Natural Heritage Rank	90
Habitat Condition	90
Threats	91
Literature Cited.....	91
 APPENDIX B	
HABITAT DESCRIPTIONS	93
Table B1	93
Table B2	98
 APPENDIX C	
LIST OF PRIMARY INDIVIDUALS CONTACTED	101

LIST OF TABLES AND FIGURES**Tables**

Table 1.	Linear measurements (mm) of Cassin's Sparrow	4
Table 2.	Information about nest dimensions, nest placement, and clutch size	9
Table 3.	Trends for Cassin's Sparrow from Breeding Bird Survey data	20
Table 4.	Average characteristics of plots occupied by Cassin's Sparrows	25
Table 5.	Densities of singing males per square km in two habitat types	26
Table 6a.	Results of three related studies comparing Cassin's Sparrow responses to grazing in southeastern Arizona	30
Table 6b.	Results of two related studies describing effects of grazing on vegetative cover in southeastern Arizona	30
Table 7.	Total numbers of birds recorded cumulatively on plots in burned and unburned native and exotic grassland in southeastern Arizona	32
Table 8..	Sample size and means for vegetation associated with wintering grassland bird species on the Mexican Plateau of Chihuahua, Mexico.	88
Table 9.	Sample size and means for vegetation variables and habitat associations of wintering grassland bird species on the Mexican Plateau of Chihuahua, Mexico.	89
Table 10.	Average percentage of basal cover and shrub density in plots where breeding Cassin's Sparrows were present and absent	90

Figures

Fig. 1.	Breeding and wintering distribution of Cassin's Sparrow	10
Fig. 2.	Summer distribution map for Cassin's Sparrow from Breeding Bird Survey	12
Fig. 3.	Winter distribution map for Cassin's Sparrow from Christmas Bird Count	12
Fig. 4a.	Annual indices of abundance by state for Cassin's Sparrow from Breeding Bird Survey	15
Fig. 4b.	Annual indices of abundance by physiographic strata for Cassin's Sparrow from Breeding Bird Survey	16
Fig. 5.	Annual population trend estimates for Cassin's Sparrow from Breeding Bird Survey	21
Fig. 6.	Map of Texas showing Edwards Plateau and South Texas Brushlands	23
Fig. 7.	Cassin's Sparrow distribution in Arizona	53
Fig. 8.	Historical records of Cassin's Sparrows in New Mexico	59
Fig. 9.	Cassin's Sparrow distribution in Texas	66
Fig. 10.	Cassin's Sparrow distribution in Oklahoma	74
Fig. 11.	Cassin's Sparrow distribution in Colorado	77
Fig. 12.	Cassin's Sparrow distribution in Kansas	81

EXECUTIVE SUMMARY

Cassin's Sparrow (*Aimophila cassinii*) is a grassland species endemic to the southwestern U.S. and northern Mexico. Its behavior and ecology have been shaped by these arid ecosystems and the health of its populations is dependent on the availability of grasslands that contain a shrub component. Populations of many grassland birds have experienced dramatic declines due to the loss and deterioration of grassland habitats, and there has been concern about the trends in Cassin's Sparrow populations. Without better information about population trends, ecology, and effects of management activities, and without a stronger emphasis on grassland management, Cassin's Sparrows and other grassland species may continue to experience declines.

Little information exists about historic Cassin's Sparrow population levels, and current population estimates for states in the breeding range are unknown. Significant survey-wide declines are documented by the Breeding Bird Survey (BBS) between 1966 and 1996. However, closer examination of these data suggest that the survey-wide trends are driven by population declines in the Edwards Plateau and South Texas Brushlands in Texas. No other areas within the core of its range or on the periphery show consistent, significant trends. In fact, there is consensus that in the core of its range in New Mexico Cassin's Sparrow remains the most abundant breeding bird in grasslands with a shrub component. Understanding of population patterns in this species is complicated by large yearly fluctuations in distribution and numbers at any particular location, apparently in response to precipitation. This is particularly obvious in the periphery of its range. These dramatic fluctuations have hampered a clear assessment of population status, and our understanding has been confounded by the fact that the timing of BBS data collection does not always coincide with the peak breeding season of this species. The lack of information about the Cassin's Sparrow's status, ecology, and response to management activities, and the apparent declines indicated by BBS data, have been cause for concern.

Habitat disturbance and degradation, mainly due to grazing and rangeland management practices such as shrub control, fire management, and planting of exotics, pose threats to Cassin's Sparrow populations, as does habitat conversion through suburban development and agriculture. There is evidence that heavy grazing negatively affects populations, but the information is primarily available from the southwestern portion of its range (Arizona) and may not be applicable throughout the Cassin's Sparrow's entire range. Any management practice that results in complete removal of the shrub component, or loss of grass cover and an increase in shrub density beyond a threshold preferred by the species, also poses a threat. Lack of standardized or coordinated studies of Cassin's Sparrow ecology and response to management practices in different geographic portions of its range has made it difficult to assess its status and make specific management recommendations. Limited data are available from the wintering grounds, and from its range (both breeding and wintering) in Mexico.

The greatest needs are for determining of the causes of significant declines where they occur, determining of the effects of various management activities on Cassin's Sparrow throughout its range, improved assessments of population and trends, and a better understanding of the annual population and distribution dynamics of this species, which shows such dramatic annual distributional fluctuations.

ACKNOWLEDGMENTS

Special thanks are extended to over 50 people from State agencies, U.S. Fish and Wildlife Service (USFWS), Bureau of Land Management, U.S. Geological Survey (USGS), U.S. Army, U.S. Forest Service, universities, and private organizations in the states throughout the range of the Cassin's Sparrow who provided information, without which this report could not have been completed. I particularly want to acknowledge the review and input provided by: Bruce Peterjohn, USGS Patuxent Wildlife Research Center; Ray Meyer, La Tierra Environmental Consulting; Brian Locke, Fort Bliss; Stephanie Jones, USFWS; Tom Shane; John Dunning, Purdue University; Brent Ortego, Texas Parks and Wildlife; and Chuck Hunter, USFWS. Front cover illustration by Janet M. Ruth. Joanne Munro assisted with the range map. Stephanie Jones, USFWS Region 6 Nongame Bird Coordinator, and Bill Howe, USFWS Region 2 Nongame Bird Coordinator, supported this project and made it possible. Layout and production provided by Beverly Boecher, USFWS Region 6 Visual Information Specialist.

TAXONOMY

Common Name: Cassin's Sparrow

Spanish Common Names: Gorrion de Cassin or Zacatonero de Cassin

Scientific Name: *Aimophila cassinii*

Order: Passeriformes

Family: Emberizidae

The first Cassin's Sparrow was described in 1852 by Samuel W. Woodhouse from a specimen collected near San Antonio, Texas, and given its species name in honor of John Cassin, a Philadelphia ornithologist (Terres 1980). The species was originally known as *Zonotrichia cassinii* (AOU 1998). It was subsequently and variously assigned to the genus *Peucaea* and eventually to *Aimophila* around the turn of the century (Wolf 1977). Much of the confusion seems to have stemmed from a serious lack of knowledge about the anatomy and life history of the species included in the genus.

There have been several substantial treatments of the taxonomy of species within the *Aimophila* genus (Wolf 1977, Storer 1955) and a comparison of the song patterns of *Aimophila* sparrows (Borror 1971), but they have focused primarily on evaluating the evolutionary development of these species in order to determine whether this genus actually consists of an unnatural assemblage of species (actually representing several taxonomic groups or divergent forms) (Storer 1955). None of these publications called into question the placement of Cassin's Sparrow within this genus in what is called the "botterii complex" - Botteri's Sparrow (*Aimophila botterii*), Bachman's Sparrow (*A. aestivalis*), and Cassin's Sparrow (*A. cassinii*).

No subspecies or races of Cassin's Sparrow are recognized (Pyle 1997; AOU 1957; Dunning et al. 2000).

LEGAL STATUS**United States**

Cassin's Sparrow is protected under the Migratory Bird Treaty Act of 1918. The Cassin's Sparrow is not listed as threatened or endangered under the federal Endangered Species Act. It is included on the list of "Migratory Nongame Birds of Management Concern in the United States: the 1995 List" issued by the U.S. Fish and Wildlife Service (USFWS 1995). In that report, it is listed as a species of concern in USFWS Regions 2 and 6.

Cassin's Sparrow is listed on the joint National Audubon Society-Partners in Flight "WatchList" (Muehter 1998), a list of species of national conservation concern. The WatchList identifies human alteration of habitat and loss of suitable mixed grass-shrub habitat as threats.

The Nature Conservancy (TNC) global rank for Cassin's Sparrow is G5, indicating a demonstrably secure population.

Cassin's Sparrow does not have any legal status in any of the states in which it occurs. Appendix A provides other details of its status in these states.

Legal Status

Mexico

Cassin's Sparrow is protected under the Convention for the Protection of Migratory Birds and Game Mammals of 1936, but has no other legal status.

DESCRIPTION

The Cassin's Sparrow is a fairly large, plain, grayish sparrow that lacks conspicuous markings. In flight, the long, roundish tail is obvious and the white tips of the tail feathers are sometimes apparent. This species is most easily identified by its distinctive song and dramatic skylarking behavior during the breeding season. Although often characterized in the literature as secretive and difficult to observe when not singing (Williams and LeSassier 1968; Oberholser 1974; Kaufman 1990), Schnase (1984) observed that Cassin's Sparrows readily accommodated the presence of an observer, especially early in the breeding season.

Average body mass of males in Kansas in June ($n = 11$) is 17.8 g (range = 16.9 - 18.5 g) (Rising 1996); average body mass (both sexes) in southeastern Arizona year round ($n = 125$) is 18.3 (± 2.9) g (Dunning and Bowers 1986). Size is 13-15 cm, with males being slightly larger; the sexes are similar in coloration (Rising 1996). Table 1 shows linear measurements from collected specimens.

Table 1. Linear measurements (mm) of Cassin's Sparrow. Data shown as mean (range; n). From Wolf (1977).

Measurement	Males	Females
Wing Chord	64.0 (62 - 67; 43)	62.0 (59 - 66; 16)
Tail Length	68.0 (64 - 71; 13)	66.0 (62 - 71; 13)
Tarsus	19.9 (18.5 - 21.4; 45)	19.8 (18.8 - 21.4; 37)
Culmen Length (from anterior of nostril)	7.7 (6.8 - 8.3)	7.5 (7.0 - 8.2)
Bill Depth	4.9 (4.5 - 5.5)	4.8 (4.5 - 5.1)

Plumage

Plumage references (Rising 1996; Byers et al. 1995; Kaufman 1990).

Adult - The head is brown streaked with gray and dark brown; the supercilium is buff, and there is a thin, dark brown submoustachial stripe. The bill is brownish gray, with darker upper mandible and pale bluish gray tomial edge and lower mandible. The iris is dark brown. The chin, throat and breast are pale gray or brownish gray; the belly is whitish; and there are a few well-defined dark brown or black streaks on the lower flanks. On the back, the mantle and scapulars are described as brown or gray with a rusty tinge, the feathers having dark brown subterminal spots and edged with buff or gray, giving a scaly or variegated appearance. Wings are brown; greater coverts are broadly tipped and narrowly edged with buff or grayish white, forming a wing bar variously described as fairly conspicuous to indistinct. The alula is pale yellow. Feathers in the upper tail coverts have a gray edge, a brown center, and a black subterminal crescent. The undertail coverts are buffy. Most of the upper side of the tail is dark, dusky brown, but the central two rectrices are pale brownish gray with a serrated dark central strip that spreads out into a suggestion of faint crossbars. The lateral two rectrices are edged and tipped in pale gray or white, with smaller

pale areas at the tips of the next two pairs inward. This is sometimes noticeable on a bird flushing or flying away, but it is not always apparent, and by late summer, pale tips may be partly or completely worn away. Legs are described as dull pinkish or dark flesh.

Juvenile - Juveniles are similar to adults with a brown back, feathers with buffy tips and darker brown central streaks, greater coverts edged with white, and light streaking on breast and throat.

Byers et al. (1995) noted that some birds, mainly in the eastern part of their range, tend to be more rufous above, slightly buffier below, and have plainer tails with less obvious shaft streaks and barring on the central rectrices. Although rarer, even in the eastern part of the range, the rufous morph has been observed as far away as the Farallon Islands off California (J. Dunning pers. commun.).

Willoughby (1986) reports on an unusual sequence of molts and plumages in Cassin's and Bachman's Sparrows – replacement of all pennaceous body plumage twice within a bird's first six months of age, and a gradual molt of body feathers in adults throughout the breeding season. Designated as a presupplemental molt, this molt has been fully documented in certain species only recently, having been found in 16 species of North American passerines to date (Pyle 1997).

NATURAL HISTORY

Song

The Cassin's Sparrow's primary song consists of six note complexes, beginning with a soft double or single introductory note, followed by a long, high musical trill on one pitch, and (usually) two lower, well-spaced musical notes, all with a slight minor-key quality. There is enough individual variation in this song that it has been used as a means of identifying individual males in population studies (Schnase and Maxwell 1989). A secondary song, or "chitter" song (Wolf 1977), consists of a series of chips, trills, and buzzy notes preceding the primary song (Schnase 1984). Cassin's Sparrows also give a variety of chitter calls and chip notes that have been assigned various roles by different authors, including pair bond maintenance, communication with fledglings, alarm calls, territory defense, etc. (Kaufman 1990; Schnase 1984; Wolf 1977). Unusual conditions may induce this species to sing at unusual times of year (Kaufman 1990).

Territorial males sit in low bushes or grass, or on the ground to sing, but often give spectacular flight-songs. At the beginning of the breeding season, all song is from a stationary, exposed perch and often involves reciprocal proclamation of the primary song among males. Flight songs and skylarking are infrequent until later, in association with the presence of returning females (Schnase et al. 1991; Schnase 1984). In flight songs (or skylarking), the territorial male flies up from an exposed perch, such as a bush, to as much as 5 - 10 m in the air, then sings as he glides or flutters down in an arc to a nearby bush or the ground. During the descent, wings are held flat, the head is arched backwards, and the tail is elevated. Song can be heard from mid-February to early September, depending on location, with considerable night singing at the

height of the season reported by some (Rising 1996; Howell and Webb 1995; Schnase 1984; Oberholser 1974).

Diet

The summer diet of Cassin's Sparrows consists primarily of insects, especially grasshoppers, caterpillars, and beetles. Additional insects specifically mentioned in the literature include true bugs, ants, bees, wasps, weevils, spiders, snails, and moths (Dunning et al. 2000; Kaufman 1996; Bock et al. 1992; Oberholser 1974; Williams and LeSassier 1968). The young are fed almost entirely insects (Kaufman 1996). Bock et al. (1992) note that observations of a Cassin's Sparrow nest for 18 hours in 1984 showed that of 208 insects delivered to nestlings, 197 (95%) were acridid grasshoppers. However, Wolf (1977) reported that the stomachs of ten adults taken during the breeding season (late June and early July) contained animal and vegetable matter in about equal proportions (52% and 48%, respectively; range = 5 - 95%). He also found that five migrant Cassin's Sparrow stomachs contained 99% animal material (range = 90 - 100%). There is a report of Cassin's Sparrows eating flower buds of blackthorn bush (*Condalia spathulata*) in season (Oberholser 1974). In fall and winter, Cassin's Sparrows eat the seeds of weeds and grasses (Kaufman 1996; Williams and LeSassier 1968). Oberholser (1974) particularly mentions the consumption of seeds of chickweed (*Alsinaceae* family), plantain (*Plantago* spp.), woodsorrel (*Xanthoxalis* spp.), sedge (*Carex* spp.), panicum (*Panicum* spp.), other grasses, and sorghum (*Sorghum* spp.).

Schnase (1984) reports observing birds drinking water from a small pool immediately following a rain. Although Williams and LeSassier (1968) report that Cassin's Sparrows seem to exist very well without drinking water, their conclusion appears to be based on the limited number of recorded observations of this species drinking water, the distance of most nesting areas from water, and the fact that birds rarely leave their territories.

Cassin's Sparrows forage mostly or entirely on the ground, hopping about in relatively open areas, taking items from the ground or from plant stems (Kaufman 1996, Schnase 1984). When flushed, they fly to a bush or fence, or may drop back into the grass (Rising 1996). Schnase (1984) reported that foraging occurred in a slow, methodical manner. Foliage gleaning from within mesquite (*Prosopis* spp.) and other shrubs was only prominent after nestlings and fledglings were present. Fledglings apparently acquired most of their food in this manner rather than on the ground.

Territory and Site Fidelity

Cassin's Sparrows establish and maintain breeding territories solely by song (Schnase et al. 1991); mating, nesting, and feeding occur within these territories. Mean territory size over two years ($n = 21$) in south-central Texas was found to be 2.6 (± 0.5) ha (Schnase 1984); the information was also presented as a mean density of 11 birds per 40.4 ha. A number of other studies have reported Cassin's Sparrow breeding densities. However, it is unlikely that these numbers can be compared with each other since various methods of data-gathering and analysis were used. Nevertheless, they do provide some idea of the

possible densities for this species. Another study in south-central Texas found densities ranging from 33 birds per 40.4 ha in scrubby mesquite grassland to six birds per 40.4 ha in bottomland mesquite woodland (Maxwell 1979). A Breeding Bird Census on a 61 ha plot on the Buenos Aires National Wildlife Refuge in Arizona found 15 Cassin's Sparrow territories for a density of ten territories per 40 ha (Gordon and Leitner 1996). By comparison, A. Flesch (written commun.) reports that in a good year, Buenos Aires NWR supported densities of 86 singing males per 40 ha. In an unpublished study of bird communities in sacaton (*Sporobolus* sp.)-mesquite grasslands along the San Pedro River in Arizona, one transect showed annual peak breeding densities (based on Emlen transects) of 41, 66, 91, and 19 birds/40 ha in respective years; a second transect showed annual peak densities of 39, 26, and 14 birds/40 ha (D. Krueper written commun.). A study of avian communities within a variety of habitats along the Pecos River (Hildebrandt and Ohmart 1982) found a range of Cassin's Sparrow densities (presenting calculations from the summer periods of June - July and August - September). They found 6 - 12 birds per 40 ha in sparse (little foliage volume above 1.5 m) honey mesquite (*Prosopis glandulosa*) habitat; 6 - 12 birds per 40 ha in sparse four-winged saltbush (*Atriplex canescens*) habitat; 6 - 24 birds per 40 ha in low (little foliage above 3 m) to sparse tamarisk (*Tamarix chinensis*) habitat; 2 - 7 birds per 40 ha in cleared communities dominated by annual and perennial weeds and shrubs; and 3 - 4 birds per 40 ha in cleared communities dominated by grass.

Schnase (1984) found no overlap in territorial boundaries, and adjacent territories were separated by 15-75 m; Johnsgard (1979) reported that territorial males may be spaced 50-100 yards apart. Both Williams and LeSassier (1968) and Johnsgard (1979) report observations of clusters or groups of breeding Cassin's Sparrows and suggested that they may be semi-colonial.

Research on site fidelity in wintering grassland birds in southeastern Arizona (Gordon In Press a and b) found high within-season recapture rates for Cassin's Sparrows on seven ha plots, indicating very sedentary behavior for this species. Using three years of data, he calculated the recapture event rate - *rer* (the number of recaptures divided by the number of opportunities for recapture). Cassin's Sparrow (*rer* = 0.11) and Grasshopper Sparrow (*Ammodramus savannarum*) (*rer* = 0.09) remained within a very small area (or territory) during the winter, showing significantly higher ($P < 0.05$) recapture rates than Baird's Sparrow (*A. bairdii*) (*rer* = 0.04), Savannah Sparrow (*Passerculus sandwichensis*) (*rer* = 0.01), Vesper Sparrow (*Pooecetes gramineus*) (*rer* = 0.02), and Brewer's Sparrow (*Spizella breweri*) (*rer* = 0.004). Patterns of between-year capture and recapture rates in wintering Cassin's Sparrows indicate great variability, possibly tied to between-year nomadism, between-year population fluctuation, or expansion-retraction along the edge of their range (C. Gordon written commun.). For example, at the same plots with the same level of effort, nine Cassin's Sparrows were captured in the winter (January to March) of 1997 and 43 were captured in 1998. One of the

nine individuals from 1997 was recaptured in 1998, and in 1999, one "1997 bird" (a different one), and one "1998 bird" were recaptured (all of these recaptures on the same seven ha plots on which they were first banded), indicating that between-year site fidelity does exist to some extent.

Breeding Ecology

Breeding in Cassin's Sparrow across its range can occur from March through September. Rising (1996) notes that breeding appears to take place in early summer in coastal Texas, Kansas, Colorado, and north-east New Mexico, and in late summer (after the rains) in southeastern Arizona. See Appendix A for specific information about breeding timing and records from individual states.

Schnase (1984) reports indirect evidence that Cassin's Sparrows form stable, monogamous pair bonds. Some sources believe that this species may double-brood (Baicich and Harrison 1997; Rising 1996; Wolf 1977). However, Schnase (1984) reported that, although re-nesting took place in three cases where abandonment or destruction of a clutch occurred before mid-June, there was no evidence that any of the 25 pairs he observed successfully reared more than one clutch.

Schnase (1984) reports that females returned later than males in the spring and their return coincided with the onset of skylarking by males. Males pursued females to the border of their territories. Males frequently pursued females in slow, horizontal flight no more than 2-3 m above the ground while producing the "chitter" call. Copulation has only been observed rarely. Schnase (1984) reports that the male initiates a courtship display involving an erect head and tail with wings fluttering in an outstretched position which is followed by copulation; this was seen twice on the ground and once in a low mesquite.

Cassin's Sparrows nest on or near the ground. There are approximately equal numbers of reports of ground nests and nests elevated a few inches off the ground in shrubs or other vegetation approximating shrub structure (e.g., cactus). Nests on the ground are usually concealed in tall grass or grass tufts, or at the base of shrubs or *Opuntia* cacti (Baicich and Harrison 1997; Rising 1996; Schnase 1984, Johnsgard 1979; Williams and LeSassier 1968). Nests in shrubs are rarely located more than 12 inches above the ground (Table 2). They are often found in the midst of a tangled patch of *Opuntia* cactus (Williams and LeSassier 1968). The nest is a deep cup constructed of dead grasses, weed stems, bark and plant fibers, and sometimes grass flowers. It is lined with finer grasses and grass flowers, rootlets, and sometimes hair (Baicich and Harrison 1997; Rising 1996; Williams and LeSassier 1968).

Table 2. Information about nest dimensions, nest placement, and clutch size from studies in southeastern Arizona (Maurer et al.1989), Texas (Schnase 1984; Schnase et al. 1991) and New Mexico (A. Pidgeon written commun.).

	Maurer et al. 1989	Schnase 1984; Schnase et al. 1991	Pidgeon written commun.
Avg. nest height			
from ground (cm)	10.8 (\pm 5.9) (n = 18)	4.0 (\pm 2.3) (n = 10)	15.0 (n = 6)
Avg. cup depth (cm)	5.4 (\pm 0.4) (n = 17)	6.4 (\pm 1.0) (n = 10)	N/A
Avg. cup width (cm)	6.5 (\pm 0.4) (n = 18)	5.9 (\pm 0.6) (n = 10)	N/A
Nest plant height (m)	0.7 (\pm 0.2) (n = 18)	0.4 (\pm 0.1) (n = 9)	0.6 (n = 6)
Avg. clutch size	3.0 (\pm 0.9) (n = 10)	2.2 (\pm ??.?) (n = ??)	3.7 (n = 10)

The subelliptical eggs of Cassin's Sparrows are white and unmarked, smooth and slightly glossy. The average size is 19 x15 mm. Cassin's Sparrows lay three to five eggs, usually four (Table 2) (Baicich and Harrison 1997; Johnsgard 1979; Williams and LeSassier 1968). Berthelesen and Smith (1995) found a slightly larger average clutch size in their study (4.4 ± 0.61 , n = 34).

Little documented evidence was found on the incubation period for Cassin's Sparrow. Baicich and Harrison (1997) estimate it at ten days. Schnase et al. (1991) observed incubation of 11 days in one nest. They found that females laid one egg each morning and began incubation with the third egg of a four-egg clutch. Males were never observed at the nest, and Schnase et al. (1991) assumed that females were the primary brooders. Dunning et al. 2000 Data for three Arizona nests in which the incubation period was 11 days, 11 days, and 9 days for the three nests (Dunning et al. 2000).

Nestlings are altricial, with sparse, very dark down (Baicich and Harrison 1997); Schnase (1984) described nestlings as naked except for sparse, light-gray down on the head and back, with pronounced yellow rictal flanges and dark red mouth lining. Most records indicate that the nestlings are tended by both parents (Baicich and Harrison 1997; Williams and LeSassier 1968; Johnson 1956), but Schnase et al. (1991) found little evidence regarding male-female cooperation in feeding nestlings. The parents are extremely secretive in their approach to the nest, making nest finding very difficult. A. Flesch (written commun.) reported observing parents carrying fecal sacs. Nestlings leave the nest at approximately nine days (Baicich and Harrison 1997, Schnase et al. 1991). Schnase et al. (1991) did find that females assumed primary responsibility for care of the young once they fledged. In addition, they found that within two days of fledging, young were capable of repeated flights of 10-15 m, and that periods of independent foraging in vegetation and on the ground were common for fledglings eight days after leaving the nest.

Eventually fledglings became less dependent and associated with fledglings from adjacent territories in flocks of as many as 10-20 individuals that moved throughout territories (Schnase 1984).

Very little information is available regarding productivity in Cassin's Sparrows and the minimal information available from different studies is widely variable. Schnase (1984) observed a total of 40 fledglings produced by 25 males for a 1.6 fledglings/male ratio over three summers. Two of the 25 males were unpaired, and five of 23 pairs were not successful in fledging any young. Schnase identified productivity by male because individual birds in the study (males) were identified primarily by variation in song. The presentation of these data made further interpretation difficult. A study of breeding bird use of Conservation Reserve Program (CRP) lands in the Texas Panhandle (Berthelsen and Smith 1995) estimated Cassin's Sparrow nest success ($n = 34$) as 44 (± 0.89) % through fledging, using the Mayfield method. Preliminary data from a study on Fort Bliss ($n = 10$) found the mean number fledged per nest was 1.9 (A. Pidgeon written commun.).

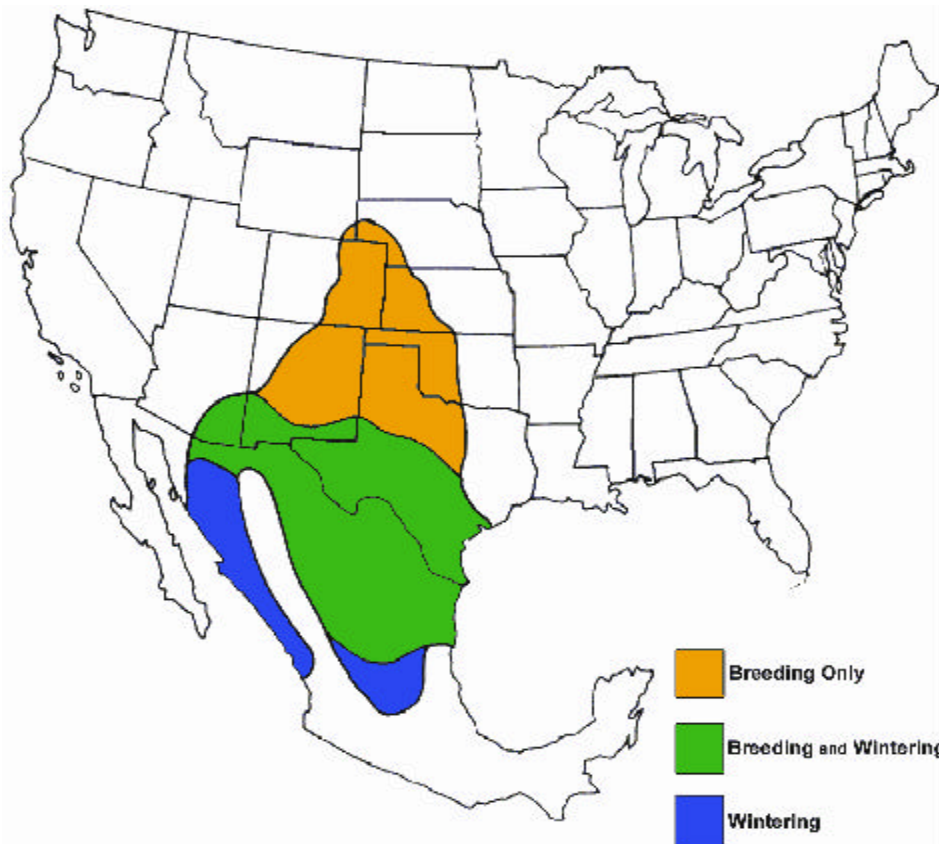
Migratory Behavior

Nothing is known about the migratory behavior of this species.

RANGE

Cassin's Sparrow is a species of the southwestern U.S. and central Mexico (Figure 1).

Figure 1. Breeding and wintering distribution of Cassin's Sparrow. They are found in suitable grassland/shrubland habitat within the boundaries shown.



There is little information about the historical range of Cassin's Sparrow, and therefore little evidence of whether the species' range has expanded or contracted. This is complicated by the annual fluctuations in distribution of this species. However, records in the last twenty years of Cassin's Sparrows breeding in Wyoming and Nebraska may represent an expansion of their distribution, in some years at least. Hubbard (1977) suggests that the more recent documentation of breeding Cassin's in southwestern New Mexico and southeastern Arizona may also represent an expansion of their breeding range.

Breeding

Even the current breeding range for this cryptic species continues to be difficult to define. Cassin's Sparrows are sometimes very common but are irregular, with large numbers often appearing in an area after good rains have caused vegetation to turn green (Kaufman 1996). In addition, because there have been so few records of Cassin's Sparrow nests, many of the descriptions of breeding range are based on the presence of singing males.

The breeding distribution of the Cassin's Sparrow is described by Breeding Bird Survey (BBS) data (Figure 2).

Figure 2. Summer distribution map for Cassin's Sparrow from Breeding Bird Survey (BB) 1982-1996 (Sauer et al. 1997). This is the average relative abundance of the species detected per BBS route per year.

BBS SUMMER DISTRIBUTION MAP 1982-1996

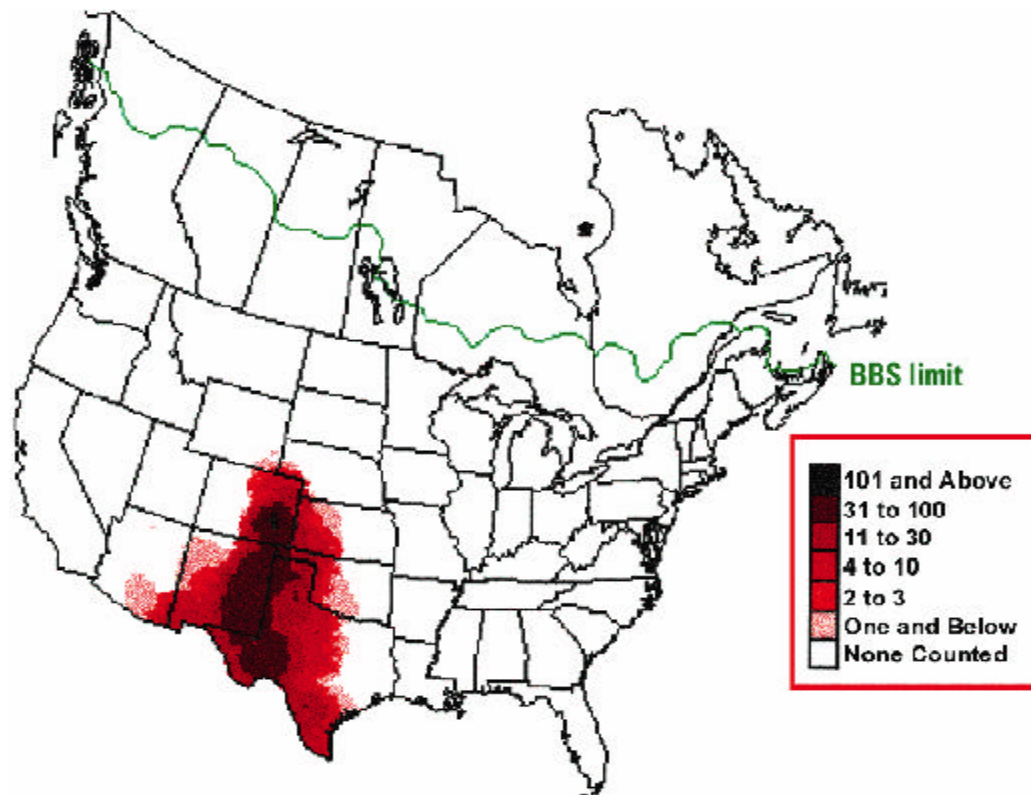
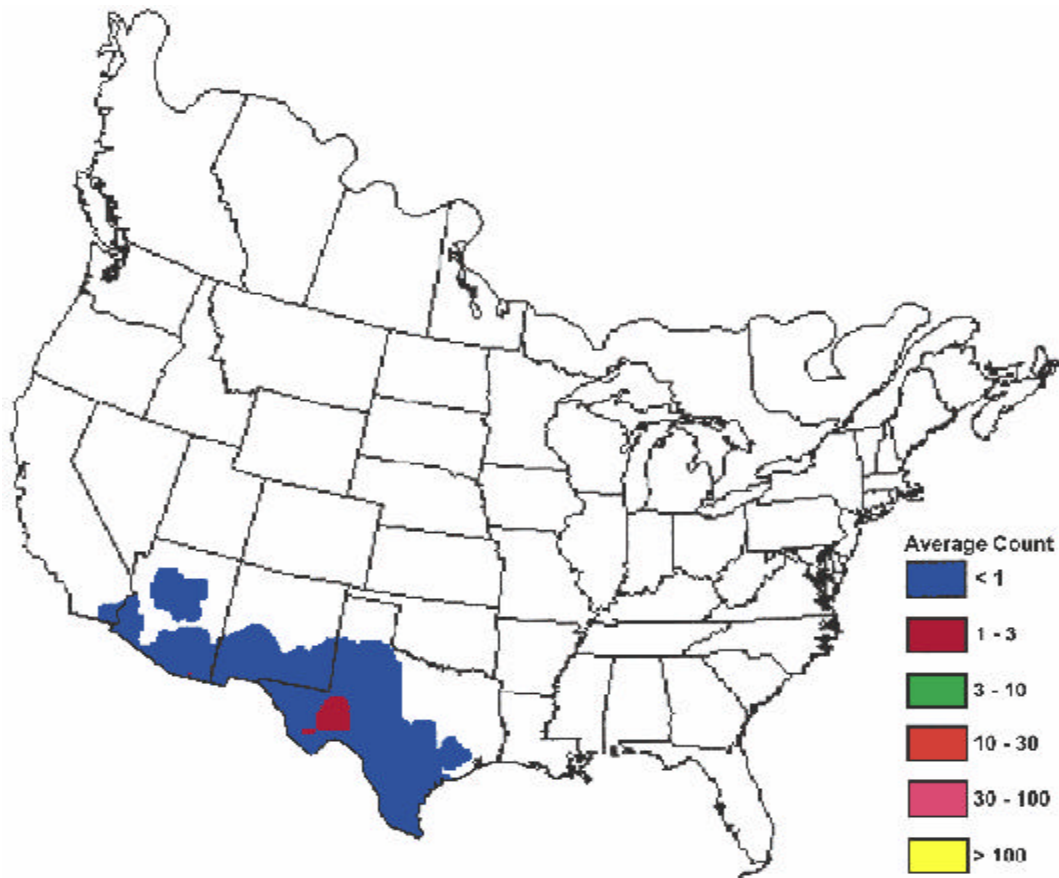


Figure 3. Winter distribution map for Cassin's Sparrow from Christmas Bird Count (CBC) 1966 - 1989 (Sauer et al. 1996). This is average relative abundance of the species per CBC circle.

CBC WINTER DISTRIBUTION 1966 - 1989



A compilation of existing descriptions of the species' breeding distribution from the literature yields the following (Howell and Webb 1995; Rising 1996; AOU 1998): Cassin's Sparrows breed from southwestern Nebraska, western Kansas, southeastern Colorado (irregularly into northeastern Colorado), southern and eastern New Mexico, western Oklahoma, western two-thirds of Texas, Chihuahua, Coahuila, in the interior south to Zacatecas and San Luis Potosí, and on the Atlantic slope from Nuevo Leon to Tamaulipas. Sporadic records exist for central and eastern Wyoming, and southwestern South Dakota. See Appendix A for detailed information on distribution within individual states.

Migration

Cassin's Sparrows are migratory in the northern part of their range, withdrawing basically into the southern part of their range and possibly a little farther south in Mexico for the winter. Defining the arrival and departure times for Cassin's Sparrows throughout their range is somewhat difficult because the data are derived from miscellaneous arrival, breeding, and nesting dates. A migratory flux of Cassin's Sparrows arrives in Texas in March, even in areas where some individuals overwinter (Hubbard 1977), and Texas has the earliest breeding records for Cassin's Sparrow - early March (Hubbard 1977; Oberholser 1974). They are

reported breeding in Mexico in April (Howell and Webb 1995). They also return to New Mexico in large numbers in early April (Hubbard 1977) and to Oklahoma by late April (Baumgartner and Baumgartner 1992). The first nest-building in southeastern Colorado was observed in mid-May (J. Bradley pers. commun.), but the Colorado Breeding Bird Atlas records most nesting activity beginning in early June (Kingery 1998). Egg dates for Kansas begin in mid-May (Johnsgard 1979). Breeding of Cassin's Sparrows begins in southeastern Arizona in July (Maurer et al. 1989; Monson and Phillips 1981).

It appears that Cassin's Sparrows may leave Colorado and Oklahoma by the end of August. The last nest monitored for fledglings in southeastern Colorado during a 1996 study was in the first week of August (J. Bradley pers. commun.), and Cassin's Sparrows are recorded through August in Oklahoma (Baumgartner and Baumgartner 1992). The majority leave New Mexico by late September (Hubbard 1977). In Texas, breeding records occur through early August and the winter season for Cassin's Sparrows begins in mid-October (Oberholser 1974). Breeding in southeastern Arizona and Mexico continues through September (Maurer et al. 1989; Monson and Phillips 1981; Howell and Webb 1995). Migration patterns in Arizona continue to be poorly defined, and although Cassin's Sparrows winter over most of their breeding range in Mexico, there may be some withdrawal south during that period (Howell and Webb 1995).

Cassin's Sparrows sometimes turn up far outside their normal range during migration, with scattered records from coast to coast (Kaufman 1996). Roberson (1980) reports five records of spring and fall vagrants in the Southeast Farallon Islands, California, as well as spring and summer nomads in potential breeding habitat in southern California (25 records), where singing males defended territories for a brief time and then disappeared. They have been reported as casual or accidental in Nevada, Ontario, Nova Scotia, Missouri, Illinois, Indiana, and New Jersey (Rising 1996; AOU Checklist 1998; Dunning et al. 2000). Russell and Monson (1998) also documented unexpected locations for Cassin's Sparrows outside their normal range in Mexico in years of above-normal rainfall (e.g., a dozen singing Cassin's Sparrows among sand dunes near Puerto Peñasco (far northwestern Sonora) in late March-early April 1984).

There are reports of gender differences in migration patterns, with males appearing in Texas in the spring at least two weeks before the females (Schnase et al. 1991; Schnase 1984).

Wintering

The winter distribution of Cassin's Sparrows in the U.S. is based on Christmas Bird Counts (Figure 3).

Unfortunately, similar information does not exist for its primary winter range in Mexico. A compilation of the descriptions in the literature of the species' wintering range results in the following (Howell and Webb 1995; Rising 1996; AOU 1998): Cassin's Sparrows winter in southeastern Arizona, only rarely or sporadically in southern New Mexico, in western and south-central Texas, and into Mexico on the Pacific slope from Sonora through

Sinaloa to Nayarit and south in the interior including Chihuahua, Coahuila, Zacatecas, San Luis Potosí and Guanajuato. See Appendix A for available details on winter distribution in individual states.

**Distribution Changes
In Response To
Precipitation**

There is a consensus, throughout the literature and among the contacts made for this report, that breeding Cassin's Sparrows are very responsive to precipitation. However, little is offered in the way of evidence or specific descriptions of that response. In addition, there appear to be some differences of opinion regarding how this response manifests itself. Many references associate variations in Cassin's Sparrow abundance with variations in precipitation patterns and associated vegetation growth, but some suggest that there are more Cassin's Sparrows when there is more rain (Phillips 1944; Williams and LeSassier 1968), while others suggest that there are more birds when there is less rain (M. Howery pers. commun.; C. Sexton, written commun.; Andrews and Righter 1992). These differences may be related to different geographic locations and associated weather patterns. Baumgartner and Baumgartner (1992) spoke most clearly about this. They noted that Cassin's Sparrows are most abundant in western Oklahoma, but that they expand eastward in the state during periods of drought, when vegetation is stunted and pastures that normally sustain tall or mixed grasses approximate the more arid conditions of western plains.

Maurer (1985) conducted a broad study of avian community responses to temporal distribution of rainfall and spatial distribution of mesquite trees on the Santa Rita Experimental Range (SRER). Although the focus was on community-level responses, he did present information specific to Cassin's Sparrows. In southeastern Arizona, July through September is the season of greatest rainfall, with an associated high grass productivity (Cable 1975) and increase in available insect biomass (Maurer 1985). During the first year of this study, the site received average rainfall; during the second year it received abnormally high winter precipitation and somewhat delayed, but normal, summer rainfall. The following data were extracted from Maurer (1985), but did not include statistical tests for significance. In grassland habitats with low mesquite densities (the habitat preferred by Cassin's Sparrows), Cassin's Sparrow densities increased in the breeding season following greater precipitation (1982 - 43.2 males/km²; 1983 - 71.2 males/km²). Even in mesquite savannah habitat (less preferred by Cassin's Sparrows), bird densities increased following the year of greater precipitation (1982 - 4.9 males/km²; 1983 - 34.5 males/km²).

To summarize these observations, it appears that the broad temporal fluctuations in Cassin's Sparrow distribution and numbers (Figure 4a and 4b) are a response to changes in timing and amount of precipitation.

Figure 4a. Annual indices of abundance by state for Cassin's Sparrow from Breeding Bird Survey. Annual indices of abundance are estimated as residuals from the route-regression. The line, depicting the predicted trend in counts over time, is drawn using the regional trend estimate and a regional average count (Sauer et al. 1997).

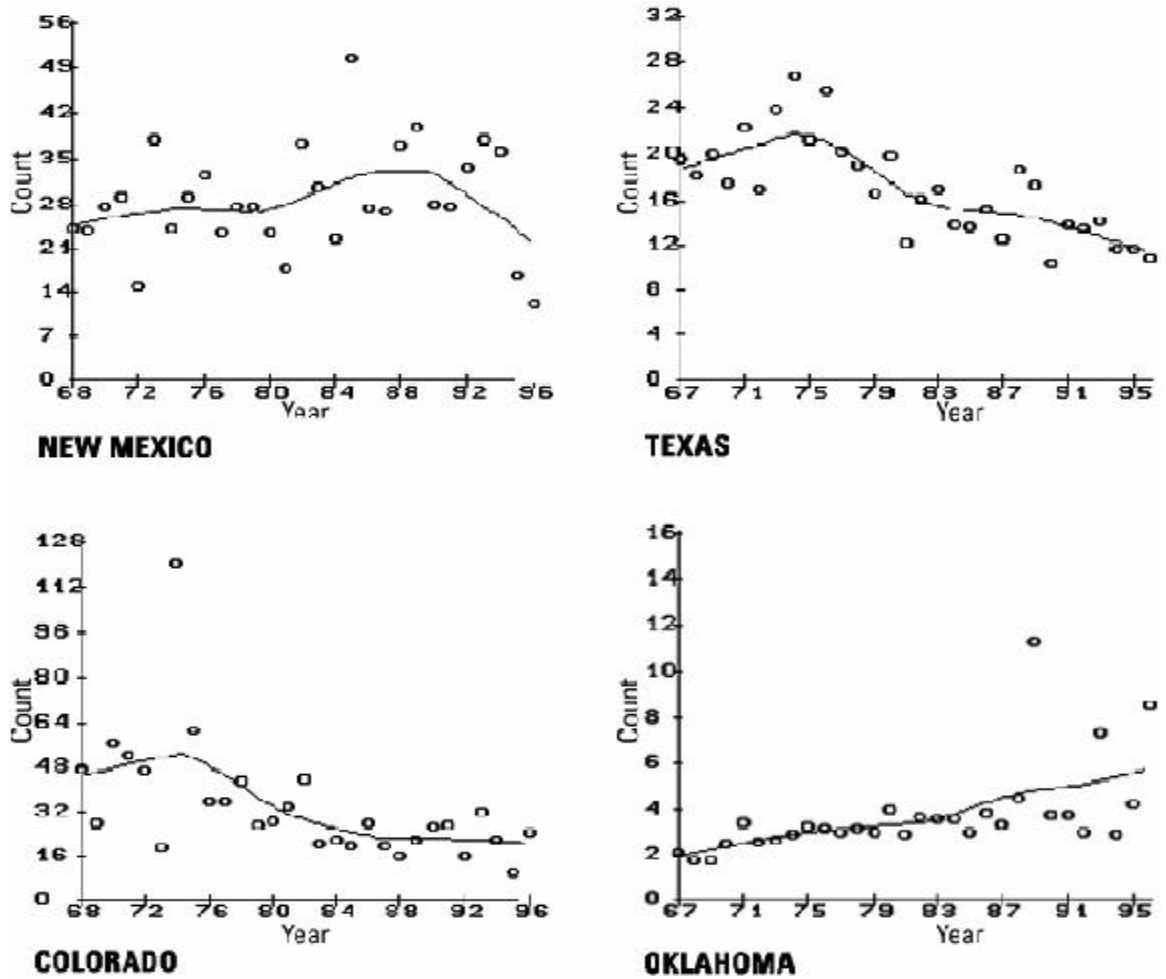
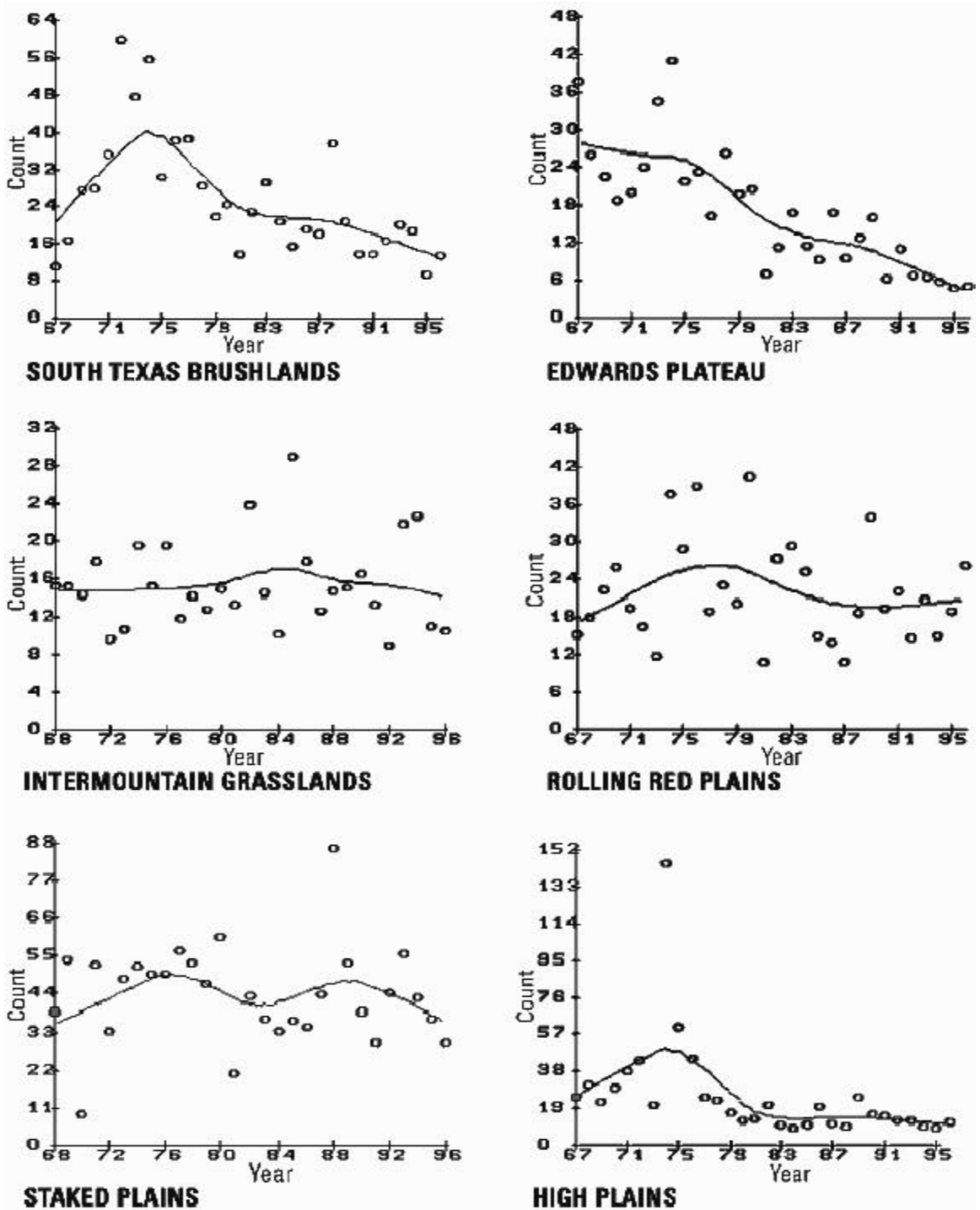


Figure 4 b. Annual indices of abundance by physiographic strata for Cassin's Sparrow from Breeding Bird Survey. Annual indices of abundance are estimated as residuals from the route-regression. The line, depicting the predicted trend in counts over time, is drawn using the regional trend estimate and a regional average count (Sauer et al. 1997).



The most likely factors to which they are ultimately responding are changes in vegetative structure and vigor. Thus, at the eastern and northern edges of their range, where there is usually more rainfall and the grass structure is usually too tall or dense for Cassin's Sparrow habitat, Cassin's Sparrows only expand or increase in abundance in dry years. In these dry years the vegetative structure is stunted and sparse, and more closely approximates their preferred habitat. In contrast, at the southwestern edge of their range, where rainfall can be quite sporadic and the grass structure in dry years is not sufficient to support Cassin's Sparrows, Cassin's Sparrows only expand or increase in abundance in wet years, when the vegetative structure is lush enough for them. In the core of their range, a similar pattern may be occurring, which is manifest as increases in abundance in years with precipitation and habitat structure that are optimal, and decreases in suboptimal years. However, such fluctuations would be more difficult to observe because they are not accompanied by expansions in distribution.

There remains much to understand about the factors affecting Cassin's Sparrows dramatic fluctuations in distribution. Although they appear to be responding to the effects of changing precipitation patterns, the actual process by which precipitation affects them is unclear. They may be responding to changes in vegetative structure or composition needed for nesting, hiding from predators, or courtship displays, as suggested above. In that case, the rapid response noted in the birds, which often seem to appear and begin singing within days of the first rains of the season and before the vegetation has responded, remains to be explained. It may mean that they have evolved to respond to the initiation of rain itself as a proximal cue, rather than the actual greening of vegetation which follows. An alternative explanation for the Cassin's Sparrow response to precipitation is that they are responding to changes in prey populations (particularly insects such as grasshoppers) that in turn are responding to changes in precipitation. There is no direct evidence of this association, but Maurer (1985) concluded that the influence of rainfall on insect productivity strongly affected the avian community in Arizona, and there is evidence that grasshopper populations respond positively to precipitation in the southwestern U.S. (Capinera and Horton 1989; Capinera and Thompson 1987; Nerney 1961).

**Theory Regarding
Unusual “Migration”
Patterns In
Cassin’s Sparrows**

There remains an unresolved controversy regarding the migration and breeding patterns of Cassin’s Sparrows. Phillips (1944) was the first to specifically address this issue. He based his hypothesis on the lack of documentation of breeding in Arizona at the time, and his observations that large numbers of Cassin's Sparrows did not appear in the state until July and August, when males sang and were in breeding condition (enlarged testes). Phillips concluded that the species did not breed in Arizona but rather migrated east-to-west, from its principal breeding areas in Texas to southeastern Arizona, where it was an abundant fall transient and an irregular, rather common winter resident.

Subsequently, nesting Cassin's Sparrows have been documented in southeastern Arizona in late summer (Monson and Phillips 1981; Ohmart 1966). In response to this evidence, Ohmart (1969) suggested that a single population of Cassin's Sparrows took advantage of the food source provided by spring rains on the Great Plains, and then moved southwest for a second breeding season in the Sonoran Desert in response to food sources produced there by late summer rains. Wolf (1977) suggested that the late summer males might be individuals that did not mate during the breeding season (presumably on the southern Great Plains) and were migrating early without undergoing gonadal regression. Hubbard (1977) espoused the view that Cassin's Sparrows may have bred very locally and perhaps irregularly in Arizona for some time, but that the bulk of the late summer birds were nonbreeders.

Although there are no published studies addressing this issue, there are very strong opinions about the hypothesis. There are those who believe that Cassin's Sparrows are also present in southeastern Arizona during spring and early summer but are so cryptic and secretive that they are simply not observable until they begin singing and skylarking in response to late summer rains. Others are very insistent that if Cassin's Sparrows were present, even if acting secretive, experienced birders and researchers would have detected them. Still others are more comfortable with an intermediate interpretation – that Cassin's Sparrows are simply very opportunistic and move around on a much larger scale than most species, looking for the right combination of rain, vegetation, and food resources needed for breeding. In any case, this is an unresolved question regarding Cassin's Sparrow ecology.

MONITORING ACTIVITIES

Breeding Bird Survey (BBS)

Monitoring of breeding Cassin's Sparrows on a range-wide basis in the United States, and to a minimal extent in Mexico, is restricted to the BBS. The interpretation of BBS data is limited in at least some areas by the low numbers and distribution of routes completed in an area, by the highly variable nature of Cassin's Sparrow annual distributions, and by the fact that their most active, observable breeding season at times coincides with the early summer timing of BBS data collection and at times does not.

A three-year BBS feasibility study was conducted in Mexico from 1993 - 1996. None of those routes have been surveyed subsequently. With the exception of a few routes that are sporadically surveyed by U.S. citizens, the BBS does not exist in Mexico at this time. Expansion of the BBS program, or an equivalent, into Mexico would provide valuable information about Cassin's Sparrow populations there.

Results of BBS data analysis and additional details about BBS data from individual states and Mexico are presented elsewhere (Trends section and Appendix A).

Christmas Bird Count (CBC)

The Christmas Bird Counts in the southwestern part of the United States only cover a small portion of the Cassin's Sparrow winter range (Root 1988). There are a few CBCs done in Mexico by coalitions of U.S., Mexican, and in some cases Canadian citizens, primarily in Sonora, Chihuahua, and Tamaulipas, although there is no organized program for the country.

Breeding Bird Atlases

Breeding Bird Atlases (BBAs) are conducted by states to document the distribution and reproductive status of breeding birds within their borders. Most BBAs are five-year projects, however, some states plan to periodically repeat Atlas projects. Once repeated, atlas projects will provide valuable information on changes in Cassin's Sparrow distribution. Although only one state within its range (Colorado) has published its breeding bird atlas, Cassin's Sparrows were detected during BBA data collection in six states - Arizona (Arizona Breeding Bird Atlas unpub. data), Texas (Arnold and Benson unpub. data), Oklahoma (Oklahoma Breeding Bird Atlas unpub. data), Kansas (Busby and Zimmerman unpub. data), Colorado (Kingery 1998), and Nebraska (Sharpe et al. unpub. data). New Mexico and Wyoming have not conducted Breeding Bird Atlas projects. Summaries of BBA data for each state can be found in Appendix A.

Although there are no other range-wide monitoring programs, there are some site-specific monitoring projects being conducted at various locations (Appendix A).

POPULATION ESTIMATES AND TRENDS

Great fluctuations in annual numbers at any particular location make it difficult to estimate the overall population of Cassin's Sparrows or monitor trends in that population.

Population Estimates

No population estimates for Cassin's Sparrows were found in the literature or during the compilation of information for this report.

Trends

The best available description of population trends for Cassin's Sparrow is from BBS data analysis. For purposes of this document, trends with a P-value ≤ 0.20 are presented; any pattern with a larger P-value is considered nonsignificant.

Survey-wide data for Cassin's Sparrow during the entire time period for which BBS data are available (1966 - 1996), show a highly significant decline (Table 3). During this same time period, Cassin's Sparrow data in Texas show a similar, highly significant downward trend, with Colorado and Kansas also showing a significant decline. No other state data within the bird's range show any significant trends in either direction for the entire BBS time period (Sauer et al. 1997). Figure 4a shows annual indices of abundance for New Mexico, Texas, Colorado, and Oklahoma. Figure 5 maps the variation in population trend estimates for this species over the entire time period covered by BBS.

Table 3. Trends (average percent change per year) for Cassin's Sparrow from Breeding Bird Survey data from 1966-1996 (Sauer et al. 1997; Sauer unpub. data^a).
P-value: * 0.10 < *P* ≤ 0.20 ** 0.05 < *P* ≤ 0.10; *** 0.01 < *P* ≤ 0.05; **** *P* ≤ 0.01⁽¹⁾

	1966 - 1996		1966 - 1979		Total Time Period 1980-1996	
	Trend <i>p</i> - value	<i>n</i>	Trend <i>p</i> - value	<i>n</i>	Trend <i>p</i> -value	<i>n</i>
SURVEY-WIDE	-2.5	**** 203	+0.4	96	-0.2	186
STATES						
Arizona	+1.5	5	N/A	N/A	+2.8	5
Colorado	-4.1	* 32	-9.6	** 8	+2.6	*** 32
Kansas	-8.3	* 10	-4.1	6	-1.2	7
New Mexico	+0.3	36	+0.5	9	-1.1	35
Oklahoma	+3.0	20	+9.3	* 8	+1.2	18
Texas	-2.9	**** 99	+1.8	63	-0.9	89
PHYSIOGRAPHIC STRATA⁽²⁾						
S. TX Brushlands	-3.4	**** 21	+5.2	** 16	-2.9	* 19
High Plains Border	-0.8	15	+8.6	* 9	-2.5	* 11
High Plains	-4.5	* 31	-8.8	*** 10	+2.5	*** 30
Edwards Plateau	-7.0	**** 19	-4.8	* 14	-5.7	**** 17
Rolling Red Plains	-0.9	19	-1.4	10	+0.6	18
Staked Plains	-0.3	27	-0.8	11	-0.6	25
Chihuahuan Desert	-1.7	29	+1.6	14	-0.5	28
Intermt. Grasslands	-0.4	18	+2.5	3	-2.7	17
REGIONS						
Central BBS Region	-2.6	**** 149	+0.3	77	0.0	134
Western BBS Region	-1.9	* 54	+1.8	19	-1.1	52
USFWS Region 2	-2.3	**** 160	+1.7	81	-0.9	* 147
USFWS Region 6	-4.4	* 43	-8.5	*** 15	+2.5	*** 39

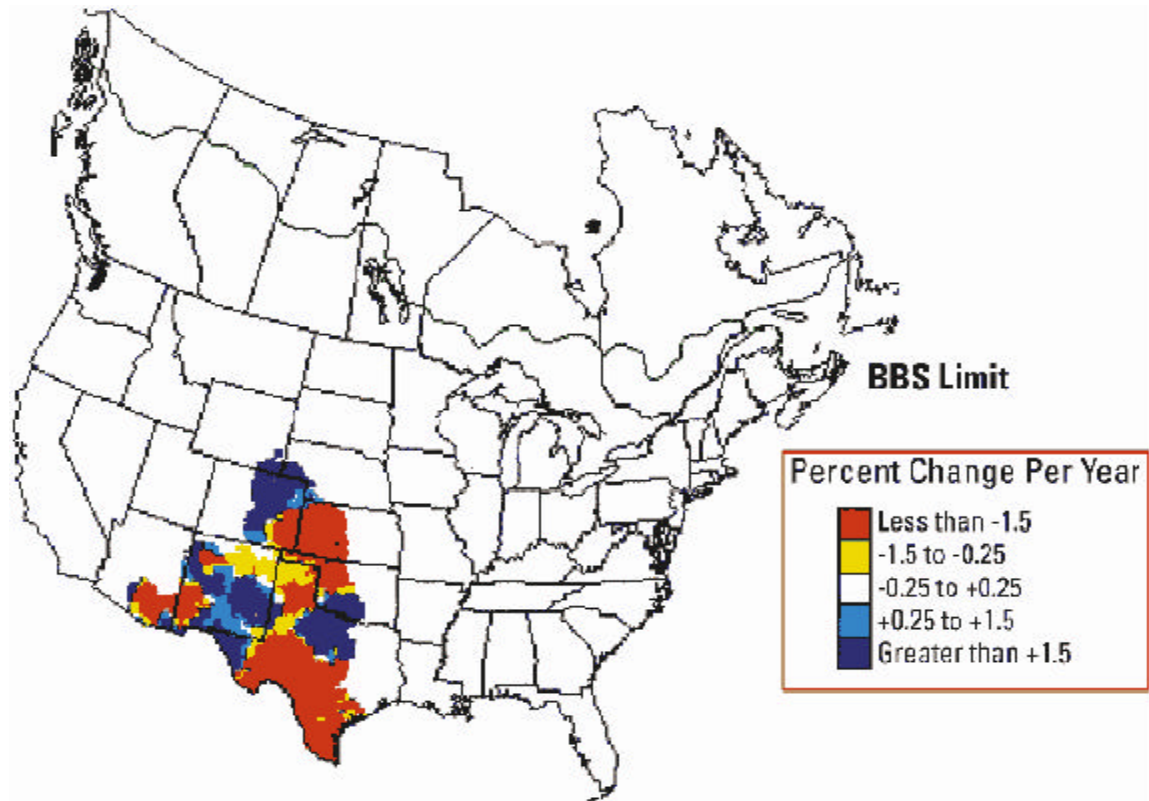
(1) Without a significant *p* - value, there is no evidence that the trend is significantly different from zero (no trend), and without sufficient sample size (BBS normally only calculates trends with a sample size of *n* > 14), trend estimates are not reliable. A few results with *n* < 14 are presented here solely to document the limited data available for some areas within Cassin's Sparrow range.

(2) Some Physiographic Strata have recorded a few Cassin's Sparrows, but the sample size is not large enough to calculate a trend estimate - Coastal Prairies; Oaks and Prairies; Osage Plains; Rolling Red Prairies; and Mexican Highlands.

When BBS data analysis is broken down into shorter time periods (Sauer et al. 1997), however, the patterns rapidly break down (Table 3). Survey-wide data for Cassin's Sparrow show no significant trends for either the 1966 - 1979 or the 1980 - 1996 periods. At the state level Colorado data show a significant decline for 1966 - 1979 and a very significant increase for 1980 - 1996. Oklahoma data show a somewhat significant increase for 1966 - 1979, and no significant pattern for 1980 - 1966. No other state data show any significant trends for either of these shorter time periods.

Figure 5. Annual population trend estimates for Cassin's Sparrow from Breeding Bird Survey 1966 - 1996 (Sauer et al. 1997)

BBS TREND MAP 1966 - 1996



In spite of this variation in temporal trend patterns at larger scales, much of which may be related to the great variation in annual distribution of this species, several basic evaluation criteria can be identified to search for potential problems at smaller scales, such as at the physiographic stratum level. Patterns in which early (1966 - 1979) trends were level or increasing and later (1980 - 1996) and overall (1966 - 1996) trends are declining would appear to be of more concern than patterns where early declines or level trends are followed by increases. In addition, trends that show up in the core of Cassin's Sparrow range are more likely to raise concern than patterns on the periphery where annual variations in distributions may be greater.

Using these criteria identifies the trends in Texas (Table 3) as a potential area of concern. We observed the most significant downward trend in Cassin's Sparrow numbers over the entire BBS time period, and no clear pattern in either of the shorter time periods. By looking at the trend patterns in individual physiographic strata (Table 3) within Texas, one can get an idea of where the problems might be. The most obvious pattern of concern is in the Edwards Plateau where there is a somewhat

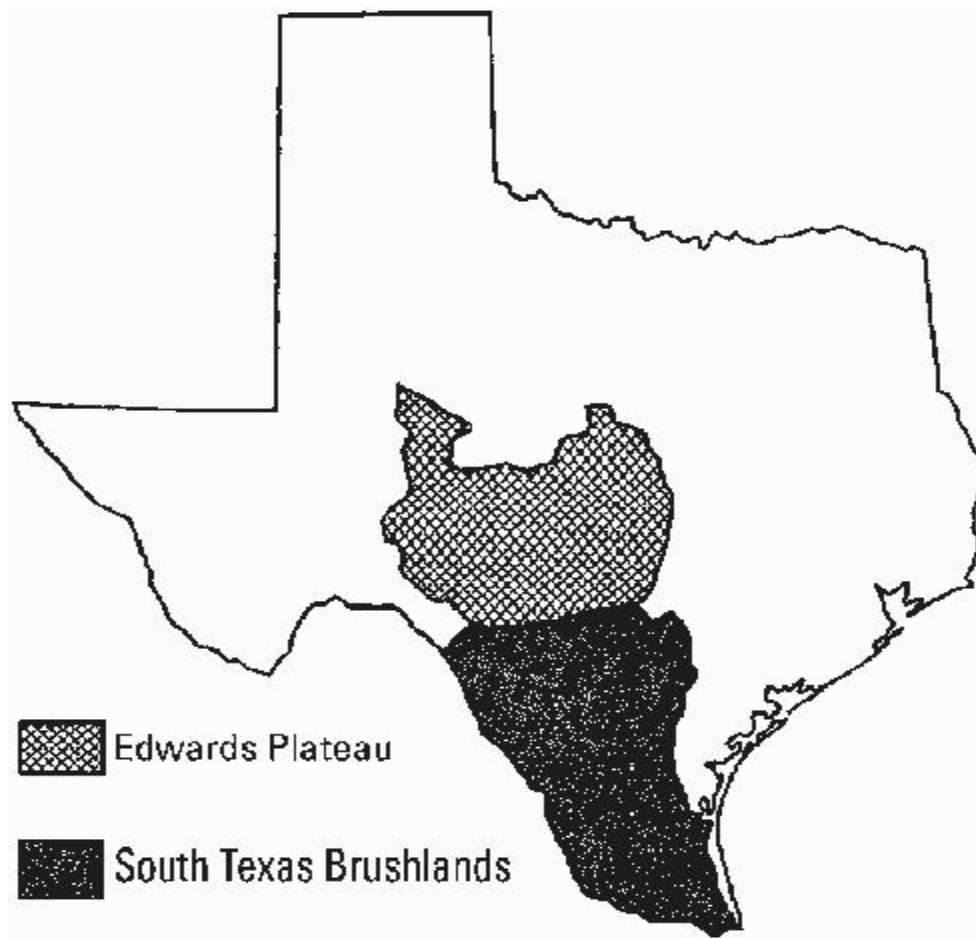
significant downward pattern in 1969 - 1979, followed by highly significant, steep declines in 1980 - 1996 and across the entire time period. Of similar concern are the patterns in the South Texas Brushlands where there was a significant increase from 1966 - 1979, then a somewhat significant decrease from 1980 - 1996, and an overall highly significant decline for the entire time period (1966 - 1996). Figure 4b shows annual indices of abundance for these and other physiographic strata. There are not any significant or consistent trends to raise concern in the other physiographic strata in Texas with large enough sample sizes to analyze for Cassin's Sparrow trends (Rolling Red Plains; Staked Plains; Chihuahuan Desert). From this information, it would appear that the declines in Texas, and possibly the survey-wide trends for this species, are being driven primarily by declines in the Edwards Plateau and the South Texas Brushlands.

Applying the same criteria to New Mexico, which is also within the core of the Cassin's Sparrow's range, the BBS data show no significant or consistent trends over time and neither do any of the physiographic strata within the state (Table 3).

Possible Explanation of Trends

Historic Landscape Change in Texas - The Edwards Plateau of central and west-central Texas (Figure 6) covers about 93,240 square kilometers (Riskind and Diamond 1988). It has undergone significant landscape-level habitat changes in recent history. Prior to settlement, most of the Plateau was a fire-maintained savannah whose principal woody species was live oak (*Quercus fusiformis*). Due to intense, confined grazing which removes fuel and reduces water infiltration rates, and the resulting decreased fire frequency, the Plateau has experienced widespread expansion of woody plants, especially Ashe juniper (*Juniperus ashei*), resulting in dense stands locally known as "cedar brakes" (Fowler and Dunlap 1986; Riskind and Diamond 1988; Taylor and Smeins 1994; Fuhlendorf et al. 1997). The result is a transformation from grassland and oak savannah communities to a woodland dominated by juniper, oak, and mesquite. It has been found that Ashe juniper has the potential to produce nearly closed canopy stands where composition and diversity of flora (such as herbaceous ground cover) and fauna can be greatly altered (Fuhlendorf et al. 1997). However, Fuhlendorf et al. (1997) did find that the influences of Ashe juniper are dependent on factors including the size of the juniper trees and long-term grazing or browsing history (with appropriate browse levels controlling some of its spread and negative effects). There is no evidence that Cassin's Sparrows use the cedar brake habitats. In Maxwell's study (1979) in the northwestern part of the Edwards Plateau, of the two habitat types in which another juniper species (*Juniperus pinchotii*) was the dominant tree - juniper-liveoak savannah and scrub oak shrubland - one Cassin's Sparrow was observed during the breeding season and winter in one year in the former, and none were observed in the latter. These numbers are small in comparison to those reported by Maxwell in more preferred habitats, as described in the "Habitat" section of this report.

Figure 6. Map of Texas showing Edwards Plateau and South Texas Brushlands physiographic strata.



In addition to the threats posed by woody encroachment, there has been substantial suburban development in the eastern and southern parts of the Edwards Plateau (B. Ortego pers. commun.; K. Bryan pers. commun.), with the Plateau becoming more important as a recreational and second home area (USFWS 1992; Fuhlendorf et al. 1997). Counties on the eastern Edwards Plateau surrounding Austin and San Antonio, as well as smaller cities such as San Marcos and New Braunfels, are experiencing population growth rates several times greater than the U.S. average and projections are that it will continue (USFWS 1990; USFWS 1992).

The South Texas Brushlands encompass about 8 million ha in the southern tip of Texas (Figure 6), just south of the Edwards Plateau. In presettlement times, much of south Texas was covered by grassland with scattered groves of thorn forest (Rappole et al. 1986). However, as a result of a combination of fire reduction and grazing pressures, by the early 1900's there had been a considerable change in the grasslands, with an increase in cacti and woody species on upland sites, an increase in annual grasses, and a decrease in perennial grasses (Rappole et al. 1986), so that south Texas is described now as semiarid brushland. In comparison with the Edwards Plateau, in the South Texas Brushlands, the

threats posed to Cassin's Sparrows may actually be related to destruction of brushland through conversion to agriculture, urban development, and brush control, as opposed to shrub encroachment. For example, since the 1920's in the Lower Rio Grande Valley (LRGV) (the southernmost part of the South Texas Brushlands), more than 95% of the original native brushland has been converted to agriculture or urban use (Jahrsdoerfer and Leslie 1988). Brushlands have been converted through mechanical clearing, pesticides, and fire. Large-scale removal of brush began in the early 1900's. By the early 1930's extensive mechanized brush removal began, developing methods including tractors pulling large cables, heavy chains, rolling choppers, root plows, brush mowers, and tree grubbers (Inglis et al. 1986). In the Rio Grande Plain alone, more than 3,000 ha of brush/year were destroyed from 1930 to 1948; more than 21,000 ha/year from 1949 to 1954; and almost 20,000 ha/year from 1955 to 1959 (Davis and Spicer 1965). From 1940 to 1981, Texas landowners treated an average of 600,000 ha annually to remove thorn forest (Welch 1982). In comparison to brushlands cleared for agriculture, rangelands that are managed for brush will at least eventually return to less diverse brushlands with a grass component. However, most efforts lead to a control-regrowth cycle of five to ten years (Davis and Spicer 1965), and the land is often planted to exotic buffelgrass (*Pennisetum ciliare*) to increase forage for livestock. This exotic grass competes with native grass and forbs, greatly reducing habitat value for birds, as well as other flora and fauna (Jahrsdoerfer and Leslie 1988). Finally, urbanization poses an additional threat to the South Texas Brushlands. Using the LRGV as an example again, human population has increased steadily since the early 1900's, with the period from 1980 to 1990 expected to outgrow the state average of 27% with a rate of 40% (Jahrsdoerfer and Leslie 1988).

HABITAT

Although Cassin's Sparrows use slightly different habitats in different parts of their range, the common denominator across all habitats seems to be that they require both a grass component (usually short grass) and a shrub component. The latter component may be actual shrub species [e.g., mesquite, sage (*Artemisia* spp.), hackberry (*Celtis* spp.), rabbitbrush (*Chrysothamnus* spp.), or oaks (*Quercus* spp.)] or other vegetative forms that approximate shrub structure [e.g. yucca (*Yucca* spp.), paddle cacti (*Opuntia* spp.), ocotillo (*Opuntia* spp.) or bunch-grasses] (Baicich and Harrison 1997; Rising 1996; Williams and LeSassier 1968). The need for the structure provided by shrubs or similar plants is related to the bird's need for perches from which to sing or launch itself for its flight song and its frequent use of low shrubs for nest placement. Schnase (1984) also noted that the mesquite thickets within Cassin's Sparrow territories were distinctly preferred when fledglings were present. It appears that relative proportions of grass and shrubs in acceptable Cassin's Sparrow habitat cover a wide range from grassland habitats with a very sparse distribution of shrubs to shrubland habitats with a grass cover (JMR).

See Appendix A for specific descriptions of the habitat used by Cassin's Sparrows in individual states. See Appendix B for additional habitat descriptions from primary references cited in sections below.

Specific research on habitat selection in Cassin's Sparrows has been limited and much of it was conducted in southeastern Arizona habitats. This is worthy of note since the application of these conclusions across the entire breeding range of Cassin's Sparrow may not be warranted. The variation in habitats used across their range is great, and Cassin's Sparrow response to habitat and environmental change may also vary. Broad application of these results should be done with care.

Breeding Season Habitat Requirements

Results of studies conducted in semidesert grasslands in southeastern Arizona at the Appleton-Whittell Research Ranch (AWRR, also called the Audubon Research Ranch) and surrounding land in Santa Cruz and Cochise Counties were consistent with the "common denominators" mentioned above. A comparison of habitat selection in three *Aimophila* sparrow species found that Cassin's Sparrows were positively and significantly correlated with upland mesquite grassland mesa habitat, as compared with sacaton bottomlands, or ravine and slope habitats (Webb and Bock 1990). A comparative study of grassland bird habitat preferences in the same area found that Cassin's Sparrows were most strongly associated with areas of high shrub canopy cover and density. They rarely occupied plots with greater than 35% bare ground, and usually avoided areas with less than 6% shrub canopy cover (Table 4). Compared to the other species in the study, they preferred sites with more, taller grass and less bare ground, and occurred more often near mesquite trees (Bock and Webb 1984). See Appendix B for additional descriptions of the upland grassland habitat at AWRR.

Table 4. Average characteristics of plots occupied by Cassin's Sparrows (from Bock and Webb 1984).

Vegetative Characteristic	Mean (SD)
Bare ground (%)	23.0 (±4.5)
Grass cover (%)	68.8 (±7.5)
Grass height (cm)	29.1 (±6.4)
Mean dist. (m) to 3 nearest mesquite trees	18.4 (±14.2)
Mesquite canopy (%)	03.7 (±3.3)
Shrub canopy (%)	10.3 (±5.5)
Shrub density (shrub/100 m ²)	23.6 (±13.9)
Herb cover (%)	02.9 (±1.9)

Results from another set of studies on bird communities in southeastern Arizona at the Santa Rita Experimental Range (SRER) in Pima County might initially appear contradictory to those mentioned above. In a comparison of avian communities in grassland habitat with low mesquite density (called "grasslands") and habitats with high mesquite density (called mesquite savannah), Maurer (1985) found that Cassin's Sparrows were more common in the "grasslands" than in "mesquite savannah" (Table 5). In a related paper focusing on habitat modeling, Maurer

(1986) found that Cassin's Sparrows were positively associated with greater ground cover and grasses typical of healthy ranges, and were negatively associated with mesquite trees and grass species characteristic of poor range conditions (e.g., Rothrock grama (*Bouteloua rothrockii*) - they tended to avoid areas of high mesquite density and low grass cover. See Appendix B for additional descriptions of the habitat at SRER.

Table 5. Densities of singing males per square km in two habitat types (from Maurer 1985).

Year	Mesquite Savannah	Grassland
1982	4.9	43.2
1983	34.5	71.2

A closer look at these papers indicates that they may not really be contradictory. I believe that the AWRR and the SRER are located at different places along a habitat continuum, with the AWRR found at one end of the continuum described as upland grasslands with a low density of large shrubs and mesquite, and the SRER at the other end described as a desert shrubland with high mesquite densities and varying amounts of grass ground cover. In this light, the combined results may actually tell us more about Cassin's Sparrow habitat use, rather than showing conflicting results. It is possible that at the AWRR, since Cassin's Sparrows require a shrub component in their habitat and very few shrubs were available, they preferred sites with more mesquites. By comparison, at the SRER where plenty of mesquite are available but Cassin's Sparrows also require a grass component, the birds preferred sites with relatively lower mesquite density. In fact, Maurer (1986) states that there is generally a negative relationship between mesquite density and grass productivity at SRER. In other words, Cassin's Sparrows require a shrub component within grasslands, but if shrub density becomes too great, there is no longer a grass component under/between the shrubs to meet the species' other need. Although it is not possible to confirm this by comparing shrub densities due to lack of compatible data in the two manuscripts, scrutiny of the literature and personal conversations with individuals familiar with these areas (D. Krueper pers. commun.; C. Bock pers. commun.) support this hypothesis.

A study of breeding biology in south-central Texas found that all Cassin's Sparrow territories included some combination of dense mesquite thicket and open, grassy areas with scattered cacti and small, shrub mesquite trees. An average of 28.4% of individual territories was composed of mesquite thickets (Schnase 1984). Another study in the same area (Maxwell 1979) compared bird densities from September 1975 to June 1977 in eight different plant communities - riparian forest, juniper (*Juniperus* spp.)-live oak savannah, scrub oak shrubland, bottom mesquite woodland, upland mesquite woodland, defoliated mesquite shrubland, scrubby mesquite grassland, and grassland. He found the highest breeding densities of Cassin's Sparrows in scrubby mesquite grassland (33 birds per 40.4 ha in 1976 and 20 birds per 40.4 ha in 1977). He described this habitat as having an absolute shrub density of 717/ha, a relatively low foliage height diversity (0.540), the lowest percent vegetative

cover (92%) of all sites, a foliar ground cover from 0.3 to 1.2 m of 22% and from 1.2 to 3.1 m of 1%. They were also found in lower densities in bottomland mesquite woodland (6 and 1/40.4 ha), upland mesquite woodland (7 and 8/40.4 ha), grassland (7 and 11/40.4 ha), and defoliated mesquite (7 and 11/40.4 ha). Winter surveys found only a few Cassin's Sparrows in upland mesquite woodland (2/40.4 ha in 1977), and juniper-live oak savannah (1/40.4 ha in 1977). Maxwell states that Cassin's Sparrows are found from open grassland through all stages of mesquite succession, being most common in scrubby mesquite grasslands and, as mesquite increases in stature and density, Cassin's Sparrows decrease in abundance and eventually abandon the site. See Appendix B for additional descriptions of the habitat at these sites.

A study conducted in southern New Mexico and central Chihuahua (Meents 1979) focused primarily on total bird community measures, but provided some species-specific information. Cassin's Sparrows were present on all four sites during the breeding season, but were most abundant at the La Campana site in northern Chihuahua (mean birds per roadside census = 74.0); values for the three southern New Mexico sites were 14.5, 17.4 and 8.0 respectively. Although she did not evaluate individual species associations with habitat, her characterizations of vegetation at the four sites indicate that the La Campana site had higher shrub cover - 8.4 % (\pm 5.6) - as compared with the other sites which had 0.5 % (\pm 0.5); 0%; and 0% respectively. Percent grass and forb cover appeared quite similar. This lack of shrub component at the other sites may explain the smaller numbers of Cassin's Sparrows found there during the breeding season. La Campana was the only site where Cassin's Sparrows were found in the winter, and there in extremely small numbers (mean birds per roadside census = 1.0). See Appendix B for additional descriptions of the habitat at these sites.

A study of grassland bird habitat use on the Comanche National Grasslands in Colorado found that sites where Cassin's Sparrows were detected could be characterized by 27% bare ground, 14.8% shortgrass, 37.8% midgrass, 8.5% forbs, 2.4% cholla, 4.6% yucca, 0.9% low shrub (<1 m), and 4.1% tall shrub (>1 m) (Gillihan 1999).

Winter Habitat Requirements

Very little research has been done to define the wintering habitat of Cassin's Sparrow. Rising (1996) reports that in the winter they occur in habitat very similar to their breeding habitat, but only in the southern part of their U.S. range. Kaufman (1996) reports that in migration and winter, they are found in pure grassland, brushy areas, and deserts. On the wintering grounds in Texas, Cassin's Sparrows in desert areas seek brushy draws and canyons, while in southern Texas they use prickly-pear cactus (*Opuntia* sp.) and thick brush that dot savannahs (Oberholser 1974). K. Bryan (pers. commun.) stated that Cassin's Sparrows used a more limited set of habitat types in the winter in Texas than they did while breeding. He felt they were using the thickest, well-developed grassland with a shrub mosaic, and although they were in the Trans-Pecos in the winter, they weren't using the desert scrub that they did during breeding season. In southeastern Arizona, Cassin's Sparrows occupy small grassy cienegas in lowland desert flats

otherwise dominated by creosote bush (*Larrea tridentata*). These cienegas have dense grass coverage, with scattered mesquite and other shrubs (J. Dunning pers. commun.).

A study of the size and structure of wintering avian communities in seven habitat types in south Texas, found that Cassin's Sparrows occurred in three habitat types -- open brushland (60% grass/forbs and 10% low shrubs), dense brushland (50% grass/forbs and 30% low shrubs), and two-layered brushland (50% grass/forbs, 30% low shrubs, and 10% tall shrubs). These three habitat types could be defined as grassland/shrub habitats along a continuum from grass with scattered patches of dense shrubs and mesquite, to dense shrubland with a layer of taller mesquite and acacia shrubs above the dominant shrub layer. Cassin's Sparrows were not found in grass-forb prairies (100% grass/forbs), scrub grasslands (60% grass/forbs, 40% creeping brush and no shrubs), oak woodlands, or riparian forest. (Emlen 1972). See Appendix B for additional descriptions of the habitat at these sites.

A study of distribution patterns and habitat associations of wintering grassland birds on the Mexican Plateau (Carter et al. 1997; Carter et al. 1998) found that Cassin's Sparrows were found on plots with more than average shrub cover, bare ground, litter, and tall grass.

MANAGEMENT

Because Cassin's Sparrows are very responsive to vegetative structure and grass/shrub components of their habitat (see above), they are potentially affected by a number of management practices including grazing and shrub control. However, reaching any conclusion about the effects of various management practices or environmental conditions on Cassin's Sparrows is difficult due to the limited literature on this subject. As mentioned elsewhere in this report, there have been several studies each on grazing, fire, and exotics impact on Cassin's Sparrows and other grassland birds, but they have focused on a small area that arguably could be called the periphery of the species' range - southeastern Arizona. Therefore, any application of this information to other parts of Cassin's Sparrow range should be done with caution.

See Appendix B for additional habitat descriptions from primary references cited in sections below.

Grazing

There are definite reasons to view the existing literature regarding Cassin's Sparrow responses to grazing with caution. As Saab et al. (1995) state, ". . . birds respond differently to livestock grazing in different places. The same amount of grazing that can be used to create ideal habitat for a species in a tallgrass prairie may be equally certain to destroy that same species' habitat in a shortgrass steppe or semidesert grassland. Therefore, management recommendations, derived from (synthesized) data . . . should be tailored to the various sorts of grasslands involved." In fact, they go on to single out Chihuahuan Desert grasslands as an example of climatically stressed habitats where environmental perturbations like grazing can result in conversion into desert shrublands. Although the grasslands of southeastern Arizona cannot technically be classified in this group, they certainly represent arid grasslands that may be more susceptible to grazing impacts than Cassin's Sparrow habitat

in other parts of its range. In light of the evidence of Cassin's Sparrow distributional response to changes in precipitation, it seems likely that it is a species for which a particular grazing regime or intensity may have very different effects under different vegetation or precipitation conditions. It is certainly the case that some habitats within the core of Cassin's Sparrow habitat, such as eastern New Mexico, are almost all grazed, and yet continue to support substantial Cassin's Sparrow populations (JMR).

The effects of grazing on Cassin's Sparrows can be addressed at two levels. The most obvious is the direct and immediate effect of grazing on the habitat structure preferred by Cassin's Sparrows - reduction of vegetative height and density, or changes in species composition through grazing preference. Most of the information presented here falls in that category.

Knopf (1996), in his discussion of endemic grassland birds and their distribution across grassland habitats in the west, places Cassin's Sparrows at the mixed grass to mixed grass/shrub end of a bareground-shortgrass-mixed grass-mixed/shrub habitat continuum, and at the moderate-light-none end of an excessive-heavy-moderate-light-none continuum representing historical (bison) grazing patterns. He states that breeding habitats of Cassin's Sparrow were probably outside the distribution of historically large herds of bison on the plains.

A study comparing breeding grassland bird use of southeastern Arizona grasslands on grazed and ungrazed land (Bock and Webb 1984) concluded that Cassin's Sparrows were excellent indicators of lightly grazed or protected range, but only where shrubs or small trees are present. Over two breeding seasons, Cassin's Sparrows were found only on ungrazed sites (Table 6a). Both Cassin's Sparrows and Grasshopper Sparrows were found to occupy areas with more and taller grass cover and less bare ground than did Horned Larks (*Eremophila alpestris*) and Lark Sparrows (*Chondestes grammacus*) (Table 4).

Another study of grazed and ungrazed sites in the same area (AWRR and an adjoining ranch) during the breeding and nonbreeding seasons (Bock et al. 1984) found that Cassin's Sparrows were significantly more abundant on ungrazed plots than on grazed plots in both breeding and winter seasons (Table 6a). In fact, in both cases this species was only found on ungrazed sites. The amounts of ground cover and shrub cover were major determinants of the bird communities. The ungrazed plots supported 45% more grass cover, a comparatively heterogeneous grass community, and significantly more herbaceous cover than did grazed plots (Table 6b). Woody plants were significantly more abundant overall on ungrazed plots (although mesquite was uncommon throughout and did not differ between treatments), and various individual shrub species were denser and/or larger on the ungrazed plots (showing evidence of cattle browsing on grazed plots). An extension of this study, including an additional site and additional year of data, confirmed the above results (Tables 6a and 6b) – although some Cassin's Sparrows were found on grazed plots, they were

significantly more abundant on ungrazed upland grassland sites across seasons (Bock and Bock 1988).

Table 6a. Results of three related studies comparing Cassin's Sparrow responses to grazing in southeastern Arizona (Bock and Webb 1984; Bock et al. 1984; Bock and Bock 1988).
* significantly greater than other treatment $P < 0.01$; ** $P < 0.001$.

Source	Ungrazed	Grazed
1. Bock and Webb (1984)		
Mean birds/plot		
Breeding season 1981 ($n = 9$)	4.0 (± 2.0)*	0
Breeding season 1982 ($n = 14$)	2.2 (± 1.0)*	0
2. Bock et al. (1984)		
Total birds/treatment		
Breeding season ($n = 2$)	66**	0
Wintering season ($n = 2$)	42**	0
3. Bock and Bock (1988)		
Total birds/treatment		
Across seasons ($n = 4$)	209**	19

Table 6b. Results of two related studies describing effects of grazing on vegetative cover in southeastern Arizona (Bock et al. 1984; Bock and Bock 1988). Asterisks (*) indicate treatment significantly greater than other treatment * $P < 0.05$; ** $P < 0.001$

Source	Vegetation Category	Ungrazed	Grazed
Bock et al. 1984	Percent Ground Cover		
	Grasses - total	80.4**	55.6
	Herbs - total	12.0**	5.6
	Woody plants - total	13.5	11.5
	Bare ground	17.6	34.6**
	Woody plant numbers		
	Total woody plants/plot	37.6**	9.5
Bock and Bock 1988	Percent Basal Area Cover		
	Grasses	52.0*	36.0
	Herbs	13.0	10.0
	Shrubs	6.0*	1.0
	Bare ground	27.0	51.0**

An unpublished study of bird community responses to the removal of cattle from the BLM's San Pedro Riparian National Conservation Area in southeastern Arizona found that Cassin's Sparrow density increased from 1986 (before cattle were removed), through 1987 (when they were removed), to 1991. This response appears to be related to changes in sacaton-mesquite habitats along the river following cattle exclusion - foliage volume at several levels increased substantially during this time period (D. Krueper written commun.).

Although not supported by particular documentation, Sutton (1967) describes preferred Cassin's Sparrow habitat in Oklahoma variously as "moderately" or "lightly" grazed sand prairie with a scattered shrub component.

The second and related question regarding the effects of grazing is, what are the more long-term effects of grazing on the landscape and subsequently on Cassin's Sparrow habitat? The complicated nature of grassland ecology, especially as it applies to different types of grasslands, is beyond the scope of this document. However, in general it is recognized that the long-term result of grazing in many southwestern grassland habitats is a significant reduction of fuel loads and a subsequent reduction in the frequency and intensity of fire that, historically, has controlled the invasion of woody shrubs into grassland ecosystems (McPherson 1995; Wright and Bailey 1982). It is possible, therefore, that in grassland habitats with insufficient shrub component to support Cassin's Sparrows, grazing may result in increased shrub cover and therefore increased Cassin's Sparrow habitat. In comparison, in shrubland habitat an increase in shrub density that results in insufficient grass ground cover, may reduce or degrade preferred Cassin's Sparrow habitat. Documenting such connections would be extremely difficult, however, and caution should be exercised in applying such ideas to management because of the potential mixed impacts on other species.

Burning

Most literature regarding Cassin's Sparrow responses to fire addresses the short-term issue of its response to the direct, immediate effects of fire on a habitat. A comparison of bird communities in burned and unburned sacaton grasslands in southeastern Arizona (Bock and Bock 1978) found that total bird populations responded dramatically to summer burns with large numbers of seed-eating birds, including various sparrows, concentrating on the burns in the first two postburn years. The effect of the fires on vegetation was to reduce sacaton cover and greatly increase herb production through two postfire growing seasons. Although this study did not conduct statistical analyses of individual species numbers, the data presented for Cassin's Sparrow numbers indicate this same pattern. The differences may have been even more dramatic since data were collected throughout the year and pooled to arrive at mean bird numbers. This method also precludes any conclusions about seasonal differences in habitat use. A review of this study (Bock and Bock 1988), using some different analyses, found that Cassin's Sparrows were significantly more abundant on the burned sacaton plots ($P < 0.001$) than on the unburned plots.

In comparison, a study comparing bird community response to wildfire in native and exotic grasses (Bock and Bock 1992) presents a more complicated picture that initially appears to contradict some of the above results. However, although this study was also conducted at the AWRR, it was conducted on upland mesa grasslands, which Cassin's Sparrows prefer (Webb and Bock 1990), rather than the very different lowland, sacaton grasslands studied in Bock and Bock (1978). A fire in July 1987 significantly reduced grass cover through two years on both native and exotic sites, did not alter the proportion of exotic grass cover in the exotic plots, reduced shrub cover, and resulted in an increase in herbaceous growth. Total bird numbers in the fall increased dramatically on burned plots in both native and exotic grasses for two postfire seasons. However, Cassin's Sparrows were uncommon in the fall and did not show any significant responses to burns. For breeding Cassin's Sparrows, results were clearest in native grasses, where breeding Cassin's Sparrows were significantly less abundant on burned native

grasslands for two postfire years (Table 7). It appears that during the breeding season they preferred burned to unburned exotic grasses, but their response to burns in exotic grasslands may have been confounded by an apparent reduction in numbers of Cassin's on unburned exotic grasslands over the period of the study (Bock and Bock 1992).

Table 7. Total numbers (means and SD) of birds recorded cumulatively on summer and winter counts on 50 m diameter plots in burned and unburned native and exotic grassland in southeastern Arizona - fire occurred July 1987 (Bock and Bock 1992). * values for burned and unburned significantly different within grassland type $P < 0.01$; ** $P < 0.001$

Season	Year	Native grass		Exotic grass	
		Burned (n =14)	Unburned (n =14)	Burned (n =11)	Unburned (n =11)
Breeding (May-Aug.)	1984-85	1.18 (± 0.60)	1.29 (± 0.47)	0.46 (± 0.52)	0.21 (± 0.43)
	1987	0.00*	0.86 (± 0.77)	0.00	0.14 (± 0.36)
	1988	0.55 (± 0.52)**	1.86 (± 0.77)	0.64 (± 0.51)**	0.00
	1989	1.55 (± 0.93)	1.36 (± 0.84)	0.91 (± 0.54)**	0.00
	1990	1.09 (± 0.94)	1.29 (± 0.61)	0.46 (± 0.52)*	0.00
Winter (Sept-Nov.)	1984	0.36 (± 0.51)	0.29 (± 0.61)	0.18 (± 0.60)	0.00
	1987	0.00	0.14 (± 0.36)	0.09 (± 0.30)	0.14 (± 0.36)
	1988	0.18 (± 0.62)	0.43 (± 0.65)	0.00	0.00
	1989	0.09 (± 0.30)	0.07 (± 0.27)	0.00	0.00
	1990	0.36 (± 0.51)	0.29 (± 0.47)	0.00	0.00

In a study of the effects of fire on grassland birds on the Buenos Aires NWR, Gordon (In Press b) found that Cassin's Sparrows were significantly more abundant on unburned plots (n = 3) than burned plots (n = 3) in the first postburn year, even though there had been no significant difference in abundance between plots previous to the burns. During additional bird monitoring surveys conducted on the Buenos Aires NWR (A. Flesch written commun.), data were collected on sparrow use of plots with different fire histories. Flesch provided the following observations, which are consistent with the pattern found by Bock and Bock (1992) for breeding Cassin's Sparrows in native grasses. Cassin's Sparrows were not as abundant on first-year postfire, and perhaps second-year postfire plots. In 1997, no Cassin's were detected on plots that had been burned that spring. In 1998, several singing males were found on plots that had been burned 3.5 months earlier. Flesch suggests that the presence of some Cassin's Sparrows on burned plots in 1998 was due to the unusually high rainfall received in late winter and early spring 1998, resulting in more rapid grass regrowth.

The second level at which fire can affect Cassin's Sparrows is by its long-term effect on habitat type. It is widely recognized that fire interacts with other factors (e.g., soil, herbivory, vegetation type) to restrict woody plant establishment in grasslands and that fire suppression resulting from reductions in fuel loads, especially from grazing, in the most extreme cases may result in transformation of grassland to shrubland (McPherson 1995; Wright and Bailey 1982). Although Cassin's Sparrows do require a shrub component in their habitat, dense woody

shrublands without a substantial grass cover provide less than ideal Cassin's Sparrow habitat (Maurer 1985; Maurer 1986).

Conservation Reserve Program Lands (CRP)

A study of the value of CRP lands to breeding nongame birds in the Texas Southern High Plains (southern part of the Panhandle) found, not surprisingly, that these plantings were valuable habitat for grassland birds in a landscape dominated by farms and cropland (Berthelesen and Smith 1995) – only two nongame bird nests were found in crop fields. A comparison was made of bird use in the most commonly established CRP cover types – blue grama (*Bouteloua gracilis*)/side-oats grama (*B. curtipendula*); blue grama/Kleingrass (*Panicum coloratum*); and blue grama/plains bluestem (*Bothriochloa ischaemum*) mixtures. In one year, Cassin's Sparrow nest density/acre was significantly higher in blue grama/side-oats grama mixtures than in the other two. The second year showed no significant differences, and nest densities between years in the blue grama/side-oats grama mixtures were significantly different. Insufficient data precluded comparison of nest success estimates between different CRP cover types, but pooling did find a significant difference in nest success estimates (using the Mayfield method) and clutch sizes for Cassin's Sparrows between years.

Tamarisk

Tamarisk, or salt cedar, is an exotic that was originally introduced into the United States from Eurasia for ornamental and soil erosion control purposes. It has escaped and spread throughout riparian habitats in the Southwest, where it has demonstrated remarkable adaptability and competitiveness with native plants under the arid, saline conditions often found due to water control practices. It has resulted in many management disagreements related to its wildlife benefits and the potential impacts of control activities.

A study along the middle Pecos River in New Mexico, designed to establish baseline data on the effects of tamarisk removal on breeding bird communities (Livingston and Schemnitz 1995), found that Cassin's Sparrows were most abundant in grasslands with mixed shrubs (including tamarisk), and used this habitat as well as grasslands devoid of tamarisk (in this case alkali sacaton grasslands) more than sites with dense stands of tamarisk.

Another study of avian use of tamarisk on the middle Pecos River Valley (Hunter et al. 1988) found that Cassin's Sparrows did not use any of the riparian habitat types during the winter. However, in the breeding season, a few Cassin's Sparrows were found using honey mesquite (3/40 ha) and tamarisk (1/40 ha) habitat, where these species provided a shrub component but minimal upper canopy and middle canopy structure. They were not found in the two types of cottonwood-willow habitats.

A more thorough study of avian habitat use along the Pecos River from 1979 to 1981 (Hildebrandt and Ohmart 1982) found more evidence comparing Cassin's Sparrow use of tamarisk and other habitats.

Using density estimates from two summer periods - June to July, and August to September - they found the following data for Cassin's Sparrows: no birds in the densest two tamarisk-dominated habitats that provided substantial canopy structure (substantial foliage from 4.6 to 7.6 m, and substantial foliage from 1.5 to 4.6 m respectively); six to seven birds per 40 ha for tamarisk habitat with little foliage above 3 m; and 16 to 24 birds per 40 ha for sparse (little foliage above 1.5 m) tamarisk habitat. For comparison, they found 6 - 12 birds per 40 ha in sparse four-winged saltbush habitat; 6 - 12 birds per 40 ha in sparse honey mesquite habitat; two to seven birds per 40 ha in cleared communities dominated by weeds and shrubs; and three to four birds per 40 ha in cleared communities dominated by grass.

THREATS

Habitat

Cassin's Sparrows are shrub-grassland specialists. The loss of grasslands with a shrub component through conversion to agriculture, suburban development, and desert scrublands (Welch 1982; Fowler and Dunlap 1986; Jahrsdoerfer and Leslie 1988; Riskind and Diamond 1988; Taylor and Smeins 1994; Fuhlendorf et al. 1997; U.S. Census Bureau 1999a) is the primary threat to Cassin's Sparrow habitat. Over-grazing and poor rangeland management also contribute to the loss of Cassin's Sparrow habitat (Bock et al. 1984; Bock and Bock 1988). Regulation of Cassin's Sparrow populations could also be influenced by other factors (e.g., habitat fragmentation, plot size, etc.) or by the same factors occurring on wintering grounds or during migration. However, we know little about these issues.

Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

No evidence was found to suggest that direct use of this species for commercial, recreational, scientific, or educational purposes poses a threat.

Disease or Predation

No records were found to suggest that disease is a particular threat to Cassin's Sparrow populations.

There were few records regarding predation upon this species. Williams and LeSassier (1968) note records of predation by a shrike (*Lanius* spp.), snakes, and possibly red ants (a nest was discovered in which nestlings were consumed by red ants although it was uncertain whether they killed the nestlings or simply consumed them when they were already dead). Schnase et al. (1991) cited indirect evidence that predation may be high in Cassin's Sparrows; they reported that only 54% of the eggs laid were successfully fledged by birds in their study. Cassin's Sparrows occasionally enter rodent burrows to escape predation (Bowers and Dunning 1985). Montoya et al. (1997) studied avian predation and the diet of Aplomado Falcons (*Falco femoralis*) in Mexico and found that, although Cassin's Sparrows were a relatively common potential prey item in the area, they were not found in falcon pellets or prey remains. They suggested that Cassin's Sparrows might have been too small as prey items when the most common available species and prey species were meadowlarks (*Sturnella* spp.).

Inadequacy of Existing Regulatory Mechanisms

Current regulations directed at protection of bird populations and individuals appear to provide adequate protection for Cassin's Sparrows in the United States. It is protected under the Migratory Bird Treaty Act of 1918 in the U.S. In Mexico the species is protected under the Convention for the Protection of Migratory Birds and Game Mammals of 1936.

However, there is no regulatory protection for Cassin's Sparrow breeding or wintering habitat in the United States or Mexico. There are specific locations that are protected for a variety of uses and wildlife resources (e.g., National Grasslands, state Wildlife Management Areas, and other federal, state, and private land holdings), but none of these are focused particularly on the needs of Cassin's Sparrows, such as habitat. Incentive programs like the Conservation Reserve Program (CRP) may provide suitable habitat for Cassin's Sparrows if certain plantings are used (Berthelsen and Smith 1995), but there are no particular recommended management practices provided at this time. One exception is a recent set of best management practices, including some for Cassin's Sparrows, provided by the Colorado Bird Observatory to the Comanche National Grasslands in Colorado (Gillihan 1999).

Other Natural or Manmade Factors

Pesticides - Pesticides have not been documented as a threat.

Population size - Although there is little reliable information on current population size, and the secretive nature and large seasonal variations in local populations make drawing conclusions difficult, populations are broadly believed to remain high in many parts of its range. At this time, there is no evidence to suggest that small population size itself poses a threat to this species' survival.

Nest Parasitism - Cassin's Sparrows are considered uncommon cowbird hosts (Friedmann 1963). All records provided by Friedmann (1963) were from Texas; he did acknowledge that it was possible that Cassin's Sparrows seem to be an uncommon host because their nests are so difficult to find and therefore evidence of parasitism is also rarely documented. Kingery and Julian (1971) reported a Cassin's Sparrow nest containing three Cassin's Sparrow eggs and one Brown-headed Cowbird (*Molothrus ater*) egg on the Comanche National Grasslands in Baca County, Colorado. Schnase (1984) observed three nests parasitized by Brown-headed Cowbirds, each with four Cassin's Sparrow eggs and one or two cowbird eggs; two were subsequently abandoned, and the third, from which the cowbird egg was removed, fledged one young. Hunter and Howe (unpub. man.) report a nest with two Cassin's Sparrow young and one cowbird that fledged, and adults feeding fledgling cowbirds nearby at the same time, south of Artesia, New Mexico in June 1980.

Suburban development - In light of Cassin's Sparrow requirements for a relatively "natural" habitat composed of a mixture of grass and shrubland, habitat degradation and loss due to suburban development has the potential to negatively affect this species. Although not specifically focused on Cassin's Sparrow habitat, two studies on the impact of

suburban development on native bird communities in southern Arizona indicate the general impact such activities have on southwestern bird communities. Both found that, although higher bird densities were found on suburban sites, 52 to 72% of the total density was composed of three or four exotic species, and certain native desert species were not present (Emlen 1974; Rosenberg et al. 1987). Suburban development usually results in an increase in landscaping with exotic plants and a decrease in native plant species. Mills et al. (1989) found that in Tucson, native bird species richness and densities of native territorial species were strongly correlated with the volume of native plant species and lacked any correlation with exotic plant species volume. These results suggest that similar threats are faced by Cassin's Sparrows, since their habitat preferences are not compatible with the normal habitats provided in suburban development.

The suburban growth occurring in many parts of the southwestern U.S. makes this a real threat. The U.S. Census Bureau (1996) projects (using the middle series projections) that the resident population of the United States will increase by approximately 26.3 % from 1996 to 2025. In comparison, four of the states within the Cassin's Sparrow range show U.S. Census Bureau projections (1999a) exceeding the national average for the same time period: New Mexico (55.0 %); Arizona (52%); Texas (45.2 %); and Colorado (38.5 %). The U.S. Census Bureau recently released additional information about the growth rates in specific cities from 1990 to 1998 (U.S. Census Bureau 1999b), stating that smaller cities experienced the fastest growth. On average, cities containing at least 10,000 people grew 6.6% between 1990 and 1998; cities with populations of more than one million in 1998 grew by 3.5 %; and cities with populations between 10,000 and 50,000 grew the fastest (8.6 %). In comparison to these national averages, the following cities within the Cassin's Sparrow range exceeded the national averages (U.S. Census Bureau 1999c), exemplifying the potential habitat destruction posed by the expected suburban sprawl related to this growth: Laredo, TX (43%); New Braunfels, TX (33.6 %); Brownsville, TX (28.8 %); McAllen, TX (27.1 %); Deming, NM (27.1%); Las Cruces, NM (22%); Santa Fe, NM (20.1 %); El Paso, TX (19.3 %); Austin, TX (17%); Sierra Vista, AZ (15.4 %); San Antonio, TX (14.1 %); Del Rio, TX (14%); Nogales, AZ (13.1 %); Silver City, NM (12.9 %); Las Vegas, NM (11.8 %); Midland, TX (11.5 %); Tucson, AZ (10.8 %).

Exotic grasses - A study of the ecological effects of exotic lovegrasses (*Eragrostis* sp.) on the AWRR (Bock et al. 1986; Bock and Bock 1988) found that total bird abundance was significantly greater on native grass sites than on exotic grass sites in both summer and winter. During the breeding season Cassin's Sparrows were significantly more abundant on native grass plots than on exotic plots. In winter the pattern was the same but it was not statistically significant. The study found that native grass cover, native herb canopy, herb species richness, shrub density, and shrub canopy were significantly reduced on plots dominated by exotic grasses. Total grasshopper numbers were significantly reduced on exotic plots, an important observation since Cassin's Sparrows consume substantial numbers of grasshoppers in the

breeding season (Bock et al. 1986). A study on effects of burns on native and exotic grassland communities (Bock and Bock 1992), found that Cassin's Sparrows appeared to avoid both burned and unburned exotic lovegrasses (Table 7).

Grazing - There is evidence that in the southwest portion of its range, Cassin's Sparrows are negatively affected by grazing. However, there have been no similar studies conducted in the core of its range or on the eastern edge to determine whether the different vegetation and precipitation characteristics found there result in different responses to grazing.

Burning - With a few exceptions (e.g., sacaton grasslands), Cassin's Sparrows will avoid burned sites for one or two years, probably due to the temporary reduction in grass and shrub structure. However, from a long-term perspective, burning Cassin's Sparrow habitat may have a positive effect if it results in less dense shrub cover and, if fire management permits a mosaic of burned and unburned sites, in the short-term Cassin's Sparrows will not be negatively affected.

Brush Control - In light of Cassin's Sparrow requirements for a shrub component in their habitat, programs to promote brush or shrub control to benefit grazing have a potential to negatively impact this species. However, their response is probably dependent on the particular circumstances in specific locations - complete shrub removal would likely have a negative impact, while reduction in shrub density may be beneficial in some circumstances.

Unfortunately, no studies were found that specifically described the response of Cassin's Sparrows to brush control practices. However, on the SRRR (Maurer 1985; 1986), the sites described as having lower mesquite density were sites where mesquite control efforts had been implemented. It was these sites that were preferred by Cassin's Sparrows (see description in Breeding Habitat section), suggesting that in some cases, where the shrub component has become too dense for optimal habitat, shrub control may benefit the species.

Oberholser (1974) provides some observations about the history of brush control in Texas. He suggests that Cassin's Sparrow habitat has actually increased since 1933 when the Soil Conservation Service began to subsidize ranchers for brush control. By 1968 brush removal had been attempted on much of this species' range in the western two thirds of Texas. In cases where clearing was followed by a regrowth of native grasses and a sprouting of young mesquites and low bushes, Cassin's Sparrows have benefitted. However, more efficient mechanical and chemical means of extirpating all woody vegetation have been developed (Oberholser 1974) that are effective at much larger scales than initial efforts. In addition, native grasses are being replaced with foreign plants (Rising 1996; Oberholser 1974), posing new threats to this species.

Tamarisk - At least in some areas, where tamarisk habitat provides a shrub component without a substantial canopy, it can be used by Cassin's Sparrows. However, tamarisk habitat significance for Cassin's Sparrows is minimal since tamarisk is a riparian species and Cassin's Sparrows are only found in a few riparian habitats (e.g., bottomland sacaton grasslands), and it provides no threat to Cassin's Sparrows.

ASSESSMENT RECOMMENDATION

Recommendation on Current Status

The recommendations presented in this section have been jointly developed by the author and Stephanie L. Jones, USFWS Region 6 Nongame Migratory Bird Coordinator, and Bill Howe, USFWS Region 2 Nongame Migratory Bird Coordinator, after review of the contents of this document.

Existing information warrants neither a conclusion that the Cassin's Sparrow range-wide population is in serious decline, nor dramatic range-wide conservation measures. In fact, BBS data indicate that in the core of its range in New Mexico it is very abundant and its population is relatively stable. Therefore, we recommend no change in Cassin's Sparrow official status at this time.

However, there is evidence of serious population declines in certain parts of Texas (Edwards Plateau and South Texas Brushlands), apparently due to major habitat loss and degradation. These declines are associated with landscape-level habitat changes due to ongoing woody encroachment, agricultural and suburban development, and shrub control activities. Fluctuations in Cassin's Sparrow numbers from year to year at a particular site appear to be associated with its response to precipitation-related habitat conditions, and may confound efforts to understand population trends. And, lack of information about Cassin's Sparrow population trends in Mexico omits a substantial portion of the species' range-wide population. Additional information about population trends in the Edwards Plateau and South Texas Brushlands as well as Mexico, and about causes of local, annual population fluctuations, would be valuable in supplementing BBS data and focusing more localized conservation efforts.

There also remain substantial gaps in our knowledge of this species' natural history and ecology. There is no question that Cassin's Sparrows are adversely affected by loss of shrubby grassland habitat to cropland or suburbs, but our understanding of the effects of grazing and other rangeland management activities on remaining habitat is less clear. There is evidence that Cassin's Sparrows are negatively affected by heavy grazing in the most arid, southwestern part of their breeding range, but additional comparative studies are recommended to determine their responses to types and levels of rangeland management in the core of their range. In addition, there is very little information available regarding their wintering or migration ecology, or their breeding ecology in Mexico.

The threats to this species still exist. Based on current land use and population growth patterns, the factors negatively affecting its popula-

tions in the Edwards Plateau and South Texas Brushlands promise to increase and spread, even into the core of its range. Therefore we recommend maintaining the Cassin's Sparrow as a species of special concern, monitoring its status, and promoting research and monitoring to expand our knowledge of its ecology, status, and responses to management activities.

CONSERVATION

Cassin's Sparrow is a member of a guild of species that are dependent on the health and availability of shrubby, arid grasslands. Other species could benefit to some degree from conservation efforts aimed at Cassin's Sparrow breeding habitat, although details of their natural history, range, and habitat requirements will vary. These other species include Grasshopper Sparrow, Loggerhead Shrike (*Lanius ludovicianus*), Botteri's Sparrow, Western Meadowlark (*Sturnella neglecta*) and Eastern Meadowlark (*S. magna*). Many additional species that rely on the same arid grasslands within the Cassin's Sparrow's winter range would also benefit from conservation efforts there. These include Vesper Sparrow, Baird's Sparrow, Savannah Sparrow, Lark Bunting (*Calamospiza melanocorys*), Chestnut-collared Longspur (*Calcarius ornatus*), and Brewer's Sparrow.

Cassin's Sparrow numbers fluctuate dramatically from year to year at any particular site. This appears to be associated with its response to fluctuating habitat conditions and climate, particularly precipitation. These dramatic distributional changes suggest a species that might be able to find suitable habitat wherever it exists within the breeding range. However, if these fluctuations are indeed related to local and regional weather conditions, then suitable habitat would need to be provided throughout the breeding range to accommodate locally variable precipitation and habitat conditions in any particular year. These dynamics could make it difficult to designate and preserve suitable habitat because Cassin's Sparrows may not be found in large numbers on a particular site every year, except in the core of its range in eastern New Mexico and western Texas.

Long term conservation of Cassin's Sparrows is linked to conservation of arid grassland ecosystems, on both their breeding and wintering ranges. The limited information available regarding Cassin's Sparrow response to various habitat management regimes makes it difficult to recommend broad conservation actions. However, some general recommendations can be made, based on what we know, to help direct research to provide additional information.

- In the southwest portion of their range (southeastern Arizona and southwestern New Mexico), where there is evidence that heavy grazing can have detrimental effects on Cassin's Sparrow habitat, removing cattle or at least reducing grazing pressure will promote the preferred combination of shrub and grass structure on Cassin's Sparrow habitat. Even throughout the rest of its range, we do know that management of rangeland to maintain a cover of grass underneath a shrub layer that has not become too thick is crucial for Cassin's Sparrow habitat needs.

- Woody encroachment across many southwestern grasslands has mixed implications for Cassin's Sparrows. Where the shrub joined pure grasslands, but have not become too dense, it may have resulted in increased Cassin's Sparrow habitat. However, if the shrubs are of the wrong species (e.g., juniper), or they become too dense, they are not suitable Cassin's Sparrow habitat. In addition, range managers have responded to woody encroachment with extensive shrub control activities, which have the potential to negatively affect Cassin's Sparrows. In areas where shrub removal is a major range improvement activity, avoidance of methods that completely eliminate shrubs, and focus on rehabilitation methods that create a native grass cover with at least a minimal native shrub component would be beneficial.
- In areas where continuation of potentially negative management activities is inevitable, focus on minimizing the impact (e.g., reducing grazing pressure) and cooperating with the landowners to conduct research to document the actual effects of the practices on Cassin's Sparrows.

In light of the lack of information about Cassin's Sparrow ecology, status, and response to management activities, perhaps the best conservation action is support of additional research and monitoring that will provide us with the information necessary to conserve this species and its habitat.

Research Priorities

- An initiative to survey potential Mexican habitat for Cassin's Sparrows is warranted due to the lack of knowledge of its breeding and wintering distributions and population status in Mexico. The habitat use research needs described below also would benefit from comparative studies in Mexico.
- Much of Cassin's Sparrow habitat throughout its range is grazed, and because there is evidence that they are sensitive to the effects of grazing on their habitat structure and composition in the southwestern edge of their range, studies to document the effects of grazing and other range management activities on Cassin's Sparrow habitat in the core of their range (e.g., New Mexico and Texas) would be valuable.
- Ongoing shrub control and suburban development are also potential factors affecting Cassin's Sparrows; efforts to take advantage of opportunities to work with ranchers and developers to test the effect of their activities on Cassin's Sparrows should be encouraged.
- Because there is evidence that Cassin's Sparrows are declining in the Edwards Plateau and the South Texas Brushlands, efforts to study Cassin's Sparrows there should be focused on identifying patterns of habitat change or other factors associated with Cassin's Sparrow declines.
- Because the Conservation Reserve Program (CRP) is one of the few opportunities offering the possibility for creating additional bird

habitat, studies of the effects of different CRP plantings on Cassin's Sparrows would be valuable. A design focusing on comparisons of different plantings, possibly including more "natural" grass/shrublands, rather than comparisons with croplands, would be most productive.

- A suggestion has been made that habitat management activities aimed at promoting the recovery of the Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*) would also benefit Cassin's Sparrows where their ranges overlap (B. Busby pers. commun.). A study to document the effects of these activities would be valuable.
- Little is known about Cassin's Sparrow reproductive biology, especially productivity data. Of special interest would be studies comparing reproductive success in different habitats. Cassin's Sparrows are observed singing and displaying in a variety of habitats, but little is known about whether productivity differs at these sites.
- Much of the information about Cassin's Sparrow habitat preferences has been extracted from broad studies of avian habitat use or studies focused on other questions. Quantitative studies specifically focused on the habitat preferences (vegetative structure and composition, etc.) of Cassin's Sparrows at the local (nesting and territory sites), habitat, and landscape level in the core of its range would be valuable.
- Cassin's Sparrows are regularly described as responding to precipitation, but few data are available to document these responses. A range-wide study of Cassin's Sparrow over a number of years that included recording of year-round precipitation data and associated vegetation and prey availability fluctuations would be helpful in confirming some of the hypotheses described in this report.

LITERATURE CITED

- American Ornithologists' Union. 1998. Check-list of North American birds, 7th edition. American Ornithologists' Union, Washington, D.C.
- American Ornithologists' Union. 1957. Check-list of North American birds, 5th edition. American Ornithologists' Union, Baltimore, MD.
- Andrews, R. and R. Righter. 1992. Colorado birds. Denver Museum of Natural History, Denver, CO.
- Arizona Breeding Bird Atlas. Unpublished data (1993-1998). Arizona Game and Fish Department, Nongame Branch, Phoenix, AZ.
- Arnold, K. A. and K. L. P. Benson, Eds. Unpublished Data. The Atlas of the Breeding Birds of Texas. Texas Breeding Bird Atlas Project, College Station, TX.
- Baicich, P. J. and C. J. O. Harrison. 1997. A guide to the nests, eggs, and nestlings of North American birds. Academic Press, San Diego, CA.
- Baumgartner, F. M. and A. M. Baumgartner. 1992. Oklahoma bird life. University of Oklahoma Press, Norman, OK.
- Berthelsen, P. S. and L. M. Smith. 1995. Nongame bird nesting on CRP lands in the Texas southern high plains. *Journal of Soil and Water Conservation* 50 (6): 672-675.
- Bock, C. E. and J. H. Bock. 1978. Response of birds, small mammals, and vegetation to burning sacaton grasslands in southeastern Arizona. *Journal of Range Management* 31(4): 296 - 300.
- Bock, C.E. and J. H. Bock. 1988. Grassland birds in southeastern Arizona: impacts of fire, grazing, and alien vegetation. ICBP Technical Publication Number 7.
- Bock, C. E. and J. H. Bock. 1992. Response of birds to wildfire in native versus exotic Arizona grassland. *Southwestern Naturalist* 37(1):73-81.
- Bock, C. E., J. H. Bock, and M. C. Grant. 1992. Effects of bird predation on grasshopper densities in an Arizona grassland. *Ecology* 73(5): 1706-1717.
- Bock, C. E., J. H. Bock, K. L. Jepson, and J. C. Ortega. 1986. Ecological effects of planting African lovegrasses in Arizona. *National Geographic Research* 2(4): 456-463.
- Bock, C. E., J. H. Bock, W. R. Kenney, and V. M. Hawthorne. 1984. Responses of birds, rodents, and vegetation to livestock enclosure in a semidesert grassland site. *Journal of Range Management* 37(3): 239-242.

- Bock, C. E. and B. Webb. 1984. Birds as grazing indicator species in southeastern Arizona. *Journal of Wildlife Management* 48(3): s1045-1049.
- Borrer, D. J. 1971. Songs of *Aimophila* sparrows occurring in the United States. *Wilson Bulletin* 83: 132-151.
- Bowers, R. K. and J. B. Dunning, Jr. 1985. Predator avoidance through burrow use by Cassin's and Black-throated Sparrows. *Western Birds* 16: 51.
- Busby, W. and J. Zimmerman, Eds. Unpublished data. Kansas Breeding Bird Atlas Project, Kansas Biological Survey, Lawrence, KS.
- Byers, C., J. Curson, and U. Olsson. 1995. Sparrows and buntings: a guide to the sparrows and buntings of North America and the world. Houghton Mifflin Co, Boston, MA.
- Cable, D. R. 1975. Influence of precipitation on perennial grass production in the semidesert southwest. *Ecology* 56: 91-96.
- Capinera, J. L. and D. R. Horton. 1989. Geographic variation in effects of weather on grasshopper infestation. *Environmental Entomology* 18: 8-14.
- Capinera, J. L. and D. C. Thompson. 1987. Dynamics and structure of grasshopper assemblages in shortgrass prairie. *Canadian Entomology* 119: 567-575.
- Carter, M. F., T. Leukering, J. S. Bradley, and C. S. Aid. 1997. Habitat associations of the Mexican Plateau winter grassland bird community. Report submitted to USFWS (Bill Howe) and NPS (Howard Ness).
- Carter, M. F., T. Leukering, and S. Hutchings. 1998. Distribution and habitat associations of Mexican Plateau winter grassland bird community. Report submitted to USFWS (Bill Howe) and NPS (Howard Ness).
- Davis, R. B. and R. L. Spicer. 1965. Brush control in the Rio Grande Plains. *Texas Parks and Wildlife Department Bulletin* 46.
- Dunning, J. B. and R. K. Bowers. 1986. Bander Forum. Weights and measurements #1 - Arizona sparrows. *North American Bird Bander* 11: 59-60.
- Dunning, J. B., Jr., R. K. Bowers, Jr., S.J. Suter, and C. E. Bock. 2000. Cassin's Sparrow (*Aimophila cassinii*). In *The Birds of North America*, No. 471 (A. Poole and F. Gill, eds.), The Birds of North America, Inc., Philadelphia, P.A.

- Emlen, J. T. 1972. Size and structure of a wintering avian community in southern Texas. *Ecology* 53(2): 317-329.
- Emlen, J. T. 1974. An urban bird community in Tucson, Arizona: derivation, structure, regulation. *Condor* 76: 184-197.
- Fowler, N. L. and D. W. Dunlap. 1986. Grassland vegetation of the eastern Edwards Plateau. *American Midland Naturalist* 115(1): 146-55.
- Friedmann, H. 1963. Host relations of the parasitic cowbirds. *Smithsonian Institute Bulletin* 233.
- Fuhlendorf, S. D., F. E. Smeins, and C. A. Taylor. 1997. Browsing and tree size influences on Ashe juniper understory. *Journal of Range Management* 50(5): 507-512.
- Gillihan, S. W. 1999. Best management practices for select bird species of the Comanche National Grassland. Report submitted to U.S. Forest Service, Comanche National Grassland.
- Gordon, C. E. In Press a. Effects of fire and grazing on wintering sparrows in Arizona grasslands. *Journal of Range Management*.
- Gordon, C. E. In Press a. Movement patterns of wintering grassland sparrows in Arizona. *Auk*.
- Gordon, C. E. and W. Leitner. 1996. Breeding Bird Census - semidesert mesquite savannah II. *Journal of Field Ornithology* 67(4) Supplement: 85.
- Hildebrandt, T. D. and R. D. Ohmart. 1982. Biological resource inventory (vegetation and wildlife) - Pecos River Basin, New Mexico and Texas. Final report to U.S. Bureau of Reclamation, Amarillo, TX.
- Howell, S. N. G. and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press, Oxford, England.
- Hubbard, J. P. 1977. The status of Cassin's Sparrow in New Mexico and adjacent states. *American Birds* 31(5): 933-941.
- Hunter, W. C. and W. H. Howe. Unpub. man. Birds of the Middle Pecos Valley. Hunter, W. C., R. D. Ohmart, and B. W. Anderson. 1988. Use of exotic saltcedar (*Tamarix chinensis*) by birds in arid riparian systems. *Condor* 90:113-123.
- Inglis, J. M., B. A. Brown, C. A. McMahon, and R. E. Hood. 1986. Deer brush relationships on the Rio Grande Plain, Texas. Texas Agricultural Experiment Station Contr. TA 16129.

- Jahrsdoerfer, S. E. and D. M. Leslie. 1988. Tamaulipan brushland of the Lower Rio Grande Valley of south Texas: description, human impacts, and management options. U. S. Fish and Wildlife Service, Biological Report 88(36).
- Johnsgard, P. A. 1979. Birds of the great plains. University of Nebraska Press, Lincoln, NE.
- Johnson, J. C. 1956. Breeding of Cassin's Sparrow in central Oklahoma. *Wilson Bulletin* 68(1): 75-76.
- Kaufman, K. 1990. Advanced birding. Houghton Mifflin, Boston, MA.
- Kaufman, K. 1996. Lives of North American birds. Houghton Mifflin, Boston, MA.
- Kingery, H. E., Ed. 1998. Colorado breeding bird atlas. Colorado Breeding Bird Atlas Partnership, Denver, CO.
- Kingery, H. E. and P. R. Julian. 1971. Cassin's Sparrow parasitized by cowbird. *Wilson's Bulletin* 83(4): 439.
- Knopf, F. L. 1996. Prairie legacies - birds. Pages 135-148 in *Prairie conservation* (F. B. Samson and F. L. Knopf, Eds.). Island Press, Washington, D.C.
- Livingston, M. F. and S. D. Schemnitz. 1995. Summer bird/vegetation associations in tamarisk and native habitat along the Pecos River, southeastern New Mexico. Pages 171-180 in *Desired future conditions for southwestern riparian ecosystems: bringing interests and concerns together*. USDA Forest Service General Technical Report RM-GTR-272.
- Maurer, B. A. 1985. Avian community dynamics in desert grasslands: observational scale and hierarchical structure. *Ecological Monographs* 55(3): 295-312.
- Maurer, B. A. 1986. Predicting habitat quality for grassland birds using density-habitat correlations. *Journal of Wildlife Management* 50(4): 556-566.
- Maurer, B. A., E. A. Webb, and R. K. Bowers. 1989. Nest characteristics and nestling development of Cassin's and Botteri's Sparrows in southeastern Arizona. *Condor* 91: 736-738.
- Maxwell, T. C. 1979. Avifauna of the Concho Valley of west-central Texas with special reference to historical change. Ph.D. dissertation. Texas A & M University, College Station, TX.

- McPherson, G. R. 1995. The role of fire in the desert grassland. Pages 130 - 151 in *The desert grassland* (M. P. McClaran and T. R. VanDevender, Eds.). University of Arizona Press, Tucson, AZ.
- Meents, J. K. 1979. Avian community structure in Chihuahuan desert grasslands. Ph.D. dissertation. New Mexico State University, Las Cruces, NM.
- Mills, G. S., J. B. Dunning Jr., and J. M. Bates. 1989. Effects of urbanization on breeding bird community structure in southwestern desert habitats. *Condor* 91: 416-428.
- Monson, G. and A. R. Phillips. 1981. Annotated checklist of the birds of Arizona. University of Arizona Press, Tucson, AZ.
- Montoya, A. B., P. J. Zwank, and M. Cardenas. 1997. Breeding biology of Aplomado falcons in desert grasslands of Chihuahua, Mexico. *Journal of Field Ornithology* 68(1): 135-143.
- Muehter, V. R. (Ed.). 1998. WatchList Website <<http://www.audubon.org/bird/watch/>>. Version 97.12. National Audubon Society, New York, NY.
- Nerney, N. J. 1961. Effects of seasonal rainfall on range condition and grasshopper population, San Carlos Apache Indian Reservation, Arizona. *Journal of Economic Entomology* 54: 382-385.
- Oberholser, H. C. 1974. *The bird life of Texas*. University of Texas Press, Austin, TX. Ohmart, R. D. 1966. Breeding record of the Cassin's Sparrow in Arizona. *Condor* 68(4): 400.
- Ohmart, R. D. 1969. Dual breeding ranges in Cassin's Sparrow (abstract). Page 105 in *Physiological systems in semiarid environments* (C. C. Hoff and M. L. Riedesel, Eds.). University of New Mexico Press, Albuquerque, NM.
- Oklahoma Breeding Bird Atlas. Unpublished data. Sutton Avian Research Center, Bartlesville, OK.
- Phillips, A. R. 1944. Status of Cassin's Sparrow in Arizona. *Auk* 61: 409-412.
- Pyle, P. 1997. *Identification guide to North American birds*. Slate Creek Press, California.
- Rappole, J. H., C. E. Russell, J. R. Norwine, and T.E. Fulbright. 1986. Anthropogenic pressures on marginal, neotropical, semiarid ecosystems: the case of south Texas. *Science of the Total Environment* 55: 91-99.

- Rising, J. D. 1996. A guide to the identification and natural history of the sparrows of the United States and Canada. Academic Press, New York, NY.
- Riskind, D. H. and D. D. Diamond. 1988. An introduction to environments and vegetation. Pages 1-15 in Edwards Plateau Vegetation: plant ecological studies in central Texas (B. B. Amos and F. R. Gehlbach, Eds.). Baylor University Press, Waco, TX.
- Roberson, D. 1980. Rare birds of the west coast of North America. Woodcock Publications, Pacific Grove, CA.
- Root, T. 1988. Atlas of wintering North American birds. University of Chicago Press, Chicago, IL.
- Rosenberg, K. V., S. B. Terrill, and G. H. Rosenberg. 1987. Value of suburban habitats to desert riparian birds. *Wilson Bulletin* 99: 642-654.
- Russell, S. and G. Monson. 1998. The birds of Sonora. University of Arizona Press, Tucson, AZ.
- Saab, V. A., C. E. Bock, T. D. Rich, and D. S. Dobkin. 1995. Livestock grazing effects in western North America. Pages 311-353 in *Ecology and management of neotropical migratory birds* (T. E. Martin and D. M. Finch, Eds.). Oxford University Press, New York, NY.
- Sauer, J. R., J. E. Hines, G. Gough, I. Thomas, and B. G. Peterjohn. 1997. The North American Breeding Bird Survey results and analysis. Version 96.4. Patuxent Wildlife Research Center, Laurel, MD.
- Sauer, J. R., S. Schwartz, and B. Hoover. 1996. The Christmas Bird Count Home Page. Version 95.1. Patuxent Wildlife Research Center, Laurel, MD.
- Schnase, J. L. 1984. The breeding biology of Cassin's Sparrow in Tom Green County, Texas. Master's thesis. Angelo State University, Angelo, TX.
- Schnase, J. L., W. E. Grant, T. C. Maxwell, and J. J. Leggett. 1991. Time and energy budgets of Cassin's Sparrow during the breeding season: evaluation through modelling. *Ecological Modelling* 55: 285-319.
- Schnase, J. L. and T. C. Maxwell. 1989. Use of song patterns to identify individual male Cassin's Sparrows. *Journal of Field Ornithology* 60(1): 12-19.

- Sharpe, R., J. Jorgensen, and R. Silcock. Unpublished data. Birds of Nebraska, their distribution and ecology. Nebraska Breeding Bird Atlas Project. Nebraska Game and Parks Commission, Lincoln, NE.
- Storer, R. W. 1955. A preliminary survey of the sparrows of the genus *Aimophila*. *Condor* 57: 193-201.
- Sutton, G. M. 1967. Oklahoma birds. University of Oklahoma Press, Norman, OK.
- Taylor, C. A. and F. E. Smeins. 1994. A history of land use of the Edwards Plateau and its effect on the native vegetation. Pages 1-8 in Proceedings of Juniper Symposium (C. A. Taylor, Ed.). Technical Report 94-2. Texas Agricultural Experimental Station, College Station, TX.
- Terres, J. K. 1980. The Audubon Society encyclopedia of North American Birds. Alfred A. Knopf, New York, NY.
- U.S. Census Bureau. 1996. Resident population projections of the United States: middle, low, and high series, 1996 - 2050. Published March 1996. <<http://www.census.gov/population/projections/nation/npaltsrs.txt>>
- U.S. Census Bureau. 1999a. Projections of the total population of states: 1995 to 2025. Accessed July 12, 1999. <http://www.census.gov/populations/projections/state_stpjpop.txt>
- U.S. Census Bureau. 1999b. Phoenix and San Antonio lead largest cities in growth, small cities grow fastest, Census Bureau reports. <<http://www.census.gov/Press-Release/www/1999/cb99-128.html>>
- U.S. Census Bureau. 1999c. Population estimates for cities with populations of 10,000 and greater: 1990 - 1998. Published June 30, 1999. <<http://www.census.gov/population/www/estimates/citypop.html>>
- U.S. Fish and Wildlife Service. 1990. Final rule to list the Golden cheeeked Warbler as endangered. *Federal Register* 55(249): 53153 - 53160.
- U.S. Fish and Wildlife Service. 1992. Golden-cheeeked Warbler (*Dendroica chrysoparia*) recovery plan. Albuquerque, NM.
- U.S. Fish and Wildlife Service. 1995. Migratory nongame birds of management concern in the United States: the 1995 list. Office of Migratory Bird Management, USFWS, Washington, D.C.
- Webb, E. A. and C. E. Bock. 1990. Relationship of the Botteri's Sparrow to sacaton grassland in southeastern Arizona. Pages 199-209 in *Managing Wildlife in the Southwest* (P. R. Krausman and N.S. Smith, Eds.). Arizona Chapter of the Wildlife Society, Phoenix, AZ.

-
- Welch, T. G. 1982. Acres of rangeland treated for brush and weed control. Texas Agricultural Experiment Station, Texas A&M University, College Station, TX.
- Williams, F. C. and A. L. LeSassier. 1968. Cassin's Sparrow. Pages 981-990 in Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies (O. L. Austin, Jr., Ed.). Dover Publications, New York, NY.
- Willoughby, E. J. 1986. An unusual sequence of molts and plumages in Cassin's and Bachman's Sparrows. *Condor* 88: 461-472.
- Wolf, L. L. 1977. Species relationships in the avian genus *Aimophila*. Ornithological Monographs Number 23. American Ornithologists' Union, Baltimore, MD.
- Wright, H. A., and A. W. Bailey. 1982. Fire ecology, United States and southern Canada. John Wiley and Sons, New York, NY.

**APPENDIX A
STATE SUMMARIES**

In conducting this status assessment, information was solicited from throughout the range of the Cassin's Sparrow, with requests for information going to contacts in eight states and Mexico. The state summaries (summary for Mexico is included) which follow summarize the responses received. The following information is included, if available: state distribution summary, BBS summary, CBC summary, BBA summary, state research and monitoring efforts, known "major" breeding populations in the state, state legal status, Natural Heritage Program state rank, a brief description of habitat conditions, and a brief description of threats.

**The Natural
Heritage Program
State Ranks Defined**

- S1 = Critically imperiled or extremely rare in the state;
generally five or fewer occurrences.
S2 = Imperiled or very rare in the state;
generally six to 20 occurrences.
S3 = Rare, uncommon, or found in a restricted range in the state;
21 to 100 occurrences.
S4 = Common and apparently secure in the state.
S5 = Common and demonstrably secure in the state.

Some states utilize ranks followed by a "B", e.g., S4B, to indicate the rank applies only to the status of breeding occurrences. Ranks followed by an "N" refer to nonbreeding status, and ranks followed by an "M" refer to migration status.

UNITED STATES**ARIZONA
Summary**

Cassin's Sparrows are found in southeastern Arizona grasslands east of the Baboquivari Mountains in Pima County to the New Mexico border, and south from the Mogollon Rim and the Salt River to the Mexican border (including Santa Cruz, Cochise, and Graham Counties) (Monson and Phillips 1981; Phillips et al. 1964; Latta et al. 1999). In Arizona, Cassin's Sparrows occur in grassland mixed with acacias (*Acacia* sp.), ocotillo, oaks, and mesquite (Flesch 1997; Rising 1996; Ohmart 1966); they have also been observed in sacaton grasslands (D. Krueper pers. commun.). The first documented nest in Arizona was located in 1965 near Tucson (Ohmart 1966); Ohmart reported nesting from late July to early September. Since then nests have been found 20 km northwest of Benson, south of Elgin, and west of the San Simon Cienega near the New Mexico border (Monson and Phillips 1981). There is a single, documented nest for Cassin's Sparrow in late April-early May in Cochise County, near Douglas, Arizona in 1995 (A. Moorhouse written commun.). Breeding activity is reported from July through September (Maurer et al. 1989; Monson and Phillips 1981; Ohmart 1966). Cassin's Sparrows also winter in southeastern Arizona, with records from the Buenos Aires National Wildlife Refuge, Tucson, AWRP, and the Chiricahua Mountains (Williams and LeSassier 1968; C. Gordon pers. commun.)

BBS

BBS trend data for the state of Arizona are of limited value since there are insufficient routes ($n = 5$) for which sufficient, reliable data exist for analysis. As a description of distribution within the state, BBS data show Cassin's Sparrow records from routes in Cochise, Santa Cruz, Pima, Graham, Pinal, and Coconino Counties (J. R. Sauer unpub. data a).

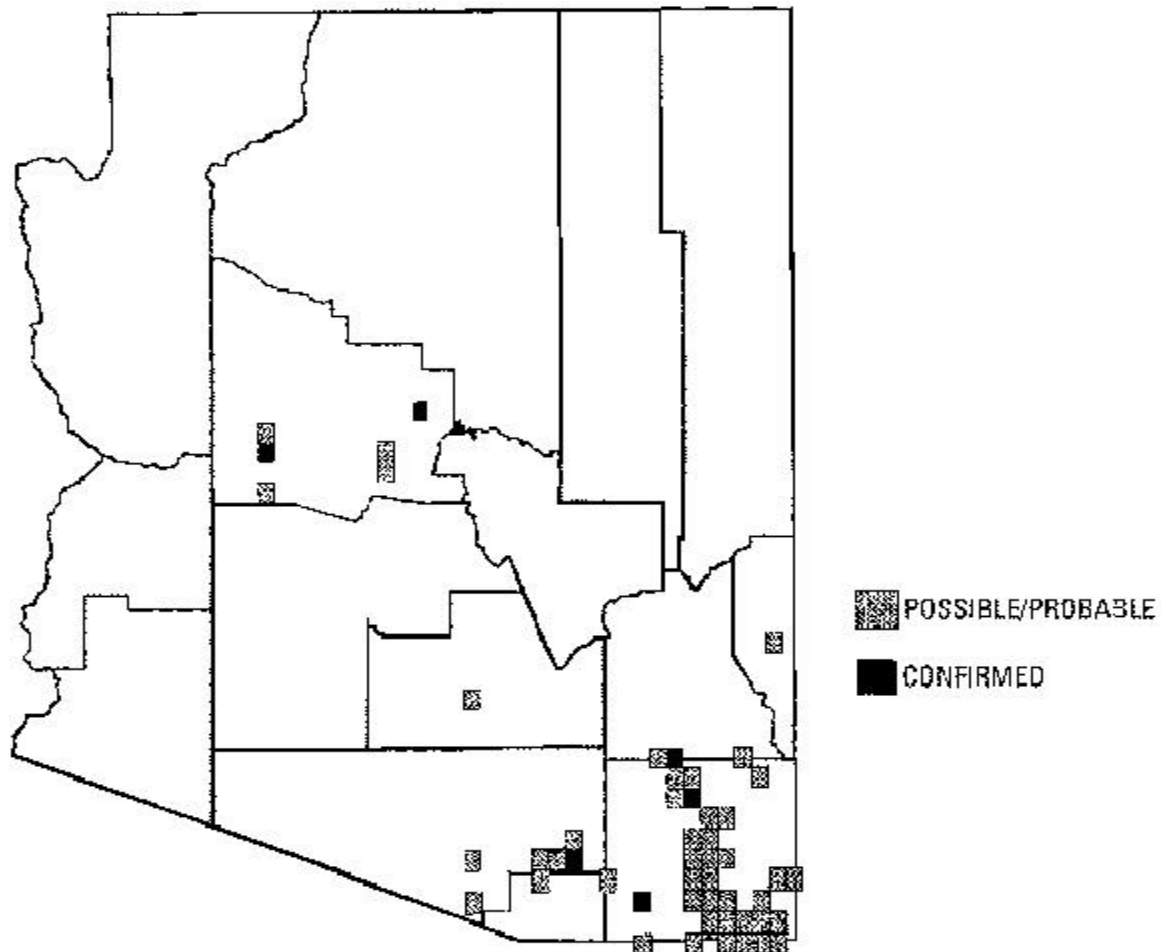
CBC

For the years 1959-1988, CBC data show Cassin's Sparrows recorded on 18 CBC circles in Arizona. Those circles that show a mean relative abundance per circle ≥ 1.00 are Nogales (1.35), Atascosa Highlands (1.00), Ramsey Canyon (2.36), Buenos Aires NWR (1.42), Elfrida (1.68), and Portal (105.3 - due to one large count year) (J. R. Sauer unpub. data b).

Atlas

The Arizona Breeding Bird Atlas field data have been collected (1993 - 1998) and the atlas is currently in draft form with hopes of publication in the near future. Atlas data (Arizona Breeding Bird Atlas unpub. data) show that most possible/probable or confirmed breeding records are located in Cochise, Pima, and Santa Cruz Counties, with a separate cluster in Yavapai County, and individual records in Pinal and Greenlee Counties (Figure 7 Atlas map). All confirmed breeding records for which habitat information is available (four of six) recorded the habitat as semidesert grassland. The majority of probable breeding records (20 of 27) were also recorded as semidesert grassland, with remaining records in Chihuahuan desert scrub, Sonoran desert scrub, Sonoran savannah grassland, and Sonoran riparian scrub.

Figure 7. Cassin's Sparrow distribution in Arizona. Shown as blocks of possible/probable, and confirmed breeding occurrence. Data gathered from 1993 - 1998 (Arizona Breeding Bird Atlas unpub. data).



Research / Monitoring

Carl and Jane Bock (University of Colorado) have conducted a substantial amount of research on grassland bird communities in southeastern Arizona, focusing on lands within and surrounding the Appleton-Whittell Research Ranch (AWRR) (Bock and Bock 1992, 1988, 1978; Bock and Webb 1984; Bock et al. 1992; Bock et al. 1986; Bock et al. 1984). Many of these manuscripts include information on Cassin's Sparrows described elsewhere in this document. They continue to be involved in research in this area, for example, recently having proposed research regarding the effects of suburban growth on grassland bird communities in the Sonoita Valley.

Brian Maurer conducted several studies of the bird communities on the Santa Rita Experimental Range (SRER) (Maurer 1986, 1985; Maurer et al. 1989) that included information about Cassin's Sparrows described elsewhere in this document.

A monitoring program to document the distribution and abundance of breeding birds on the Buenos Aires National Wildlife Refuge was initiated with a pilot project in 1996, and two years of data collection in 1997 and 1998. This resulted in a report (Flesch 1997) which describes Cassin's Sparrow as the most abundant bird detected during the point counts. In 1997, he counted a total of 207 Cassin's Sparrows at a series of 100 m limited distance point counts and 553 during unbounded counts, with a maximum of five individuals found at a single station. In 1998, Cassin's Sparrows were significantly more abundant than in 1997, with a total of 336 detected within 100 m and 919 recorded for unbounded counts (A. Flesch written commun.). Using the 100 m limited distance point counts from 1998, Flesch calculated a density of 86 singing males per 40 ha. Making the assumptions that every singing male represented a mated pair, and that the survey points provide a representative sample of the grassland on the refuge, he calculated that the 46,500 ha of grassland on Buenos Aires NWR could support approximately 100,000 pairs of Cassin's Sparrows in a good year. He did note that this may be an overestimate since some singing males might not be paired. He also reported observing birds carrying food and fecal sacs during the survey period. Buenos Aires NWR expects to continue this monitoring program.

Caleb Gordon, a doctoral student at the University of Arizona, has conducted five years of research on the wintering site fidelity of grassland birds on the Buenos Aires NWR and at the AWRR (Gordon In Press a and b). Cassin's Sparrows are among the species he has mist-netted at both sites. He has documented the wide fluctuations in Cassin's Sparrow densities on the Buenos Aires NWR between years. Nine Cassin's Sparrows were captured in the winter of 1997 and, with the same amount of effort (nine capture days), 43 were captured in the winter of 1998. Although 23 Cassin's Sparrows were captured on only three capture days in the winter of 1999, by extrapolating along the accumulation curve from previous years, he estimates that approximately 35 birds would have been captured with nine days of effort. Additional results from this work have been presented elsewhere in this document. Gordon also conducted two Breeding Bird Census plots on the Buenos Aires NWR, one of which supported a number of Cassin's Sparrows.

The BLM has conducted various bird surveys on their land in southeastern Arizona, including the San Pedro Riparian National Conservation Area (1986 - 1991; some begun again in 1998) and the Empire Cienega Resource Conservation Area (1992-1996), both of which have recorded Cassin's Sparrows. In the sacaton-mesquite grasslands along the San Pedro RNCA, one transect showed annual peak densities (based on Emlen transects) during the breeding season (July, August and September) of 41, 66, 91, and 19 birds/40 ha in respective years; a second transect showed annual peak densities of 39, 26, and 14 birds/40 ha (D. Krueper written commun.). See Grazing section above for additional information about effects of grazing on Cassin's Sparrows at this site.

Janet Ruth, a research biologist for the USGS Midcontinent Ecological Science

Center, initiated a new study on the vegetative structure and composition of habitat used by wintering grassland birds in southeast-ern Arizona in the winter of 1998-1999. She has worked in collaboration with Caleb Gordon (University of Arizona) and is conducting research on public and privately-owned grassland sites in the Sonoita Valley, the San Rafael Valley, and on the Buenos Aires NWR. Data on Cassin's Sparrows has already been collected at several of these sites and the project is scheduled to continue through the winter of 2000-2001.

Major Populations

The Buenos Aires NWR may support the largest population of breeding Cassin's Sparrows in Arizona (A. Flesch pers. commun.).

State Status

None (T. Corman pers. commun.).

Natural Heritage Rank

State rank - S4 (S. Schwarz pers. commun.).

Habitat Condition

Bahre (1995) provides the most comprehensive description of the historic changes that have occurred in the grasslands of southeastern Arizona, roughly comparable with the Cassin's Sparrow distribution in the state. He noted that the two most dramatic changes were the extensive increases in woody shrubs and trees within the grasslands, and landscape fragmentation resulting from urban and rural settlements. Parker and Martin (1952) are cited for their report that by 1952, fully half of the 3.8 million ha supporting mesquite in southern Arizona had been colonized by that species since 1850. It would be difficult to determine whether this represents increased or decreased Cassin's Sparrow habitat since their habitat preferences seem to be related to the relative density of shrubs and grass cover. Bahre also reports that thousands of ha of grassland were cleared for irrigated agriculture in the 1940's with the developed capability to tap groundwater, but that it has declined substantially since the 1970's for many reasons, unfortunately it has rarely reverted to native grasses. The Arizona Partners in Flight Bird Conservation Plan (Latta et al. 1999) indicates that semidesert grasslands, the primary habitat of Cassin's Sparrows in Arizona, were the most extensive grassland type in the state and suffered the greatest historical acreage loss. They also add heavy and over-grazing to the list of major impacts on this habitat type.

Threats

In the arid grasslands of southeastern Arizona there is sufficient information to say that heavy grazing poses an important threat to Cassin's Sparrow habitat (Bock and Bock 1988; Bock and Webb 1984) (see detailed discussion about effects of grazing in the Management section). In addition, encroachment of suburban development poses a threat in areas like the Sonoita Valley (C. Bock pers. commun.).

Literature Cited

Arizona Breeding Bird Atlas. Unpublished data (1993-1998). Arizona Game & Fish Department, Nongame Branch, Phoenix, AZ.

- Bahre, C. J. 1995. Human impacts on the grasslands of southeastern Arizona. Pages 230-264 in *The desert grassland* (M. P. McClaran & T. R. VanDevender, Eds.). University of Arizona Press, Tucson, AZ.
- Bock, C. E. and J. H. Bock. 1978. Response of birds, small mammals, & vegetation to burning sacaton grasslands in southeastern Arizona. *Journal of Range Management* 31(4): 296 - 300.
- Bock, C. E. and J. H. Bock. 1988. Grassland birds in southeastern Arizona: impacts of fire, grazing, & alien vegetation. ICBP Technical Publication Number 7.
- Bock, C. E. and J. H. Bock. 1992. Response of birds to wildfire in native versus exotic Arizona grassland. *Southwestern Naturalist* 37(1): 73-81.
- Bock, C. E., J. H. Bock, and M. C. Grant. 1992. Effects of bird predation on grasshopper densities in an Arizona grassland. *Ecology* 73(5): 1706-1717.
- Bock, C. E., J. H. Bock, K. L. Jepson, and J. C. Ortega. 1986. Ecological effects of planting African lovegrasses in Arizona. *National Geographic Research* 2(4): 456-463.
- Bock, C. E., J. H. Bock, W. R. Kenney, and V. M. Hawthorne. 1984. Responses of birds, rodents, and vegetation to livestock enclosure in a semidesert grassland site. *Journal of Range Management* 37(3): 239-242.
- Bock, C. E. and B. Webb. 1984. Birds as grazing indicator species in southeastern Arizona. *Journal of Wildlife Management* 48(3): 1045-1049.
- Flesch, A. D. 1997. Distribution and abundance of breeding grassland birds on the Buenos Aires National Wildlife Refuge: a monitoring program. Report for USFWS Buenos Aires NWR, Sasabe, AZ.
- Latta, M. J., C. J. Beardmore, & T. E. Corman. 1999. Arizona Partners in Flight Bird Conservation Plan. Version 1.0. Nongame & Endangered Wildlife Program Technical Report 142. Arizona Game and Fish Department, Phoenix, AZ.
- Maurer, B. A. 1986. Predicting habitat quality for grassland birds using density-habitat correlations. *Journal of Wildlife Management* 50(4): 556-566.
- Maurer, B. A. 1985. Avian community dynamics in desert grasslands: observational scale and hierarchical structure. *Ecological*

Monographs 55(3): 295-312.

- Maurer, B. A., E. A. Webb, and R. K. Bowers. 1989. Nest characteristics & nestling development of Cassin's and Botteri's Sparrows in southeastern Arizona. *Condor* 91: 736-738.
- Monson, G. and A. R. Phillips. 1981. Annotated Checklist of the Birds of Arizona. University of Arizona Press, Tucson, AZ.
- Ohmart, R. D. 1966. Breeding record of the Cassin's Sparrow in Arizona. *Condor* 68(4): 400.
- Parker, K. W. and S. C. Martin. 1952. The mesquite problem on southern Arizona ranges. USDA Circular 908.
- Phillips, A., J. Marshall, & G. Monson. 1964. The birds of Arizona. University of Arizona Press, Tucson, AZ.
- Rising, J. D. 1996. A guide to the identification & natural history of the sparrows of the United States and Canada. Academic Press, New York, NY.
- Sauer, J. R. Unpub. data a. North American Breeding Bird Survey results & analysis. Patuxent Wildlife Research Center, Laurel, MD.
- Sauer, J. R. Unpub. data b. Christmas Bird Count results. Patuxent Wildlife Research Center, Laurel, MD.
- Williams, F. C. and A. L. LeSassier. 1968. Cassin's Sparrow. Pages 981 - 990 *in* Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, & allies (O. L. Austin, Jr., Ed.). Dover Publications, New York, NY.

NEW MEXICO**Summary**

Southern and eastern New Mexico lie within the core of Cassin's Sparrow breeding range. There have not been any comprehensive summaries of New Mexico's birds in the last 20 years, so many of the older accounts may no longer be accurate (S. Williams pers. commun.). A map in Hubbard's (1977) article (Figure 8) on the status of this species shows records of birds ranging from the northeast (Union County) to the southeast (Lea County) to the southwest (Hidalgo and Grant Counties) and south of a diagonal line across the state (including Sierra, Socorro, Bernalillo, Santa Fe, and San Miguel Counties). Hubbard (1977) suggests, based on the lack of historical evidence prior to 1960, that Cassin's Sparrow has undergone a change in summer distribution and breeding status, increasing in the southwestern parts of New Mexico over the last decade or so (1960 to 1977). Cassin's Sparrow is "only a rare, casual to occasional winter resident in the state, credibly recorded in the south near Carlsbad and Rodeo," with most birds leaving the state by late September (Hubbard 1977). S. Williams (pers. commun.) agreed that most breeding Cassin's Sparrows leave the state in winter but that some unknown number use the southern tier of counties.

Bailey (1928) stated that Cassin's Sparrows were most numerous in shortgrass habitat interspersed with small shrubs, mesquite plains in yucca patches, and barren hillsides with cacti, but that they also ranged up into the foothills of Mount Capitan to the lower edge of the juniper belt at about 5,500 feet. Other studies in New Mexico have documented Cassin's Sparrows breeding in alkali sacaton grasslands along the Pecos River (Hildebrandt and Ohmart 1982), in mesquite-perennial composites and mesquite-grasslands in the southwestern part of the state (Wolf 1977), in mesquite-grasslands and creosote bush habitats in southeastern New Mexico (Ligon et al. 1981), in grasslands with saltbush in northeastern New Mexico (Mehlman 1995), and mesa grassland, black grama grasslands, and creosote shrublands in southern New Mexico (A. Pidgeon written commun.).

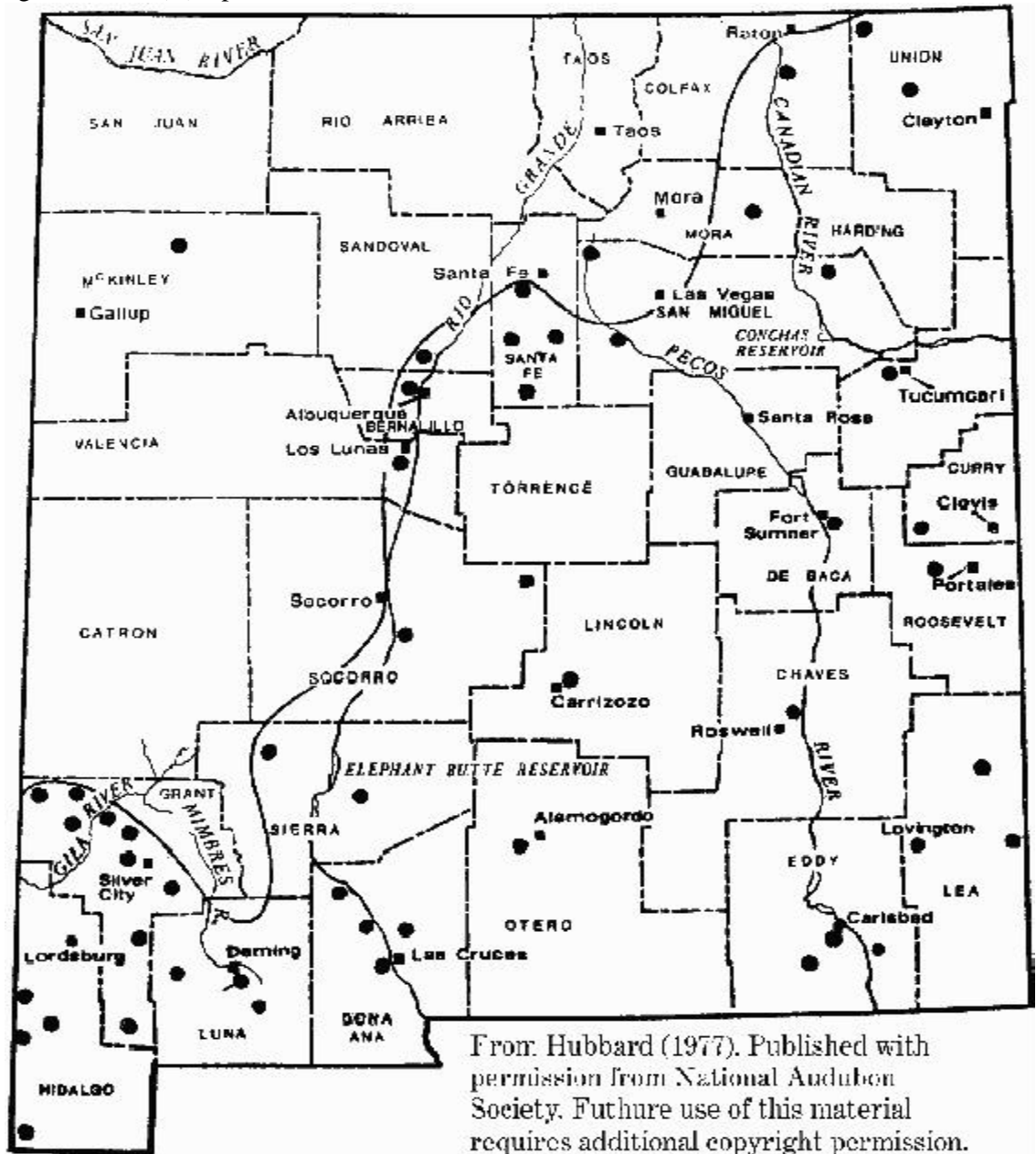
Hubbard (1977) states that Cassin's Sparrows return in numbers and begin singing in New Mexico by April and possibly in March. A. Pidgeon (written commun.) records Cassin's Sparrows during her point counts at Fort Bliss in late May, although record numbers of Cassin's Sparrows arrived there in early May (May 5 - 12) in 1997. She suggests that this earlier arrival was in response to the end of a drought lasting several years. Hubbard (1977) reports that many or most Cassin's Sparrows leave their New Mexico range by late September.

Hubbard (1977) reports only three records of Cassin's Sparrow nests in New Mexico – one in San Miguel County in 1933 (Phillips 1944), and two in Lea County in 1968. He reports these nest records from 16 June, 17 June, and 3 July. Surveys of breeding birds on the Kiowa/Rita Blanca National Grasslands at Perico Creek in northeast New Mexico have reported two nests – one found on 27 June 1991 and one on 24 June 1993, each containing 3-4 eggs (Schwarz 1995).

Ligon et al. (1981) report two nests from Lea and Eddy Counties on June 2 and July 18 of 1979. A. Pidgeon (written commun.) reports ten nests from Fort

Bliss from June 2 - 21 during the years of 1996 - 1998.

Figure 8. Historical records of Cassin's Sparrows in New Mexico. Large black dots (●) represent locations cited in text.



BBS

There are no significant patterns in Cassin's Sparrow numbers in New Mexico (Table 3) for either the entire time period of available BBS data (1966 - 1996), or for either the 1966 - 1979 or 1980 - 1996 time periods (Sauer et al. 1997).

In New Mexico, which is in the core of the Cassin's Sparrow's range, there are no significant or consistent population trends over time, either statewide or in any of the physiographic strata within the state. For purposes of defining the distribution of Cassin's Sparrows, most of the routes in

the southern half of the state recorded Cassin's Sparrows; most of the routes in the eastern one third of the state recorded them, and there are a number of routes scattered throughout the rest of the state that have recorded them. However, the routes showing consistent, large numbers of Cassin's Sparrows were all in the eastern one third of the state (J. R. Sauer unpub. data a). Looking at the individual route records also gave an indication of areas where numbers were consistently high year after year, and other areas where the numbers varied substantially from year to year. Following are several examples. A route in De Baca County commonly recorded 120 - 160 Cassin's Sparrows and had a maximum year count of 244; a route in Chaves County commonly recorded 50 - 100 with a maximum of 257; a route in Roosevelt Co. showed 30 - 50 in some years, 120 - 130 in other years, and a maximum of 251; and a route in San Miguel County showed several years above 115 and one year with 9!

CBC

For the years 1959 - 1988, CBC data show that Cassin's Sparrows were recorded on five CBC circles in New Mexico, but they are very scarce, with a mean relative abundance per circle not exceeding 0.6. The locations were Peloncillo Mountains, Carlsbad Caverns NP, Loving, Las Cruces, and Caballo (J. R. Sauer unpub. data b).

Atlas

There is not a Breeding Bird Atlas project in New Mexico.

Research / Monitoring

Various surveys for breeding birds are being conducted as part of the development of an Environmental Impact Statement for the McGregor Range of Fort Bliss in Otero County, New Mexico (U.S. Army 1998; A. Pidgeon written commun.). These data indicate that certain desert shrubland and grassland habitats on Fort Bliss support significant numbers of Cassin's Sparrows in some years. These data use point counts to document bird detections in seven different habitat types (six study plots per habitat type). In years with more rain, like 1997 (B. Locke pers. commun.), the following habitat types supported substantial numbers of Cassin's Sparrows - creosote shrubland (1996 - 17; 1997 - 203); mesa grassland (1996 - 22; 1997 - 93); and black grama grassland (1996 - 3; 1997 - 193) (A. Pidgeon written commun.). Mesquite shrublands did not support any Cassin's Sparrows; sandsage (*Artemisia filifolia*) shrublands (1996 - 2; 1997 - 3) and pinyon pine/juniper (1996 - 0; 1997 - 1) supported very few; and Viscid acacia supported a moderate number in one year (1996 - 0; 1997 - 22). B. Locke (written commun.) reported that the reason that mesquite shrublands and sandsage shrublands did not support Cassin's in this location was because there is very little grass cover due to the sandy soils; in comparison, the creosote shrublands supported an understory of grama grasses. Intensive nest searching was also conducted as part of this project, but the timing (mid-April to the end of June) does not coincide well with the timing of Cassin's Sparrow nesting. However, some information regarding timing, size, and placements of nests was available (A. Pidgeon written commun.) - see Breeding Ecology section. She did note that Cassin's Sparrows were present in late spring-early summer because they did get Cassin's Sparrows on the point counts (see above) which are done in May. She also noted that in 1998, they were in the field until the

end of July and that, although Cassin's Sparrows were present in the above-mentioned habitat types earlier, they did not find any Cassin's nests until after the rains began in the middle of June.

A series of transect surveys conducted during the winter (1996) at Fort Bliss, primarily to document distribution of Baird's Sparrow comparing upland and swale grassland habitats, also documented Cassin's Sparrow presence during the winter (U.S. Army 1998). Cassin's Sparrows were only found in the swale habitat and the rate of detections/survey ($n = 24$) was 1.25.

A series of point count surveys were conducted in the summer of 1995 to compare the bird community at the Maxwell National Wildlife Refuge (Colfax County, New Mexico) with the surrounding region (Mehlman 1995). Cassin's Sparrows were found in low numbers both on the refuge and in the surrounding region (2 - 18 individuals per survey), with somewhat larger numbers found during the point count surveys in the surrounding region. They were consistently found in grassland habitat with a saltbush component.

A number of "BBS-type surveys" of breeding birds have been conducted annually on the Kiowa/Rita Blanca National Grasslands in northeast New Mexico during the 1990's (Schwarz, 1991 - 1997). The survey conducted at Perico Creek regularly recorded 27 to 35 individuals. Schwarz recorded several nest records (see above). In addition, the Colorado Bird Observatory, under contract by the U.S. Forest Service, is conducting an inventory on the Kiowa/Rita Blanca National Grasslands in 1999, using the area search protocol (M. Carter pers. commun.).

The Bureau of Land Management (C. Alford pers. commun.) has contracted for some grassland bird work involving vegetation/habitat use of grassland birds. However, efforts to contact the contractor through BLM were not successful.

Julie Meents conducted research for her dissertation on "Avian Community Structure in Chihuahuan Desert Grasslands" for New Mexico State University (Meents 1979) at sites in southern New Mexico (Otero Mesa; Nutt; and Cloverdale) and northern Chihuahua, Mexico (La Campana). Although she focused primarily on broader measures of the total bird community (species diversity, species dominance, density, standing crop biomass, and body size class), she does provide information about average census numbers for Cassin's Sparrows at each site. Along 7.2 km roadside censuses, 14.5 Cassin's Sparrows were recorded in summer at Otero Mesa, 17.4 in summer at Nutt, 8.0 in summer at Cloverdale, and 74.0 in summer and 1.0 in winter at La Campana.

Christopher Rustay with Hawks Aloft is conducting some "BBS-type" surveys of grassland birds in New Mexico (northwestern quadrant of the state) in association with his work on Ferruginous Hawks, under contract with BLM and other sources of funding. He did record some

Cassin's Sparrows. Interestingly, he did observe several Cassin's Sparrows in southern San Juan County, the very northwestern part of the state (C. Rustay pers. commun.).

From 1975 through 1981 the species composition and densities of the bird community on the Los Medaños Waste Isolation Pilot Plant (WIPP) in southeastern New Mexico (Eddy and Lea Counties) were studied (Ligon et al. 1981). Of the four major habitat types studied during 1978 to 1981, Cassin's Sparrows were found regularly in mesquite-grasslands and creosote bush habitats, showed up minimally one year in mesquite-shinnery oak, and were not found in hummock-mesquite habitat. Using Emlen transects to estimate density of individuals per square km, Cassin's Sparrows were found at densities of 2.0, 64.0, 35.4, and 5.1 in respective years in mesquite-grassland habitats, and at densities of 71.0, 82.9, 56.0, and 81.6 in creosote bush habitats. Cole and Ligon (1978) suggest that heavy rainfall during fall/winter/spring of 1978-79 may have resulted in a demonstration of the upper limit to normal year-to-year variation in bird densities and reproductive success. Vegetation analyses for that time period showed a substantial increase in grass and forb cover and a sharp decrease in bare ground. A 25-mile roadside census conducted twice monthly from October 1978 - September 1979 showed that end of May through early September was the peak time for observing Cassin's Sparrows, recording a range of 11 to 36 individuals along the route (Cole and Ligon 1978). Two Cassin's Sparrow nests were found and monitored during the summer of 1979, each hatching and fledging three young.

During Baird's Sparrow surveys conducted on Otero Mesa, singing male Cassin's Sparrows were observed in April of 1996 and 1999. In addition, during the winter Cassin's Sparrows were detected at densities of 1.25/km, 0.04/km, and 0.4/km respectively during the winters of 1996/97, 1997/98, and 1998/99 (R. Meyer pers. commun.).

Major Populations

New Mexico clearly supports a large portion of the breeding population of Cassin's Sparrows, but insufficient information exists to identify specific areas within the state that support major populations.

State Status

None (S. Williams pers. commun.). There is some consensus among experts in New Mexico that there, in the core of its range, populations are stable, and it is one of the most abundant breeding birds (S. Williams pers. commun.; H. Schwarz pers. commun.).

Natural Heritage Rank

State rank - S5B/S5N (M. Altenbach pers. commun.).

Habitat Condition

Historically, since European settlement, grassland vegetation types in New Mexico have diminished greatly. During the last 150 years this has resulted primarily in an increase in desert scrubland. In addition, the transition desert grassland type now occupies areas previously occupied by Mesa-Plains grasslands. There has also been an extensive advance of juniper savannah, at the expense of grassland types. These changes have been attributed to the impacts of grazing, farming, and modification of fire frequencies

(Dick-Peddie et al. 1993). They state that these “successional” trends were set in motion early in the 20th century and predict that subsequent range management efforts are unlikely to halt, let alone reverse the trends. Therefore, they project continuing transformation of Mesa-Plains grassland to juniper savannah and desert grassland, and transformation of much of the desert grasslands to desert scrubland. There was very little documentation available regarding the specific condition of Cassin’s Sparrow habitat in New Mexico. It seems possible that the transformation of grasslands (defined by Dick-Peddie et al. 1993 as supporting very low shrub density) to desert grasslands (which have a larger shrub component) may have been beneficial to Cassin’s Sparrows. This may help explain the lack of significant declines in Cassin’s Sparrow numbers demonstrated by the BBS. However, the further transformation of desert grasslands to desert scrubland will be less beneficial, as these habitats support much less grass cover and a much denser shrub component.

Threats

There was very little information available about the particular threats that face Cassin’s Sparrows in New Mexico. However, as mentioned above, transformation of desert grasslands to desert scrubland may pose threats to Cassin’s Sparrow habitats. In addition, as treated elsewhere in this document, shrub control efforts initiated in response to woody encroachment pose an additional threat to the species.

Literature Cited

- Bailey, F. M. 1928. Birds of New Mexico. New Mexico Department of Game and Fish, Albuquerque, NM.
- Cole, D. C. and J. D. Ligon. 1978. Densities and species composition of the avifauna of the Los Medaños WIPP Site, southeastern New Mexico. Chapter 10 in Annual report of biological investigations at the Los Medaños Waste Isolation Pilot Plant area of New Mexico for FY 1978 (T. L. Best and D. W. Jackson, Eds.). Submitted to Sandia Laboratories.
- Dick-Peddie, W. A., W. H. Moir, & R. Spellenberg. 1993. New Mexico vegetation: past, present and future. University of New Mexico Press, Albuquerque, NM.
- Hildebrandt, T. D. and R. D. Ohmart. 1982. Biological resource inventory (vegetation and wildlife) - Pecos River Basin, New Mexico & Texas. Final report to U.S. Bureau of Reclamation, Amarillo, TX.
- Hubbard, J. P. 1977. The status of Cassin’s Sparrow in New Mexico and adjacent states. *American Birds* 31(5): 933-941.
- Ligon, J. D., J. Haydock, and J. C. Bednarz. 1981. Avifauna baseline studies at the Los Medaños WIPP site, southeastern New Mexico. Report. University of New Mexico, Albuquerque, NM.
- Meents, J. K. 1979. Avian community structure in Chihuahuan desert grasslands. Ph.D. dissertation. New Mexico State University, Las Cruces, NM.

- Mehlman, D. W. 1995. A survey of grassland bird species of the Maxwell National Wildlife Refuge. Report contracted by USFWS, Maxwell NWR.
- Phillips, A. R. 1944. Status of Cassin's Sparrow in Arizona. *Auk* 61: 409-412.
- Sauer, J. R. Unpub. data a. North American Breeding Bird Survey results & analysis. Patuxent Wildlife Research Center, Laurel, MD.
- Sauer, J. R. Unpub. data b. Christmas Bird Count results. Patuxent Wildlife Research Center, Laurel, MD.
- Sauer, J. R., J. E. Hines, G. Gough, I. Thomas, & B. G. Peterjohn. 1997. The North American Breeding Bird Survey results & analysis. Version 96.4. Patuxent Wildlife Research Center, Laurel, MD.
- Schwarz, H. R. 1997. Cibola National Forest breeding bird survey report for 1997. USDA Forest Service.
- _____. 1996. Cibola National Forest breeding bird survey report for 1996. USDA Forest Service.
- _____. 1995. Cibola National Forest breeding bird survey report for 1995. USDA Forest Service.
- _____. 1993. Cibola National Forest breeding bird survey report for 1993. USDA Forest Service.
- _____. 1991. National Grasslands Breeding Bird Report - Cibola National Forest. USDA Forest Service.
- U.S. Army. 1998. 1996-97 post-wide survey of federally listed & other species of concern at Fort Bliss. Report prepared by TRC Mariah Associates, Inc.
- Wolf, L. L. 1977. Species relationships in the avian genus *Aimophila*. Ornithological Monographs Number 23. American Ornithologists' Union, Baltimore, MD.

TEXAS

Summary

The Cassin's Sparrow is a common to fairly common breeder in the western two-thirds of Texas (Oberholser 1974) - a major part, with New Mexico, of the core of their range. Oberholser reports that breeding birds were collected north to Potter and Lipscomb, east to Dallas, south to Cameron, and west to El Paso Counties. His map (Oberholser 1974) is very similar to the more recent map provided by the Texas Breeding Bird Atlas project (see below). Seyffert (1985) also describes Cassin's Sparrow as an uncommon to common summer resident throughout the Texas Panhandle counties.

The breeding season in Texas goes from early March to early August (Oberholser 1974). In Texas, Cassin's Sparrows occur in several habitat types. They inhabit shortgrass plains, chiefly where scattered low mesquites, cacti, yucca, or oaks occur. In the Texas Panhandle, they have been observed in playa lake basins (Fischer et al. 1982), they reportedly thrive in lush, open grasslands with occasional low bushes or sunflowers (Oberholser 1974), and along the southern Texas coast they are found in tall bunchgrass (Oberholser 1974). Williams and LeSassier (1968) also mention several references to Cassin's Sparrow found in or near mountainous regions - treeless, grassy plains with scattered yucca on the southern slopes of the Davis Mountains in the Trans-Pecos, Texas (5,000+ feet); open meadows with surrounding oaks in the Davis Mountains; and on the mesa that surrounds the Chisos Mountains (4,000 feet); etc.

Eggs are reported from March 1 through August 1 (Oberholser 1974); Williams and LeSassier (1968) report egg dates from April 12 to July 23. The Texas Breeding Bird Atlas project (Arnold and Benson unpub. data) reports nesting activity from early May to late June.

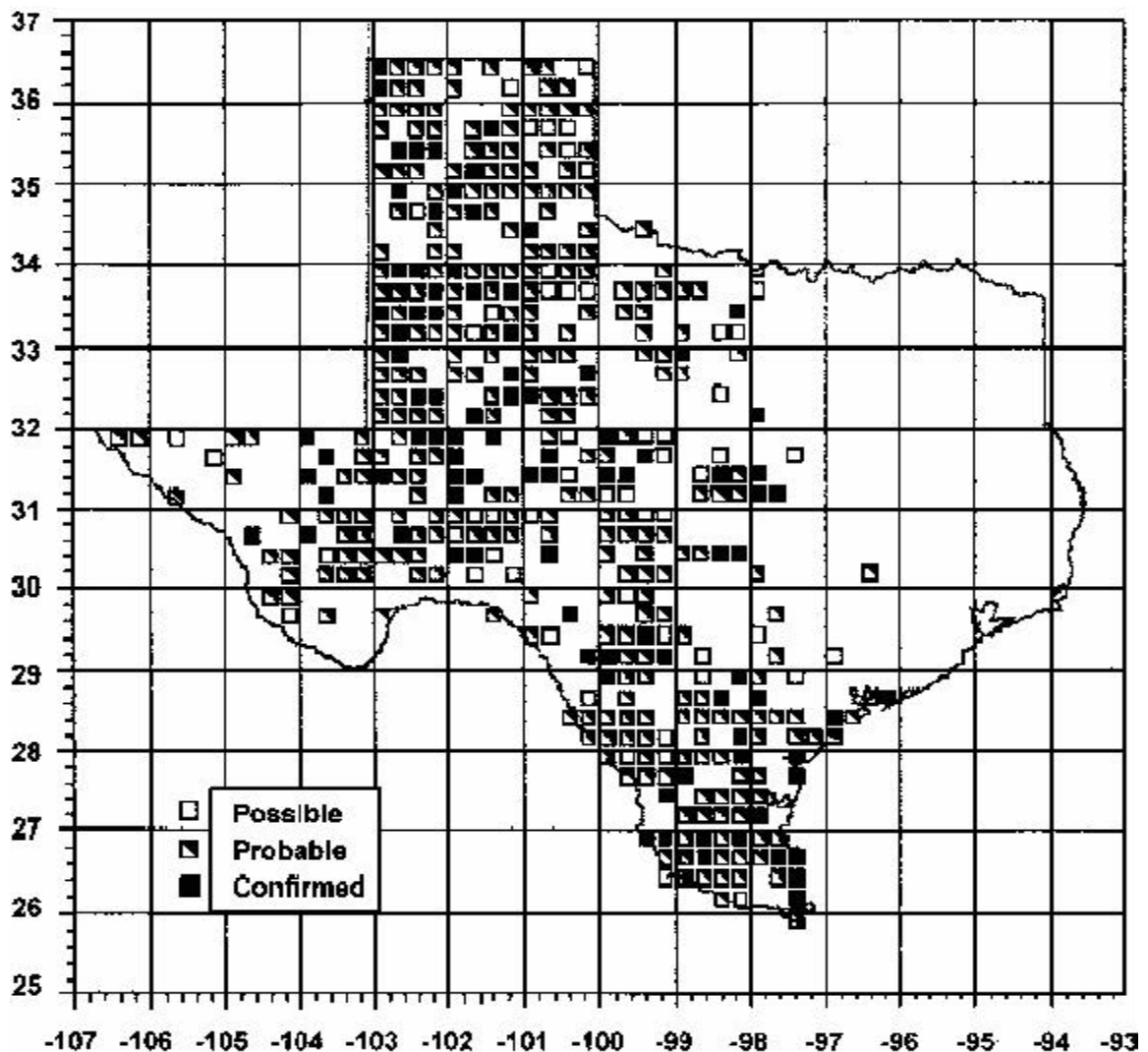
In winter, Cassin's Sparrows withdraw south, occurring only in western and south-central parts of the state, north to about the 33rd parallel (Oberholser 1974; Williams and LeSassier 1968). Oberholser reports that wintering birds were taken northwest to Culberson and Brewster, east to Bexar and Nueces, and south to Cameron Counties. The Checklist of the Birds of Texas (Texas Ornithological Society 1995) describes it as an uncommon winter resident from El Paso County, the Edwards Plateau, and south through the South Texas Plains. Bryan (pers. commun.) stated that Cassin's Sparrows used a more limited set of habitat types in the winter than they did while breeding. He felt they were using the thickest, most well-developed grassland with a shrub mosaic, and although they were in the Trans-Pecos in the winter, they weren't using the desert scrub that they might use during breeding season.

BBS

For the entire time period of available BBS data (1966 - 1996), there was a highly significant decline ($P = 0.00$; $n = 99$) of - 2.9 % per year for Cassin's Sparrows in Texas (Table 3). There were no significant patterns for the state for either the 1966 - 1979 or 1980 - 1996 time periods (Sauer et al. 1997). See the Population Trends section and Table 3 for a breakout of trends in the Physiographic Strata that comprise

Texas and a discussion of their significance. Consistent with distributional information elsewhere (although too numerous to list here by county), Cassin's Sparrows were recorded on almost every BBS route in the western 2/3 of the state (J. R. Sauer unpub. data a).

Fig. 9. Cassin's Sparrow distribution in Texas. Shown as blocks with possible, probable and confirmed breeding occurrences. Data gather from 1987 - 1992, from Arnold and Benson (unpub. data).



CBC

For the years 1959 - 1988, CBC data show that Cassin's Sparrows were recorded on 56 CBC circles in Texas. Those locations where the mean relative abundance per circle ≥ 1.0 were Laguna Atascosa NWR (1.4), Falcon Dam SP (2.1), Zapata (8.9), Chisos Mountains (1.6), Del Norte Mountains (2.1), Sheffield (1.3), Imperial (1.8), and Odessa (2.0) (J. R. Sauer unpub. data b).

Atlas

The Atlas of the Breeding Birds of Texas (Arnold and Benson unpub. data) is currently in draft form with hopes of publication in the next year. The species account states that Cassin's Sparrows breed in the western part of Texas from the Panhandle to the Gulf Coast, but in the winter are found only in the southern part of the state. It goes on to say that project data (1987-1992) (Figure 9) indicate that they breed from the High Plains and the Davis Mountains to the Hill Country and the Coastal Prairies, and that nesting activities are recorded from early March through August. The Texas Breeding Bird Atlas project did not collect data regarding habitat type.

Research / Monitoring

John Schnase conducted research for his Master's Thesis on "The breeding biology of Cassin's Sparrow in Tom Green County, Texas" for Angelo State University (Schnase 1984) at the Angelo State University Management, Instruction and Research area. This information provides the most extensive treatment available of Cassin's Sparrow ecology and behavior. His results (Schnase 1984; Schnase and Maxwell 1989; Schnase et al. 1991) are described throughout this report.

A study of landscape scale habitat relations for birds in Big Bend National Park (W. Barrow pers. commun.) was conducted from 1995 to 1997 by Kevin Gutzwiller (Baylor University) and Wylie Barrow (USGS National Wetlands Research Center). They conducted point counts at 70 permanent plots at the park and measured 23 habitat characteristics at a landscape scale (within 1 km and 2 km of the points) using Geographic Information Systems (GIS). A manuscript analyzing these data is expected during the winter of 1998-99. Although Cassin's Sparrows are sporadic in abundance at Big Bend in the spring (W. Barrow pers. commun.), in 1997 they did record Cassin's at 19 of their points (in 1995 and 1996 they were recorded at two and six points respectively), and hope to publish information about their association with landscape features.

Berthelesen and Smith (1995) conducted a study of the value of Conservation Reserve Program (CRP) lands to breeding nongame birds in the Texas Southern High Plains (southern part of the Panhandle) that provided some information about Cassin's Sparrow responses - see the Management section on CRP.

Maxwell (1979) conducted a study of the bird community in the Concho Valley of west-central Texas for his dissertation. This included a comparison of bird densities in eight different plant communities. See more about his results in the Habitat section.

Emlen (1972) conducted one of the few studies of the size and structure of wintering avian communities in seven habitat types in south Texas. This included some information about Cassin's Sparrows - see Wintering Habitat section.

Major Populations

Texas clearly supports a major portion of the total breeding population of Cassin's Sparrows. No information was available to describe particular locations for major population centers within the state.

State Status	None (D. Scott pers. commun.)
Natural Heritage Rank	Former State rank - S4B. The Texas Natural Heritage Program no longer exists, but the Texas Parks and Wildlife Department maintains the database. Although Cassin's Sparrows do winter in Texas, the database did not include a nonbreeding state rank (D. Scott pers. commun.)
Habitat Condition	<p>Samson and Knopf (1994) report that Texas historically had 7,800,000 ha of shortgrass that has been reduced to 1,600,000 ha (decline of 80%), and had 14,100,000 ha of mixed grass that has been reduced to 9,800,000 ha (decline of 30%). It is difficult to know exactly how these categories compare with Cassin's Sparrow habitat in Texas, especially because desert shrub/grasslands are not discussed in this reference and undoubtedly represent some Cassin's Sparrow habitat. However, it does provide an idea of the scope of habitat change that occurred with the advent of European settlement in Texas.</p> <p>Oberholser (1974) provides some comments about Cassin's Sparrow response to brush control efforts in Texas beginning in the 1930's (see below). Maxwell (1979), in his description of the history of Concho Valley, Texas states that the 19th century grasslands have largely been replaced by mesquite woodland and shrubland on deeper soil sites and juniper savannah on thinner soil slopes. He noted that several species that utilize brushy mesquite land in the 1970's were also common in 1887, including Cassin's Sparrows.</p>
Threats	<p>In light of Cassin's Sparrow requirements for a shrub component in their habitat, programs to promote brush or shrub control to benefit grazing have a potential to negatively impact this species. Oberholser (1974) provides some observations about the history of brush control in Texas. He suggests that Cassin's Sparrow habitat has actually increased since 1933 when the Soil Conservation Service began to subsidize ranchers for brush control. By 1968 brush removal had been attempted on much of this species' range in the western two thirds of Texas. In cases where clearing was followed by a growth of native grasses and a sprouting of young mesquites and low bushes, he states that Cassin's Sparrows have benefitted. However, more extensive and efficient mechanical and chemical means of extirpating all woody vegetation have been developed (Oberholser 1974) and wide application of these methods is posing new threats to this species. However, it appears that the impacts are somewhat dependent on the history and ecology of the particular habitat.</p> <p><u>Edwards Plateau</u> The Edwards Plateau of central and west-central Texas has undergone significant landscape-level habitat changes in recent history. Prior to settlement, most of the Plateau was a fire-maintained savannah whose principal woody species was a live oak (<i>Quercus fusiformis</i>). Due to intense, confined grazing which removes fuel and reduces water infiltration rates, and the resulting decreased fire frequency, the Plateau has experienced widespread expansion of woody plants, especially Ashe juniper (<i>Juniperus ashei</i>), resulting in dense stands locally known as "cedar brakes" (Fowler and Dunlap 1986; Riskind and Diamond 1988; Taylor and Smeins 1994; Fuhlendorf et al. 1997).</p>

The result is a transformation from grassland and oak savannah communities to a woodland dominated by juniper, oak, and mesquite. In addition to the threats posed by woody encroachment, there has been substantial suburban development in the eastern and southern parts of the Edwards Plateau (B. Ortego pers. commun.; K. Bryan pers. commun.), with the Plateau becoming more important as a recreational and second home area (USFWS 1992; Fuhlendorf et al. 1997). For more discussion of these issues and their implication for Cassin's Sparrows, see the Population Estimates and Trends section of this document.

South Texas Brushlands In presettlement times, much of the South Texas Brushlands was covered by grassland with scattered groves of thorn forest, with densely forested low and riparian areas (Rappole et al. 1986). However, as a result of a combination of fire reduction and grazing pressures, by the early 1900's there had been a considerable change in the grasslands, with an increase in cacti and woody species on upland sites, an increase in annual grasses, and a decrease in perennial grasses (Rappole et al. 1986), so that south Texas is described now as semiarid brushland. In comparison with the Edwards Plateau, in the South Texas Brushlands, the threats posed to Cassin's Sparrows may actually be related to destruction of brushland through conversion to agriculture, urban development, and brush control, as opposed to shrub encroachment. For more discussion of these issues and their implication for Cassin's Sparrows, see the Population Estimates and Trends section of this document.

Along the eastern coast of Texas, the occurrence of Cassin's Sparrow is limited by (1) conversion of native prairies to agriculture and other uses, (2) excessive grazing on private property, and (3) insufficient grazing in areas where grass forms dense layers up to 50 cm high, which is not satisfactory habitat for Cassin's Sparrows (B. Ortego pers. commun.).

Literature Cited

- Arnold, K. A. and K. L. P. Benson, Eds. Unpublished Data. The Atlas of the Breeding Birds of Texas. Texas Breeding Bird Atlas Project, College Station, TX.
- Berthelsen, P. S. and L. M. Smith. 1995. Nongame bird nesting on CRP lands in the Texas southern high plains. *Journal of Soil and Water Conservation* 50(6): 672-675.
- Emlen, J. T. 1972. Size and structure of a wintering avian community in southern Texas. *Ecology* 53(2): 317-329
- Fischer, D. H., M. D. Schibler, R. J. Whyte, and E. G. Bolen. 1982. Checklist of birds from the playa lakes of the southern Texas panhandle. *Bulletin of the Texas Ornithological Society* 15: 2-7
- Fowler, N. L. and D. W. Dunlap. 1986. Grassland vegetation of the eastern Edwards Plateau. *American Midland Naturalist* 115(1): 146- 55.

- Fuhlendorf, S. D., F. E. Smeins, and C. A. Taylor. 1997. Browsing & tree size influences on Ashe juniper understory. *Journal of Range Management* 50(5): 507-512.
- Maxwell, T. C. 1979. Avifauna of the Concho Valley of west-central Texas with special reference to historical change. Ph.D. dissertation. Texas A & M University, College Station, TX.
- Oberholser, H. C. 1974. The bird life of Texas. University of Texas Press, Austin, TX.
- Rappole, J. H., C. E. Russell, J. R. Norwine, and T.E. Fulbright. 1986. Anthropogenic pressures on marginal, neotropical, semiarid ecosystems: the case of south Texas. *Science of the Total Environment* 55: 91-99.
- Riskind, D. H. and D. D. Diamond. 1988. An introduction to environments and vegetation. Pages 1-15 *in* Edwards Plateau Vegetation: plant ecological studies in central Texas (B. B. Amos & F. R. Gehlbach, Eds.). Baylor University Press: Waco, TX.
- Samson, F. and F. Knopf. 1994. Prairie conservation in North America. *Bioscience* 44(6): 418-421.
- Sauer, J. R. Unpub. data a. North American Breeding Bird Survey results and analysis. Patuxent Wildlife Research Center, Laurel, MD.
- Sauer, J. R. Unpub. data b. Christmas Bird Count results. Patuxent Wildlife Research Center, Laurel, MD.
- Sauer, J. R., J. E. Hines, G. Gough, I. Thomas, and B. G. Peterjohn. 1997. The North American Breeding Bird Survey results and analysis. Version 96.4. Patuxent Wildlife Research Center, Laurel, MD.
- Schnase, J. L. 1984. The breeding biology of Cassin's Sparrow in Tom Green County, Texas. M.S. thesis. Angelo State University, Angelo, TX.
- Schnase, J. L., W. E. Grant, T. C. Maxwell, and J. J. Leggett. 1991. Time and energy budgets of Cassin's Sparrow during the breeding season: evaluation through modelling. *Ecological Modelling* 55: 285-319.
- Schnase, J. L. & T. C. Maxwell. 1989. Use of song patterns to identify individual male Cassin's Sparrows. *Journal of Field Ornithology* 60(1): 12-19.
- Seyffert, K. D. 1985. The breeding birds of the Texas panhandle. *Bulletin of the Texas Ornithological Society* 18:7-20.

- Taylor, C. A. and F. E. Smeins. 1994. A history of land use of the Edwards Plateau and its effect on the native vegetation. Pages 1-8 *in* Proceedings of Juniper Symposium (C. A. Taylor, Ed.). Technical Report 94-2. Texas Agricultural Experimental Station, College Station, TX.
- Texas Ornithological Society. 1995. Checklist of the birds of Texas. Texas Ornithological Society.
- U.S. Fish and Wildlife Service. 1992. Golden-cheeked Warbler (*Dendroica chrysoparia*) recovery plan. Albuquerque, NM.
- Williams, F. C. and A. L. LeSassier. 1968. Cassin's Sparrow. Pages 981-990 *in* Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies (O. L. Austin, Jr., Ed.). Dover Publications, New York, NY.

OKLAHOMA Summary

Sutton (1967) describes Cassin's Sparrows as transients and summer residents in western Oklahoma. It is described as regularly occurring in the three panhandle counties (Cimarron, Texas, and Beaver Counties), as well as the following western counties (Harper, Woodward, Ellis, Roger Mills, and Beckham Counties) (M. Howery pers. commun.). Baumgartner and Baumgartner (1992) note that Cassin's Sparrows expand eastward in drought years when normally tall or mixed grassland approximates the arid conditions further west, and recede westward in wet years when the vegetation is too lush. In these dry years they are found as far east as Alfalfa, Major, Blaine, Canadian, Caddo, Comanche, and Tillman Counties (M. Howery pers. commun.; J. Grzybowski pers. commun.). This is quite similar to Davis's (1963) and Sutton's (1967) statements that they have been seen eastward to Grant, Oklahoma, Cleveland, McClain, Caddo, Comanche, Jefferson, and Love Counties, although their lines are drawn slightly further east in the state.

Sutton (1967) reports Cassin's Sparrows as seen from March 24 to November 21; Baumgartner and Baumgartner (1992) list it as seen from late April through August with the above dates shown as "outliers." Sutton (1967) reports nest records for Woods, Cimarron, Cleveland, and Texas Counties. Egg dates are from May 26 - July 22 (Johnsgard 1979; Sutton 1967).

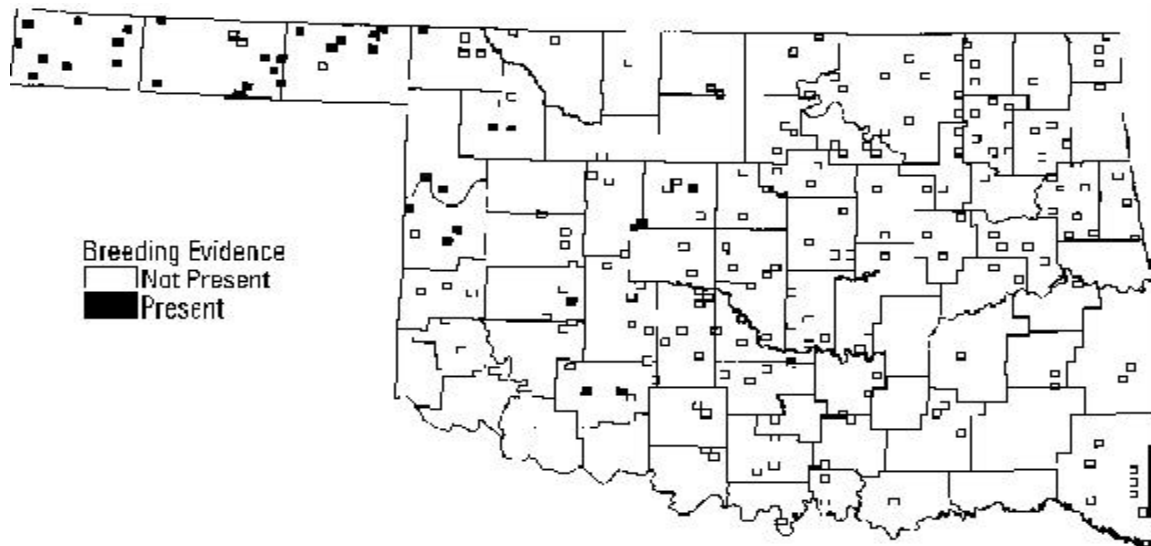
In Oklahoma, lightly grazed sandy prairies with scattered sage, yucca, cactus, mesquite, and shinnery oaks are preferred habitats (Johnsgard 1979; Sutton 1967); Baumgartner and Baumgartner (1992) list them as present in the following grassland associations in western Oklahoma - mixed-grass plains, shinnery oak-grassland, mesquite-grassland, and shortgrass plains. M. Howery (written commun.) describes Cassin's Sparrows as one of the three most common species in the sandsage/bluestem grasslands of northwestern Oklahoma. He also noted that they are fairly common in shinnery oak/bluestem grasslands, found locally in shortgrass prairie where yucca, cholla and/or sandsage are present in the panhandle, and locally in mesquite/bluestem grasslands in southwestern Oklahoma. In years when they are found in central Oklahoma, they are usually in tallgrass prairie pastures.

BBS

For the entire time period of available BBS data (1966 - 1996) there was no significant pattern for Cassin's Sparrow numbers in Oklahoma (Table 3). For 1966 - 1979 there was a somewhat significant increase ($P = 0.20$; $n = 8$) of +9.3% per year, and for 1980 - 1996 there was no significant pattern (Sauer et al. 1997). To describe distribution in Oklahoma, Cassin's Sparrows were found on all BBS routes within Cimarron, Texas, Beaver, Harper, Woods, Woodward, Roger Mills, Dewey, Beckham, Harmon, Greer, Kiowa, and Cotton Counties and on some routes in Grant, Caddo, and Stephens Counties. The routes showing the largest, most consistent numbers of Cassin's Sparrows were all in the panhandle, commonly recording 25 - 70 birds but rarely showing more than 100; a few western states showed consistent annual numbers of 5 - 15, and other counties showed sporadic, individual records (J. R. Sauer unpub. data a)

CBC	N/A
Atlas	The Sutton Avian Research Center has taken the lead on an Oklahoma Breeding Bird Atlas project, and 1998 was the second year of field data collection on this project. A preliminary map (Oklahoma Breeding Bird Atlas unpub. data) produced after the first two years of field data collection (Figure 10) indicates Cassin's Sparrow detections that are quite consistent with state distributions described above.
Research / Monitoring	No references were found to research or monitoring projects, other than BBS, that covered Cassin's Sparrows in Oklahoma.
Major Populations	M. Howery (written commun.) has observed large numbers (100+) of Cassin's Sparrows on the Cooper Wildlife Management Area (WMA) of Woodward County, and the Ellis County WMA. He reports that they are also fairly common on the Packsaddle WMA (Ellis County), the Black Kettle National Grasslands (Roger Mills County), and the Sandy Sanders WMA (Beckham and Greer Counties). Howery has also received reports that they are common on Lake Optima National Wildlife Refuge (Texas County) and the Beaver River WMA (Beaver County). Probably none of these references could be called major populations of Cassin's Sparrows when compared with populations in the core of their range in Texas and New Mexico.
State Status	None (M. Howery pers. commun.)
Natural Heritage Rank	State ranks - S3B, S2M (M. Howery pers. commun.). The imperiled migratory score is probably due to the fact that there are few Cassin's Sparrows migrating through Oklahoma.
Habitat Condition	<p>Samson and Knopf (1994) report that Oklahoma historically had 2,500,000 ha of mixed grass and 1,300,000 ha of shortgrass; however they were unable to find any estimates of current coverage. Although, these numbers are not directly comparable, and he did not have data for shortgrass in Oklahoma, Knopf (1994) reports that for private land in Oklahoma, 60,950 km² of mixed grass remains as rangeland, while 46,820 km² is in cropland and 28,890 km² is in pasture-land, based on USDA figures from 1987. Note that this does not include any public lands in grassland in the state.</p> <p>Insufficient information was available to make statements about the specific condition of Cassin's Sparrow habitat in Oklahoma.</p>
Threats	In the western part of the state, where Cassin's Sparrows are found, there is little suburban development, and much of the land remains in rangeland, with little converted to irrigated cropland (M. Howery pers. commun.). There is little information available about specific threats to Cassin's Sparrows or their habitat in Oklahoma.

Figure 10. Cassin's Sparrow distribution in Oklahoma. This is based on the first two years (1997-1998) of data collection of the five-year Oklahoma Breeding Bird Atlas project (Oklahoma Breeding Bird Atlas unpub. data). Shown as blocks where Cassin's Sparrows were present (includes possible, probable and confirmed breeding occurrences).



Literature Cited

Baumgartner, F. M. and A. M. Baumgartner. 1992. Oklahoma bird life. University of Oklahoma Press, Norman, OK.

Davis, W. M. 1963. Eastward records of Cassin's Sparrow in Oklahoma. *Southwestern Naturalist* 8(1): 49-50.

Johnsgard, P. A. 1979. Birds of the great plains. University of Nebraska Press, Lincoln, NE.

Knopf, F. L. 1994. Avian assemblages on altered grasslands. *Studies in Avian Biology* Number 15.

Oklahoma Breeding Bird Atlas. Unpublished data. Sutton Avian Research Center, Bartlesville, OK.

Samson, F. and F. L. Knopf. 1994. Prairie conservation in North America. *Bioscience* 44(6): 418-421.

Sauer, J. R. Unpub. data a. North American Breeding Bird Survey results and analysis. Patuxent Wildlife Research Center, Laurel, MD.

Sauer, J. R., J. E. Hines, G. Gough, I. Thomas, and B. G. Peterjohn. 1997. The North American Breeding Bird Survey results and analysis. Version 96.4. Patuxent Wildlife Research Center, Laurel, MD.

Sutton, G.M. 1967. Oklahoma birds. University of Oklahoma Press, Norman, OK.

COLORADO Summary

Cassin's Sparrows are common to abundant summer residents in the southeastern plains of Colorado. They are regularly found in the southeastern part of the state (from Las Animas, Huerfano, Pueblo, and El Paso Counties east to the border) and irregularly into the northeast (including portions of Kit Carson, Yuma, Washington, Sedgwick, Logan, Washington, Morgan, and Weld Counties) (Andrews and Righter 1992; Kingery 1998). They are considered accidental in the eastern foothills in summer and winter (two records) (Andrews and Righter 1992).

Andrews and Righter (1992) and Rising (1996) state that Cassin's Sparrows are found primarily in rabbitbrush and sandsage grasslands in Colorado. However, the Colorado Breeding Bird Atlas (Kingery 1998) found that nearly 50% of all habitat records were from shortgrass prairie, with sage habitats comprising another 25%. This difference may be a result of different habitat definitions, since the shortgrass prairie used by Cassin's Sparrows undoubtedly includes a shrub component of some sort.

Cassin's Sparrows begin arriving in Colorado around mid-April (Kingery 1998). The first nest record for the state was found near Barr Lake on June 14, 1907; the nest contained four eggs (Bailey and Niedrach 1965). The majority of nesting dates occur from early June through mid-July (Kingery 1998), although Kingery and Julian (1971) reported a nest with eggs on May 16 in southeast Colorado. Colorado Bird Observatory (CBO) studies in southeast Colorado observed the first nest-building behavior in mid-May and the latest nest being observed for fledging in the first week of August (J. Bradley pers. commun.).

BBS

For the entire time period of available BBS data (1966 - 1996) there was a somewhat significant decline ($P = 0.18$; $n = 32$) of - 4.1 % per year (Table 3). For 1966 - 1979 there was a significant decline ($P = 0.06$; $n = 8$) of - 9.6% per year, and for 1980 - 1996 there was a very significant increase ($P = 0.03$; $n = 32$) of + 2.6% per year (Sauer et al. 1997). To describe the distribution in the state, Cassin's Sparrows were found on all BBS routes in Baca, Prowers, Bent, Otero, Crowley, Pueblo, El Paso, Lincoln, Cheyenne, Yuma, Washington, Morgan, and Logan Counties, and on most routes in Las Animas, Kit Carson, Adams, and Weld Counties (J. R. Sauer unpub. data a). The numbers vary both annually and geographically. The routes that commonly record more than 100 birds on a route year after year are all located in the southeastern part of the state; there are quite a few routes in the northeastern part of the state that show consistent numbers annually but they rarely reach 100. There are also examples of the large fluctuations in population from year to year. A few examples follow: a route in Lincoln County that commonly had 80 - 120 Cassin's, with a maximum of 230; a route in Yuma County that commonly had 40 - 70 with a maximum of 111; a route in Prowers County that in some years had 25 - 60, other years 120 - 135, and a maximum of 359; and a nearby route that had anywhere from 5 to 340 (J. R. Sauer unpub. data a).

CBC

N/A

Atlas

The Colorado Breeding Bird Atlas (Kingery 1998), for which field data were collected from 1987 to 1995, provides the most up-to-date information about the avifauna of Colorado. Breeding Cassin's Sparrows concentrated in southeastern Colorado (from Las Animas, Huerfano, Pueblo, and El Paso Counties east to the border), with many also nesting in the northeastern part of the state (including portions of Kit Carson, Yuma, Washington, Sedgwick, Logan, Washington, Morgan, and Weld Counties) (Figure 11 - Atlas map). With two exceptions (from April), atlas data did not note spring arrival until the second half of May, but noted that that might be because Cassin's Sparrows tend to delay courtship after arrival. The majority of nesting dates occurred from early June through mid-July. Nearly 50% of all habitat records were from shortgrass prairie, with sandsage shrubland habitats comprising another 25%. Perusal of only the confirmed breeding records found a similar pattern with 50 - 60% of the records from shortgrass prairie, primarily in the southeast, and 20% from either lowland sagebrush habitat in the southeast or tallgrass-sandsage in the northeast.

Research / Monitoring

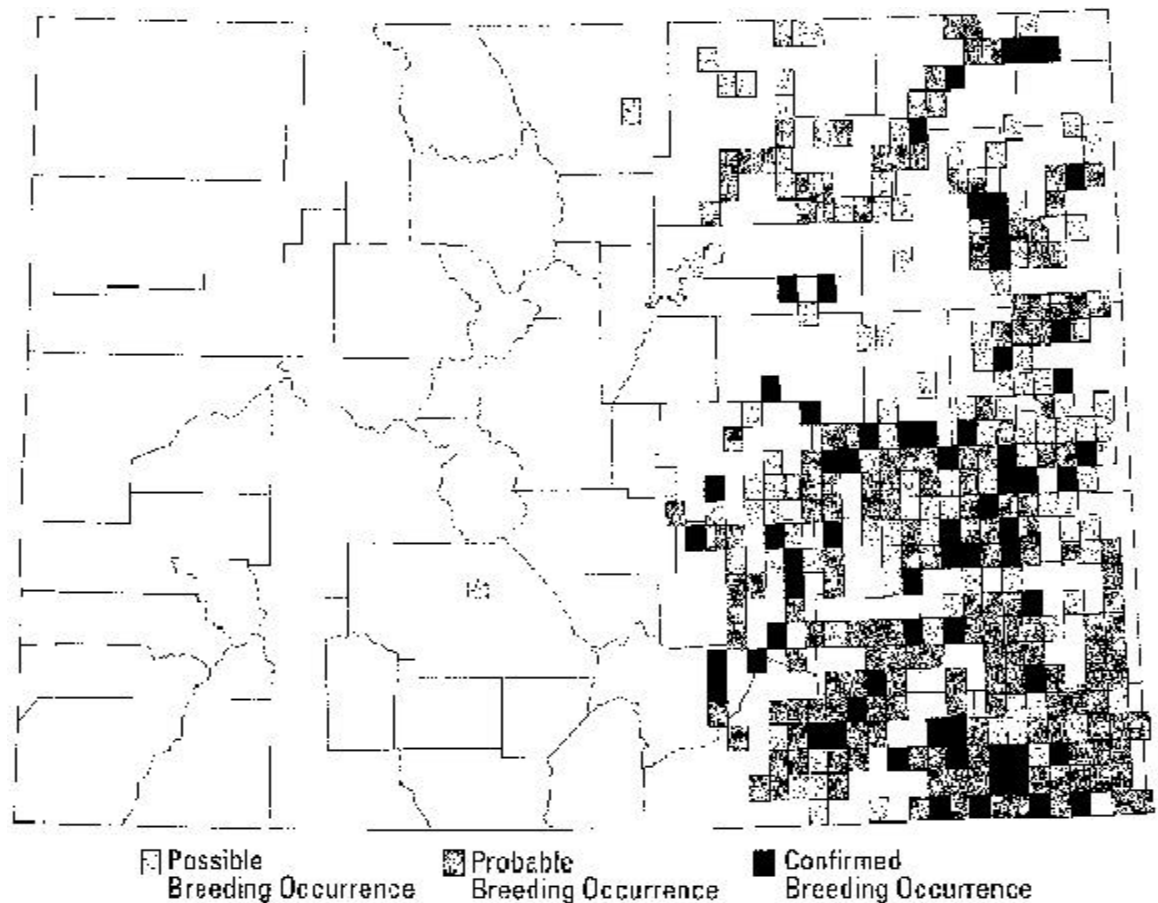
In response to the need for better monitoring of many Colorado birds that are not sufficiently monitored by existing programs, Colorado Bird Observatory and the Colorado Division of Wildlife initiated the Monitoring 2001 program to develop habitat-based bird monitoring stations that gather demographic data throughout the state. Cassin's Sparrows are classified as a species for which BBS data in Colorado are inadequate and as a priority species for the Monitoring 2001 program. It is also targeted by CBO's Shortgrass Prairie Project (CBO 1997).

The Colorado Bird Observatory has been conducting a number of projects in southeastern Colorado that include Cassin's Sparrow as a target species. Point counts were conducted from 1995 through 1997. In 1996, a Cassin's Sparrow nest study produced information on nest habitat and survivorship; preliminary analyses show that daily survival rates are quite low on the Comanche National Grasslands (about 0.17 using Mayfield method; $n = 27$) (J. Bradley pers. commun.). A project in 1998, in cooperation with the Comanche National Grasslands, focused on habitat use by singing males. It found that sites where Cassin's Sparrows were detected were characterized by 27% bare ground, 14.8% shortgrass, 37.8% midgrass, 8.5% forbs, 2.4% cholla, 4.6% yucca, 0.9% low shrub (<1 m), and 4.1% tall shrub (>1 m) (Gillihan 1999). The best management practices recommended by CBO for Cassin's Sparrows suggest the management of grassland parcels to provide a mixture of shortgrass and midgrass (40 - 80% total cover), with 20-30% bare ground, and scattered shrubs (5-35% canopy cover) (Gillihan 1999).

The Colorado Division of Wildlife has initiated a project in southeastern Colorado (Comanche National Grasslands) that will focus on Cassin's Sparrows and several other species. It involves comparing transect and point count surveys to determine the most effective methods for surveying birds and developing an index of productivity. In the first field season (1999), point counts have been conducted on singing male Cassin's Sparrows (and other target species), and nest searches have

found at least six nests (K. Giesen pers. commun.).

Figure 11. Cassin's Sparrow distribution in Colorado. Shown as blocks of possible, probable, and confirmed breeding occurrences. From Kingery (1998).



Major Populations

The core area for Cassin's Sparrows in Colorado is the Comanche National Grasslands in Baca County in the southeastern part of the state (J. Bradley pers. commun.). In some years the Pawnee National Grasslands in northeastern Colorado may support smaller populations.

State Status

None (K. Giesen pers. commun.).

Colorado Division of Wildlife has developed COVERS, the COLORADO VERTEBRATE RANKING SYSTEM, for identifying conservation priorities among native vertebrates in the state. Based on existing sources of data and peer review, COVERS employs a two-step ranking system for identifying species with high conservation needs. A species is evaluated on its degree of biological imperilment, state of knowledge of the species, current management status, relative importance of Colorado populations to species overall, socioeconomic issues, and additional biological factors. As part of a larger ranking system, the scores for any one species should be interpreted within the context of the scores of similar taxonomic groups. Therefore, presenting COVERS scores for Cassin's Sparrows alone would not be helpful. However a

comparison of COVERS biological scores for Cassin's Sparrows and those of other grassland birds indicates that Cassin's Sparrow falls into a low-to-median position along the continuum of priority grassland bird species in Colorado (Gross and Melcher 1998).

Natural Heritage Rank

State rank - S4B (M. Wunder pers. commun.).

Habitat Condition

Knopf (1994) reports that for private land in Colorado, 98,030 km² of Colorado's shortgrass prairie remains as rangeland, with 42,910 km² now in cropland and 5,100 km² in pasture-land, based on USDA numbers in 1987. This does not include public lands, the largest of which are the Comanche National Grassland (453,707 acres, much in midgrass and shortgrass prairie), and the Pawnee National Grassland (193,060 acres interspersed with private and other public lands).

Threats

There was very little information available about particular threats that face Cassin's Sparrows in Colorado.

Literature Cited

- Andrews, R. & R. Righter. 1992. Colorado birds. Denver Museum of Natural History, Denver, CO.
- Bailey, A. M. and R. J. Niedrach. 1965. Birds of Colorado. Vol. II. Denver Museum of Natural History, Denver, CO.
- CBO. 1997. Reference guide to the monitoring & conservation status of Colorado's breeding birds. Colorado Bird Observatory, Brighton, CO.
- Gillihan, S. W. 1999. Best management practices for select bird species of the Comanche National Grassland. Report submitted to U.S. Forest Service, Comanche National Grassland.
- Gross, J. E. and C. P. Melcher. 1998. COVERS: Identifying species at risk and setting priorities for conservation of vertebrates in Colorado. Unpublished report submitted to Colorado Division of Wildlife, Fort Collins, CO.
- Kingery, H. E. Ed. 1998. Colorado breeding bird atlas. Colorado Breeding Bird Atlas Partnership, Denver, CO.
- Kingery, H. E. & P. R. Julian. 1971. Cassin's Sparrow parasitized by cowbird. *Wilson Bulletin* 83(4): 439.
- Knopf, F. L. 1994. Avian assemblages on altered grasslands. *Stude in Avian Biology* Number 15: 247-257.
- Rising, J. D. 1996. A guide to the identification and natural history of the sparrows of the United States and Canada. Academic Press, New York, NY.

Sauer, J. R. Unpub. data a. North American Breeding Bird Survey results and analysis. Patuxent Wildlife Research Center, Laurel, MD.

Sauer, J. R., J. E. Hines, G. Gough, I. Thomas, and B. G. Peterjohn. 1997. The North American Breeding Bird Survey results and analysis. Version 96.4. Patuxent Wildlife Research Center, Laurel, MD.

**KANSAS
Summary**

Cassin's Sparrows breed in southwestern Kansas (regularly to Hamilton, Finney, and Comanche Counties), and less commonly they extend to Cheyenne County (Johnsgard 1979). Thompson and Ely (1992) describe their distribution as chiefly south of the Arkansas River but also north to Wallace County and east to Edwards. They also note that in "irruption" years populations increase in size and birds occur much further north and east, with nesting occurring east to Rice County. Cassin's Sparrows are listed as an abundant migrant and summer resident, and one of the five most conspicuous birds on Cimarron National Grassland (Cable et al. 1996).

They are found primarily in rabbitbrush and sandsage grasslands (Rising 1996; B. Busby pers. commun.). Williams and LeSassier (1968) reference an earlier report from Kansas that Cassin's Sparrows frequent barren spots and sandy lands that have a component of low, stunted bushes, bunch grass, or cactus. Eggs are laid from mid-May to mid-July (Johnsgard 1979). Nest dates from the Cimarron National Grasslands included 2 June, 7 June, 8 June, and 12 June (Cable et al. 1996).

BBS

BBS trend data for the state of Kansas are of limited value since there are so few routes in western Kansas where Cassin's Sparrows are found ($n = 10$ for 1966-1996 time period), and therefore few for which sufficient, reliable data exist for analysis. As a description of Cassin's Sparrow distribution within the state, Cassin's Sparrows were observed on routes within Sherman, Wallace, Logan, Gove, Decatur, Phillips, Ellis, Barton, Kearny, Meade, Clark, Comanche, Barber, Barber, Pratt, Stafford, and Ottawa Counties. Only the routes in Kearney, Wallace, and Sherman show consistent records of Cassin's Sparrows, with all other routes showing sporadic records of individual birds. For example - the route in Kearney commonly recorded 15 - 55 with a maximum of 88; the route in Wallace showed some years with 0 - 10, others with 40 - 135, and a maximum of 165 (J. R. Sauer unpub. data a).

CBC

N/A

Atlas

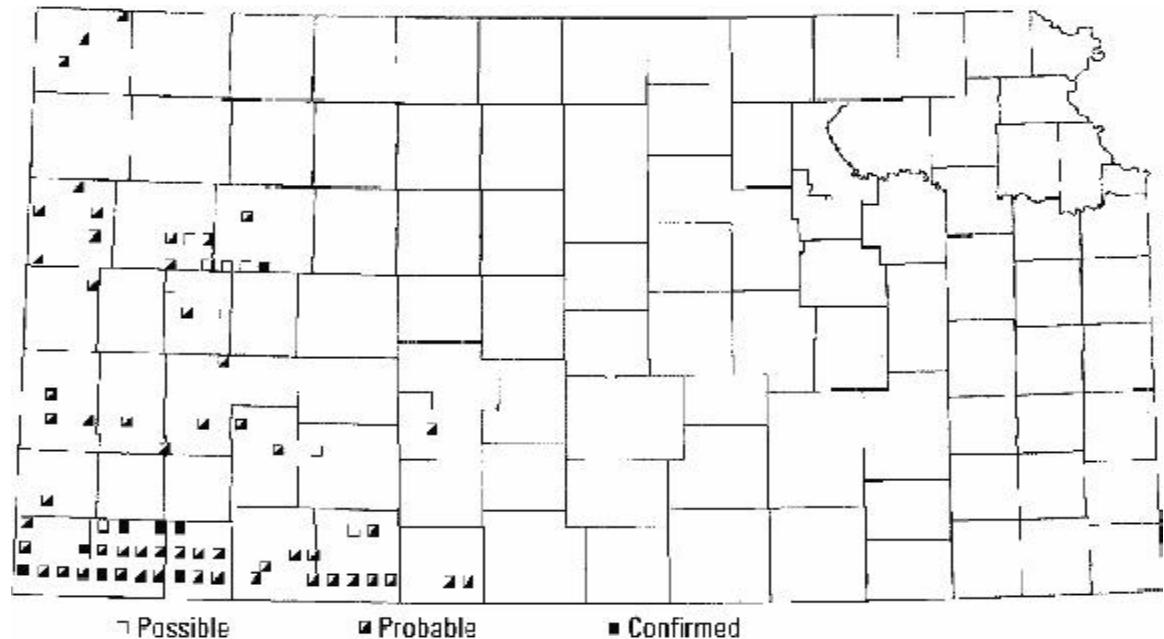
Data for the Kansas Breeding Bird Atlas have been collected (1992 - 1997) and a draft is currently being written. Atlas data (Figure 12) show the highest percentage of records in the southwestern corner of the state, with almost equal frequency of occurrence in the Red Hills, but only marginal breeding evidence in the northern High Plains (Busby and Zimmerman unpub. data). Confirmed nesting records were in Morton, Stevens, Seward, and Gove Counties. The atlas project did not gather data on abundance. Cassin's Sparrow presence is strongly related to the presence of native shortgrass and mixed-grass prairie with a shrub component (sagebrush, yucca, etc.). Typically this habitat was sandsage (*Artemisia filifolia*) prairie on sandy soils (B. Busby written commun.).

Research / Monitoring

There was not any evidence of research or monitoring programs being conducted on Cassin's Sparrows in Kansas, other than the BBS, and the

BBS coverage in western Kansas is sparse, providing little detail (B. Busby written commun.). However, the Kansas Department of Wildlife and Parks has contracted with someone to update their information on the distribution of all species in the state (J. Horak pers. commun.).

Figure 12. Cassin's Sparrow distribution in Kansas. Shown as blocks of possible, probable, and confirmed breeding occurrences. Data were collected from 1992 - 1997, from Busby and Zimmerman (Unpub. data).



Major Populations

Cassin's Sparrows are common to abundant in areas like the Cimarron National Grasslands and in the sandhills along the south side of the Arkansas River in Hamilton, Kearny, and Finney Counties (B. Busby written commun.).

State Status

None (B. Busby written commun.).

Natural Heritage Rank

State rank - S3B (B. Busby pers. commun.).

Habitat Condition

Due to the amount of conversion of sandsage prairie to cropland within the Kansas range of Cassin's Sparrow, particularly since 1960, it is likely that populations have declined substantially. Large amounts of sandsage prairie along the Arkansas River were converted to irrigated agriculture in the 1970's (B. Busby written commun.).

B. Busby (pers. commun.) noted that in Kansas the Cassin's Sparrow's habitat is quite coincident with that of the Lesser Prairie-Chicken (*Tympanuchus pallidicinctus*) and that conservation efforts focused on improving Lesser Prairie-Chicken habitat might also benefit Cassin's Sparrows, especially if it involved planting sandsage.

Threats

Brush control in the form of sandsage prairie spraying is a potential threat to Cassin's Sparrows in Kansas, as their distribution there is tied to sandsage. Control was carried out on the Cimarron National Grasslands in the late 1970's and early 1980's but has not been continued since. Habitat loss was also identified as a threat, but there is not a lot of plowing under of native prairie in western Kansas, as most of the appropriate arable land has already been transformed (B. Busby pers. commun.).

Literature Cited

- Busby, W. and J. Zimmerman, Eds. Unpublished data. Kansas Breeding Bird Atlas Project, Kansas Biological Survey, Lawrence, KS.
- Cable, T. T., S. Seltman, and K. J. Cook. 1996. Birds of Cimarron National Grassland. USDA Forest Service, General Technical Report RM-GTR-281.
- Johnsgard, P. A. 1979. Birds of the great plains. University of Nebraska Press, Lincoln, NE.
- Rising, J. D. 1996. A guide to the identification and natural history of the sparrows of the United States and Canada. Academic Press, New York, NY.
- Sauer, J. R. Unpub. data a. North American Breeding Bird Survey results and analysis. Patuxent Wildlife Research Center, Laurel, MD.
- Thompson, M. C. and C. Ely. 1992. Birds in Kansas. Vol. I. University Press of Kansas, Lawrence, KS.
- Williams, F. C. and A. L. LeSassier. 1968. Cassin's Sparrow. Pages 981-990 *in* Life histories of North American cardinals, grosbeaks, buntings, towhees, finches, sparrows, and allies (O. L. Austin, Jr., Ed.). Dover Publications, New York, NY.

**WYOMING
Summary**

Wyoming lies on the extreme northwestern limit of the Cassin's Sparrow's breeding range. Cassin's Sparrow is considered an accidental species (Luce et al. 1997). The first record of Cassin's Sparrow was a singing male observed on 8 June 1978 in Natrona County (Faanes et al. 1979). Habitat was described as a south-facing slope with sagebrush and greasewood, with blue grama and green needlegrass (*Stipa viridula*) and prickly pear on the ground layer. There have been additional reports of birds from Platte County and Goshen County (Dorn and Dorn 1995). The first record of a Cassin's Sparrow nest was on 31 July 1993 in Goshen County near the Nebraska border (Dorn and Dorn 1995). This nest occurred in consolidated rolling sandhills dominated by sand sagebrush, and at that time contained three feathered young and one unhatched egg (Dorn and Dorn 1995). However, the Bird Records Committee in Wyoming has only accepted two sightings, the June 1978 sighting and a sighting in Goshen County in 1990. The nest report from 1993 was not accepted because of lack of description of the birds to go with the nest descriptions (A. Cerovski pers. commun.).

BBS

There is insufficient data to produce any BBS trend data for Wyoming. A single BBS route in Goshen County recorded two Cassin's Sparrows one year and one bird in a second year (J. R. Sauer unpub. data a).

CBC

N/A

Atlas

There isn't a Wyoming Breeding Bird Atlas. Currently the closest thing is a document called "The Atlas of Birds, Mammals, Reptiles and Amphibians in Wyoming" (Luce et al. 1997), produced by the Wyoming Game and Fish Department. It lists Cassin's Sparrow as accidental.

Research / Monitoring

There are no current research or monitoring projects focused on this species.

Major Populations

There are no major populations of Cassin's Sparrows in Wyoming. It is considered an accidental species there, with the possibility that recent observations represent a range expansion.

State Status

None (A. Cerovski pers. commun.).

Natural Heritage Rank

State rank - S1 (G. Beauvais pers. commun.); it received this score because it is on the periphery of its range. The Wyoming Natural Diversity Database does track this species, collecting any documented observations. They noted only one breeding record – the observations from Goshen County near Torrington that are mentioned above.

Habitat Condition

Not enough is known to describe habitat condition.

Threats

Not enough is known to describe threats.

Literature Cited

Dorn, R. D. and J. L. Dorn. 1995. Cassin's Sparrow nesting in Wyoming. *Western Birds* 26: 104-106.

Faanes, C. A., B. A. Hanson, and H. A. Kantrud. 1979. Cassin's Sparrow - first record for Wyoming and recent range extensions. *Western Birds* 10: 163-164.

Luce, B., B. Oakleaf, A. Cerovski, L. Hunter, and J. Priday, Eds. 1997. Atlas of birds, mammals, reptiles, and amphibians in Wyoming. Wyoming Game and Fish Department, Lander, WY.

Sauer, J. R. Unpub. data a. North American Breeding Bird Survey results and analysis. Patuxent Wildlife Research Center, Laurel, MD.

NEBRASKA**Summary**

Nebraska lies at the northern periphery of the Cassin's Sparrow breeding range and it has been variously classified as accidental, or a rare and irregular migrant and summer resident in southwestern Nebraska (Johnsgard 1996; Ducey 1988). The first record of a nesting Cassin's Sparrow was reported in mid-June 1974 in Perkins County (Williams 1974). Other records of singing males were reported from western and southwestern Nebraska including Perkins, Hayes, Lincoln, Deuel, Garden, Cheyenne, Sioux, Dundy, Box Butte, Sheridan, and Morrill Counties (Faanes et al. 1979; Williams 1974; Labeledz 1986; Sharpe et al. unpub. data). In June 1993 Bock and Scharf (1994) discovered a small nesting population (three nests found) of Cassin's Sparrows in Keith County. They were located along an abandoned roadside dominated by perennial mid-height native grasses with scattered yucca in nearby pastures (Bock and Scharf 1994). The Nebraska Breeding Bird Atlas project (Sharpe et al. unpub. data) noted spring arrival in late May and fall departure in August.

BBS

Only four BBS routes in Nebraska show a few records of Cassin's Sparrows. They are located in Hitchcock, Cheyenne, Morrill, Sioux, and Scotts Bluff Counties and showed sporadic records of one - seven birds. There were insufficient data to define any trends (J. R. Sauer unpub. data a).

CBC

N/A

Atlas

The Nebraska Breeding Bird Atlas is currently in draft form with hopes of publication in the next year. The data was collected approximately ten years ago (Sharpe et al. unpub. data) and the Nebraska Game and Parks Commission is currently working on getting this published (J. Dinan pers. commun.). They also hope to begin a repetition of the atlas data-gathering in the next two years. The draft species account (Sharpe et al. unpub. data) describes Cassin's Sparrows as rare breeders and spring and fall migrants in the west and southwest parts of the state. It notes that they occur in grasslands containing good stands of sandsage, primarily in the southwest and southern panhandle of the state.

Research / Monitoring

No projects occur other than BBS routes.

Major Populations

There are not any major populations in the state.

State Status

None. It is considered an accidental species in the state.

Natural Heritage Rank

State rank - S4.

Habitat Condition

There is not sufficient information to make a statement on the condition of habitat in Nebraska for this species.

Threats

There is not sufficient information to describe threats.

Literature Cited

- Bock, C. E. and W. C. Scharf. 1994. A nesting population of Cassin's Sparrows in the sandhills of Nebraska. *Journal of Field Ornithology* 65(4): 472-475.
- Ducey, J. E. 1988. *Nebraska Birds: Breeding Status and Distribution*. Simmons-Boardman Books, Omaha, NE.
- Faanes, C. A., B. A. Hanson, and H. A. Kantrud. 1979. Cassin's Sparrow - first record for Wyoming and recent range extensions. *Western Birds* 10: 163-164.
- Johnsgard, P. A. 1996. *The birds of Nebraska and adjacent plains states*. Nebraska Ornithological Union. Occasional Papers, No. 6.
- Labeledz, T. E. 1986. Cassin's Sparrow in Garden County. *Nebraska Bird Review* 54: 80-81.
- Sauer, J. R. Unpub. data a. North American Breeding Bird Survey results and analysis. Patuxent Wildlife Research Center, Laurel, MD.
- Sharpe, R., J. Jorgensen, and R. Silcock. Unpublished data. *Birds of Nebraska, their distribution and ecology*. Nebraska Breeding Bird Atlas Project. Nebraska Game and Parks Commission, Lincoln, NE.
- Williams, F. 1974. Southern Great Plains. *American Birds* 28: 922.

MEXICO**State**

Sonora, Chihuahua, Coahuila, Tamaulipas, Sinaloa, Nayarit, Nuevo León, Zacatecas, Guanajuato, Durango, Jalisco, San Luis Potosí

Summary

Howell and Webb (1995) report Cassin's Sparrow as a fairly common to common breeder in northern Sonora, in the interior south on the Mexican Plateau at least to Zacatecas and San Luis Potosí, and on the Atlantic slope in Tamaulipas. They report that although they are resident in much of this range there is probably some withdrawal south in the winter. They describe Cassin's Sparrow habitat in Mexico as arid to semiarid, open and semiopen brush, and grassland with scattered bushes and brush. They note breeding in Mexico from April through September. Cassin's Sparrows are uncommon to fairly common in winter on the Pacific slope from Sonora to Nayarit, and south in the interior to Guanajuato (Howell and Webb 1995). Russell and Monson (1998) also found Cassin's Sparrows wintering rather commonly through much of Sonora, especially south of the latitude of Hermosillo. They reported that winter numbers are dependent upon availability of grasslands (or weedy places) with a component of shrubs, characteristics which are dependent on favorable summer rains and little or no grazing.

BBS

A three-year BBS feasibility study was conducted in Mexico from 1993 - 1996. Routes that recorded Cassin's Sparrows were located in Coahuila near Saltillo, Ocampo, etc. and in Tamaulipas near Aldama. For these few years most records were for only a few birds; one route in northern Coahuila recorded 30 Cassin's Sparrows one year and another in northern Coahuila recorded 65 in one year (J. R. Sauer unpub. data a). None of those routes have been surveyed subsequently. With the exception of a couple of routes that are sporadically surveyed by U.S. citizens, the BBS does not exist in Mexico at this time. However, there is interest in Mexico in developing a program to monitor bird populations, that may include a BBS in portions of the country. Some discussions have been held and BBS anticipates some preliminary action within the next year or so (B. Peterjohn pers. commun.). Expansion of the BBS program, or an equivalent, into Mexico could potentially provide valuable information about Cassin's Sparrow populations there.

CBC

A number of CBCs are conducted in Mexico by coalitions of U.S., Mexican, and in some cases Canadian citizens, primarily in Sonora, Chihuahua, and Tamaulipas, although there is no organized program for the country. Additional cooperation from and support for Mexican participation in this program would be valuable. Several CBC circles in Sonora have recorded Cassin's Sparrows in one or two years (Baviacora, Yécora, and Alamos), several in Chihuahua (Rancho el Palomina and Ejido San Pedro), one in Guanajuato (San Miguel de Allende), and the Rio Corona circle in Tamaulipas consistently showed 10-20 Cassin's from 1991 to 1994 (J. R. Sauer unpub. data b).

Atlas

N/A

Research / Monitoring

A study of the seasonal fluctuations in seed-eating bird populations across three habitat types along a topographic gradient in the central Chihuahuan Desert in Mexico (Nocedal, in prep) was conducted from 1978-1981. Of the three habitat types – upper bajada (upper mountain slopes and alluvial fans), lower bajada, and playa (seasonally flooded bottomlands) – Cassin’s Sparrows were found most consistently and most abundantly in the lower bajada habitats characterized by a shrub component of mesquite, creosote bush, tar bush, etc. and a grass under story (summer 1978 - 5.9/10 ha; winter 1979 - 5.5/10 ha; summer 1979 - 4.9/10 ha; winter 1980 - 0.2/10 ha). They were also found during one winter and summer season in the playa habitat (winter 1979 - 11.8/10 ha; summer 1979 - 5.7/10 ha). Nocedal suggests that they were able to use the playa habitat as a result of larger than average seed crops due to optimal rainfall patterns during and in the previous season. Cassin’s Sparrows appeared to abandon the study area during the final summer and winter field season.

In 1996, the Colorado Bird Observatory (CBO) initiated a long-term winter project in the grasslands of Chihuahua and Durango, Mexico. The objectives are to determine distribution patterns of wintering grassland birds on the Mexican Plateau, determine habitat associated with target species, and monitor population trends over time. CBO completed a pilot season in the winter of 1995-1996 (Bradley and Leukering, 1996) and two years of data collection (1996-97 and 1997-98). Most of their surveys to date have been conducted in Chihuahua. They survey birds using the area search method and collect related vegetation data. Cassin’s Sparrows were found on 27 of 384 area search plots during 1997 (Carter et al. 1997), and on 29 of 445 plots during 1998 (Carter et al. 1998). They were generally found skulking in thick cover, usually grass, with available perch sites. Using both a Principal Components Analysis (PCA) and a univariate approach (Table 8) on 1997 data, they were found to be present on sites with higher than average shrub cover, bare ground, litter, and tall grass.

Table 8. Sample size and means for untransformed vegetation variables associated with wintering grassland bird species on the Mexican Plateau of Chihuahua, Mexico. First 4 vegetation variables present number of point-intercepts where that type of vegetation was found; vertical grass presents the number of grass intercepts at the 30 - 40 cm height; percent shrub presents a visual estimate of percent shrub cover. Values that are bolded are greater than the mean for all plots (no statistical analysis was provided). From Carter et al. (1997).

Species Ground	<i>n</i>	Bare	Forbs	Grass Grass	Litter Cover (>1 m)	Vertical	Percent Shrub
Cassin’s Sparrow	27	49.48	6.82	71.52	31.00	14.93	4.56
All Plots	384	43.47	7.18	78.56	29.41	12.57	3.03

Using PCA and univariate analysis (Table 9) on a slightly different set of vegetative variables in 1998, Cassin’s Sparrows were found at sites with more shrubs and trees with a grass component (Carter et al. 1998). General observations of Cassin’s Sparrows noted that they were most often found in areas with shrub cover and at least clumps of dense grass. They were most often flushed from dense grass but tended to drop back into or next to the bases of shrubs.

Table 9. Sample size and means for untransformed vegetation variables and habitat associations of wintering grassland bird species on the Mexican Plateau of Chihuahua, Mexico. Values greater than the mean for all plots are bold (no statistical analysis was provided). First three vegetation variables represent cover estimates. Point quarter variables present the mean distance to the nearest cactus (or shrub or tree) in each of 4 quadrants. From Carter et al. (1998).

Species	<i>n</i>	Bare Ground	Forbs	Grass	Cactus Pt. Qtr.	Shrub Pt.Qtr.	Tree Qtr.
Cassin's Sparrow	29	21.43	11.43	67.14	24.63	141.73	66.73
All Plots	445	24.44	13.90	60.10	18.96	94.33	58.65

A graduate student at the Universidad Autónoma de Chihuahua is currently gathering data for a master's thesis on "Relative abundance and biomass of grassland birds in Aplomado Falcon territories in Chihuahua, Mexico" (C. Mendez-Gonzales et al. written commun.). He has shared the raw data on Cassin's Sparrows from his first year of data collection for this report. The study areas are in north-central Chihuahua in the Counties of Villa Ahumada and Chihuahua in the Sueco zone, and the County of Coyame in the Tinaja Verde zone. During the breeding season (August), he recorded a total of 152 Cassin's Sparrows on plots at the Sueco site and 131 Cassin's Sparrows on plots at the Tinaja Verde site. Using a conservative approach (assuming that 50% of the individuals recorded during area searches were male and 50% female, and thus halving total numbers to calculate pair density), preliminary estimates of breeding density were 0.39 pairs per ha at Sueco and 0.34 pairs per ha at Tinaja Verde. By gathering vegetation data on basal cover and shrub density, he will be able to compare plots where particular species were found, with plots where they are absent (Table 10). There do not appear to be many consistent patterns between the two sites after one year of data collection, but additional data collection and analysis may clarify this. Mendez-Gonzalez felt that at the Sueco site Cassin's Sparrows were probably responding to grass cover and litter rather than shrub density, whereas at the Tinaja Verde site they seemed to be more clearly responding to shrub density. This study also distinguishes six different habitat types within the plots sampled. The sample sizes for Cassin's Sparrows are too low and the variance too high to make statistical comparisons at this time for differences in habitat preference. With the exception of open grasslands on hills which did not support any Cassin's Sparrows at either Sueco or Tinaja Verde, the other habitat types - shrub grassland, swale, open grassland, savannah, and yucca grassland - all supported mean individuals per plot ranging from 1.33 to 3.0, with no clear pattern of preference for certain habitat types.

Table 10. Average percentage of basal cover and shrub density in plots where breeding Cassin's Sparrows were present and absent - preliminary data from one year (Mendez-Gonzalez written commun.)

Location	Status	Grass	Litter	Herb. Vegetation	Shrubs	Bare Ground	Shrub Density
Sueco	Present	47.27	38.55	0.45	0.88	17.86	98.90
Sueco	Absent	19.06	17.81	0.69	1.44	61.00	282.19
Tinaja Verde	Present	37.71	34.53	0.22	1.22	26.31	197.00
Tinaja Verde	Absent	36.19	48.75	1.69	2.12	11.25	99.50

During the nonbreeding season, surveys were conducted in January, March-April, and May-June. During those time periods he recorded 7, 16, and 0 Cassin's Sparrows respectively at the Sueco site and 5, 5, and 7 Cassin's respectively at the Tinaja Verde site. A preliminary estimate of Cassin's Sparrow wintering density for those time periods found densities of 0.36, 0.82, and 0 individuals per ha respectively for Sueco, and 0.26, 0.26, and 0.36 individuals per ha respectively for Tinaja Verde.

Although most of her research was in southern New Mexico, Meents (1979) studied the bird community at a site in northern Chihuahua (La Campana). She provides information about average census numbers for Cassin's Sparrows at each site. Along 7.2 km roadside censuses, 74.0 Cassin's Sparrows were recorded in summer and 1.0 in winter at La Campana.

Major Populations

There is insufficient information to describe locations of major populations of Cassin's Sparrows in Mexico, although there is reason to believe that substantial populations of breeding Cassin's Sparrows exist in the grasslands of Sonora, Chihuahua, etc. In addition, Mexican grasslands provide the great majority of wintering habitat for the entire population of Cassin's Sparrows.

State Status

No evidence was found of any particular status designations of Cassin's Sparrows in Mexican states.

Natural Heritage Rank

N/A

Habitat Condition

Insufficient information is available to make statements about this. One of the CBO reports (Carter et al. 1998) provided the following information: "Within the state of Chihuahua the principal habitats are desert scrub (41%), pine forest (16%), and farm/pasture lands (36%) (Flores Villela and Gerez 1994). The proportion of the latter underwent a 7% increase in the decade between 1981 and 1992 as the overall proportion of perturbed lands increased. While governmental data indicate that as recently as 1981, 24% of the state was undisturbed grassland, more recent federal assessments do not recognize any natural grasslands remaining in the state (Flores Villela and Gerez 1994)."

Threats

Insufficient information is available to make statements about this.

Literature Cited

- Bradley, J. S. and T. Leukering. 1996. Distribution and habitat associations of birds wintering in Mexican grasslands: 1996 pilot season report. Report submitted to NPS (Howard Ness).
- Carter, M. F., T. Leukering, J. S. Bradley, & C. S. Aid. 1997. Habitat associations of the Mexican Plateau winter grassland bird community. Report submitted to USFWS (Bill Howe) & NPS (Howard Ness).
- Carter, M. F., T. Leukering, and S. Hutchings. 1998. Distribution & habitat associations of Mexican Plateau winter grassland bird community. Report submitted to USFWS (Bill Howe) & NPS (Howard Ness).
- Flores Villela, O. and P. Gerez. 1994. Biodiversidad y conservación en México: vertebrados, vegetación y uso del suelo (Biodiversity & conservation in Mexico: vertebrates, vegetation and land use). Universidad Nacional Autónoma de México, México, D.F.
- Howell, S. N. G. and S. Webb. 1995. A guide to the birds of Mexico & northern Central America. Oxford University Press, Oxford, England.
- Meents, J. K. 1979. Avian community structure in Chihuahuan desert grasslands. Ph.D. dissertation. New Mexico State University, Las Cruces, NM.
- Mendez-Gonzalez, C. E., A. Lafon, and R. A. Meyer. Written communication. Relative abundance & biomass of grassland birds in Aplomado Falcon territories in Chihuahua Mexico. Data from M.S. thesis research. Universidad Autónoma de Chihuahua.
- Nocedal, J. In prep. Seasonal dynamics of populations of seed-eating birds in arid grasslands of central Chihuahuan Desert. For submission to Journal of Field Ornithology.
- Russell, S. and G. Monson. 1998. The birds of Sonora. University of Arizona Press, Tucson.
- Sauer, J. R. Unpub. data a. North American Breeding Bird Survey results and analysis. Patuxent Wildlife Research Center, Laurel, MD.
- Sauer, J. R. Unpub. data b. Christmas Bird Count results. Patuxent Wildlife Research Center, Laurel, MD.

APPENDIX B: HABITAT DESCRIPTIONS

Table B1. General habitat descriptions for major references used in this document (where available).
See Table C2 for list of scientific names associated with common names used here.

Reference(s)	Location(s)	General Site & Vegetaion Description	Additional Habitat/Structure Description
<p>Bock and Bock 1978; Bock and Bock 1988; Bock and Bock 1992; Bock et al. 1984; Bock et al. 1986; Bock et al. 1992; Bock and Webb 1984; Webb and Bock 1990</p>	<p>Appleton-Whittell Research Ranch (AWRR) and surrounding lands; Santa Cruz & Cochise Counties, AZ</p>	<p>Mean precip. = 43 cm, mostly July - Sept.; mean elev. = 1500 m; livestock has been excluded from the AWRR since 1968.</p>	
		<p>(1) Upland mesa sites preferred by Cassin's Sparrows: densely covered by perennial grasses (blue & sideoats grama, plains lovegrass, curly mesquite, wolf tail & threeawn), exotic grasses (Lehman lovegrass), scattered mesquite & catclaw acacia, and low shrubs (velvet-pod, wait-a-minute, Yerbe de Pasmó, rabbitbrush, goldenweed & groundsel)</p>	<p>(1) Upland mesa sites - additional structural data associated with various grazing, fire and exotic plant treatments in these studies are presented elsewhere in this document.</p>
		<p>(2) Floodplains - broad stands of nearly monotypic sacaton over 2 m high</p>	<p>(2) Floodplains - cover (as percent of points sampled) - forbs (45 %); sacaton (74 %); other grasses (19 %); litter (1 %); bare ground (1 %)</p>
<p>Maurer 1985; Maurer 1986</p>	<p>Santa Rita Experimental Range (SRER), Pima County, AZ</p>	<p>Mean precip. = 20-40 cm from low elevations to the foothills; Dominant shrubs (mesquite, <i>Opuntia</i> cactus species, burroweed, acacias, ocotillo, mimosas & false mesquite); native perennials (Arizona cottontop, threeawn, bush muhly, several perennial grammas); and the exotic Lehman lovegrass</p>	<p>Mesquite density ranged from 33/ha to 162/ha; mean mesquite basal area ranged from 65 cm² to 899 cm²</p>

Reference(s)	Location(s)	General Site & Vegetaion Description	Additional Habitat/Structure Description
Flesch 1997; Gordon and Leitner 1996	Buenos Aires National Wildlife Refuge, Pima County, AZ	Mean precip. = 41.4 cm, with summer peak in July & Aug. and smaller winter peak from Dec. to Feb.; elev. range of 950 - 1150 m; livestock have been excluded since its establishment in 1985; mesquite-grassland with varying densities and size classes of mesquite; snakeweed and burroweed are widespread; vast majority of grass is perennial bunchgrass, with some areas dominated by natives and others by the exotic Lehman lovegrass	Some data from BBC site (Gordon and Leitner 1996): mesquite density (avg. # of plants with > 0.5 m diameter crown) = 232/ha; mesquite percent canopy cover = 9.5 %; mean canopy height = 8 m.
Schnase 1984; Schnase and Maxwell 1989; Schnase et al. 1991	Angelo State University Management, Instruction and Research area, Tom Green County, TX	Mean precip. = 50 cm, mostly in May and Sept.-Oct.; mean elev. = 587 m; Mesquite-mixed grass prairie, having large, open grassland savannahs bordered by mesquite thickets. Dominant shrubs (honey mesquite, Texas prickly pear cactus) and mid- to short grasses (no species listed)	Mesquite density varied from 50/ha in open areas to 1138/ha within thickets; prickly pear density varied from 102/ha in open areas to 217/ha within dense areas
Meents 1979	(1) Otero Mesa, Otero County, NM	(1) Otero Mesa - Elev. = 1480 m; mean precip. = 33.9 cm; dominant grasses (blue grama and black grama); dominant shrub (yucca)	(1) Otero Mesa - % cover - grass (39.4 %); forbs (7.2 %); shrubs (0.5%); basal area (10.6%); litter (23.9 %); bare ground (64.6 %); shrub density (max-min) (470 - 3/ha)
	(2) Nutt, Sierra County, NM	(2) Nutt - Elev. = 1700 m; mean precip. = 33.8 cm; dominant grass (curly mesquite); dominant shrubs (yucca & ephedra)	(2) Nutt - % cover - grass (34.6%); forbs (7.5%); shrubs (0.0); basal area (9.7%); litter (27.2 %); bare ground (63.1 %); shrub density (max-min) (90 - 0/ha)
	(3) Cloverdale, Hidalgo County, NM	(3) Cloverdale - Elev. = 1616 m; mean precip. = 37.6 cm; dominated by blue grama and buffalo grass	(3) Cloverdale - % cover - grass (43.4 %); forbs (8.9 %); shrubs (0.0); basal area (18.3 %); litter (23.1 %); bare ground (58.6 %); shrub density (max-min) (6 - 0/ha)

Reference(s)	Location(s)	General Site & Vegetaion Description	Additional Habitat/Structure Description
Meents 1979 (cont.)	(4) La Campana, Chihuahua, Mexico	(4) La Campana - Elev. = 1500 m; mean precip. = 38.1 cm; shrub cover is sparse to heavy; dominant grasses (threeawn); dominant shrubs (mimosa and brickell bush)	(4) La Campana - % cover - grass (30.9 %); forbs (8.6 %); shrubs (8.4 %); basal area (6.2 %); litter (22.9 %); bare ground (70.7 %); shrub density (max-min) (2897 - 695/ha)
Cole and Ligon 1978; Ligon et al. 1981	Los Medaños Isolation Pilot Plant, Eddy and Lea Counties, southeastern New Mexico	(1) Mesquite-grassland Dominant shrubs - snakeweed and mesquite	(1) Mesquite-grassland - percent ground cover - grass (14.8 %); forbs (47.3 %); litter (24.1 %); bare ground (27.1 %); Total shrub density = 16,000/ha
		(2) Creosote Dominant shrubs - creosote, range ratany, snakeweed, mesquite, and prickly pear	(2) Creosote - percent ground cover - grass (18.2 %); forbs (16.6 %); litter (22.6 %); bare ground (40.6 %); Total shrub density = 414,800/ha
		(3) Hummock-mesquite #1 Dominant shrubs - Sand sagebrush, rabbitbrush, snakeweed, mesquite, shin oak	(3) Hummock-mesquite #1 - percent ground cover - grass (0.6 %); forbs (1.6 %); litter (13.2 %); bare ground (67.1 %); Total shrub density = 80,816/ha
		(4) Hummock-mesquite #2 Dominant shrubs - Sand sagebrush, primrose, snakeweed, mesquite, shin oak	(4) Hummock-mesquite #2 - percent ground cover - grass (12.9 %); forbs (12.1 %); litter (22.0 %); bare ground (44.7 %); Total shrub density = 73,348/ha
Maxwell 1979	Concho Valley, Irion, Sterling & Tom Green Counties + parts of sev. other counties, TX	Mean precip. = 41 - 61 cm, maximum in May and Sept.; Maxwell characterized 8 major vegetation types - I present here only those sites having the largest numbers of Cassin's Sparrows;	
		(1) Scrubby mesquite grassland - Dominant shrub was mesquite, but also included tasajillo, prickly pear, lotebush, agarita, and small-leaf sumac; herbaceous (threeawn, annual broomweed, tobosa & buffalo grass)	(1) Scrubby mesquite grassland - live trees absent; absolute shrub density = 717/ha; foliage profile extended to 3.1 m but foliar ground cover between 1.2 and 3.1 m only 1%; between 0.3 and 1.2 was 22%; foliage ht. diversity = 0.54; percent veg. cover = 92

Reference(s)	Location(s)	General Site & Vegetation Description	Additional Habitat/Structure Description
Maxwell 1979 (cont.)	Concho Valley, Irion, Sterling & Tom Green Counties + parts of sev. other counties, TX (cont.)	(2) Grassland - Dominant shrubs (yucca, prickly pear, & sacahuista); herbaceous (cup grass, threeawn, buffalo grass & tobosa)	(2) Grassland - foliage profile extended to 1.2 m but foliar ground cover between 0.3 and 1.2 m was only 6%; foliage ht. diversity = 0.23; percent veg. cover = 94
		(3) Defoliated mesquite (historically) - Dominant trees (mesquite); dominant shrubs (mesquite, tasajillo, lotebush); herbaceous (red grama, lovegrass, annual broomweed, threeawn & buffalo grass)	(3) Defoliated mesquite - foliage profile extended to 6.1 m but foliar cover above 1.2 m was low; foliage ht. diversity = 0.86; percent veg. cover = 106
		(4) Upland mesquite woodland - Dominant tree (mesquite); dominant shrubs (mesquite, tasajillo, agarita & lotebush); herbaceous (hairy grama, curly mesquite & threeawn)	(4) Upland mesquite woodland - foliage profile extended to 6.1 m; dense foliage volume between 1.2 and 3.1 m; foliage ht. diversity = 0.95; percent veg. cover = 129
		(5) Bottom mesquite woodland - Dominant trees (mesquite, hackberry & chisumwood); dominant shrubs (prickly pear, tasajillo & mesquite); herbaceous (Texas winter grass, annual broomweed, tobosa and buffalo grass)	(5) Bottom mesquite woodland - foliage profile extended to 9.2 m; dense foliage vol. between 1.2 and 3.1 m; foliage ht. diversity = 1.14; percent veg. cover = 126
Emlen 1972	Welder Wildlife Refuge, near Sinton, TX	(1) Grass-forb prairie - Fields of bunch grass (<i>Andropogon</i> sp. and others) with a few small and medium-sized shrubs	(1) Grass-forb prairie - 100 % grass & forbs
		(2) Scrubby grasslands - Grass (buffalo grass & others) interspersed with large, sparse patches of low-running mesquite, a few larger shrubs and small trees	(2) Scrubby grasslands - 60 % grass & forbs; 40 % creeping bush

Reference(s)	Location(s)	General Site & Vegetaion Description	Additional Habitat/Structure Description
Emlen 1972 (cont.)	Welder Wildlife Refuge, near Sinton, TX (cont.)	(3) Open brushland - Similar to scrubby grassland but many scattered patches of 1.5 - 2.0 m dense shrubs and reduced amts. of running mesquite	(3) Open brushland - 60 % grass & forbs; 30 % creeping bush; 10 % low shrubs
		(4) Dense brushland - Similar to scrubby grassland but with more and larger clumps of 1.5 - 2.0 m shrubs; buffalo grass largely replaced by bristle grass as dominant	(4) Dense brushland - 50 % grass & forbs; 20 % creeping bush; 30 % low shrubs
		(5) Two-layered brushland - Similar to dense brushland but with a layer of scattered 3.0 - 4.0 m mesquite and acacia shrubs above dominant brush stratum	(5) Two-layered brushland - 50 % grass & forbs; 10 % creeping bush; 30 % low shrubs; 10 % tall shrubs
		(6) Oak woodland - Open stands of live-oak trees over a mixed assemblage of tall shrubs, low shrub clumps, and open grass on sandy soils	(6) Oak woodland - 40 % grass & forbs; 15 % creeping bush; 15 % low shrubs; 15 % tall shrubs; 15 % trees
		(7) Riverine forest - Dense or medium-dense bottomland woods with vines and thickets occurring in narrow strips near the river.	(7) Riverine forest - 10 % grass & forbs; 10 % low shrubs; 20 % tall shrubs; 60 % trees

Table B2.

Common names and scientific names for plant species referenced in Table B1

	<u>Common Name</u>	<u>Scientific Name</u>
Grasses	grama grass	<i>Bouteloua</i> spp.
	red grama	<i>B. trifida</i>
	blue grama	<i>B. gracilis</i>
	sideoats grama	<i>B. curtipendula</i>
	black grama	<i>B. eriopoda</i>
	hairy grama	<i>B. hirsuta</i>
	lovegrass	<i>Eragrostis</i> spp.
	plains lovegrass	<i>E. intermedia</i>
	Lehman lovegrass	<i>E. lehmanniana</i>
	tobosa	<i>Hilaria mutica</i>
	curly mesquite	<i>H. belangeri</i>
	wolftail	<i>Lycurus phleoides</i>
	threeawn	<i>Aristida</i> spp.
	sacaton	<i>Sporobolus airoides (wrightii)</i>
	Arizona cottontop	<i>Trichachne californica</i>
	bush muhly	<i>Muhlenbergia porteri</i>
	buffalo grass	<i>Buchloe dactyloides</i>
	cupgrass	<i>Eriochloa</i> spp.
	bluestem/beardgrass	<i>Andropogon</i> spp.
	Texas wintergrass	<i>Stipa leucotricha</i>
bristlegrass	<i>Setaria leucopila</i>	
Forbs	goldenweed	<i>Happlopappus tenuisectus</i>
	groundsel	<i>Senecio</i> spp.
	annual broomweed	<i>Amphiachris dracunculoides</i>
Shrubs	mimosa	<i>Mimosa</i> spp.
	wait-a-minute bush	<i>M. biuncifera</i>
	velvet-pod	<i>M. dysocarpa</i>
	Yerba-de-Pasmo	<i>Baccharis pteronioides</i>
	snakeweed	<i>Gutierrezia sarothrae</i>
	acacia	<i>Acacia</i> spp.
	catclaw acacia	<i>A. greggii</i>
	rabbitbrush	<i>Chrysothamnus</i> species
	burroweed	<i>Isocoma tenuisecta</i>
	mesquite	<i>Prosopis</i> spp.
	honey mesquite	<i>P. glandulosa</i>
	false mesquite	<i>Calliandra eriophylla</i>
	ephedra	<i>Ephedra</i> spp.
	creosote	<i>Larrea tridentata</i>
	sand sagebrush	<i>Artemesia filifolia</i>
	primrose	<i>Calylophus drummondianus</i>
	agarita	<i>Berberis trifolialata</i>
lotebush	<i>Ziziphus obtusifolia</i>	
small-leaf sumac	<i>Rhus microphylla</i>	
hackberry	<i>Celtis reticulata</i>	

Table B2. (cont.)

Common names and scientific names for plant species referenced in Table B1 (cont.)

	<u>Common Name</u>	<u>Scientific Name</u>
Shrubs (cont.)	chisumwood	<i>Bumelia lanuginosa</i>
	brickell bush	<i>Brickellia spinulosa</i>
	range ratany	<i>Krameria glandulosa (parvifolia)</i>
Cacti, Succulents, etc.	prickly pear cactus	<i>Opuntia</i> spp.
	Texas prickly pear cactus	<i>O. lindheimeri</i>
	prickly pear	<i>O. phaeacantha</i>
	tasajillo	<i>O. lindheimeri</i>
	Ocotillo	<i>Fouquieria splendens</i>
	Yucca	<i>Yucca</i> spp.
	sacahuista	<i>Nolina texana</i>
Trees	oak	<i>Quercus</i> spp.
	shin oak	<i>Q. harvardii</i>
	live-oak	<i>Q. virginiana</i>

**APPENDIX C:
List Of Primary
Individuals Contacted**

Marilyn Altenbach
New Mexico
Natural Heritage Program
University of New Mexico
Department of Biology
851 University Blvd. SE, Ste. 101
Albuquerque, NM 87131
505-272-3545 Ext. 231
altenbac@sevilleta.unm.edu

Carla Alford
Bureau of Land Management
198 Neel Avenue NW
Socorro, NM 87801
505-835-0412
505-835-0223 fax
calford@nm.blm.gov

Wylie Barrow
USGS
National Wetlands Research Center
700 Cajundome Blvd.
Lafayette, LA 70506
318/266-8668
wylie_barrow@usgs.gov

Carol Beardmore
Partners in Flight
Western Regional Coordinator
Arizona Game & Fish
2221 W. Greenway Rd.
Phoenix, AZ 85023-4312
602-789-3502
602-789-3926 fax
cbeardmore@gf.state.az.us

Gary Beauvais
Zoologist
Wyoming
Natural Diversity Database
P.O. Box 3381
Laramie, WY 82071-3381
307-745-5026

Karen L. P. Benson
Co-Editor
Texas Breeding Bird Atlas Project
WFSC, TAMU
College Station, TX 77843-2258
512-993-6095

Dr. Carl E. Bock
Department of EPO Biology
University of Colorado
Boulder, CO 80309-0334
303-492-7184

Jim Bradley
Colorado Bird Observatory
13401 Piccadilly Road
Brighton, CO 80601
303-659-4348

Kelly B. Bryan
Resource Coordinator
Texas Parks & Wildlife Department
P.O. Box 948
Fort Davis, TX 9734
915-426-3897

Bill Busby
Kansas Biological Survey
2041 Constant Ave.
Foley Hall
University of Kansas
Lawrence, KS 66047-2906
913-864-7692
w_busby@ukans.edu

Mike Carter
Colorado Bird Observatory
13401 Piccadilly Road
Brighton, CO 80601
303-659-4348
mike.carter@cbobirds.org

Andrea Cerovski
Nongame Bird Biologist
Wyoming Game & Fish Department
260 Buena Vista
Lander, WY 82520
307-332-7723 Ext. 232
307-332-6669 fax
acerov@missc.state.wy.us

Troy Corman
Arizona Game & Fish Dept.
2221 W. Greenway Rd.
Phoenix, AZ 85023-4312
602-789-3508
tcorman@gf.state.az.us

John Dinan
Nongame Bird Program Manager
Nebraska Game &
Parks Commission
2200 N. 33rd St.
Lincoln, NE 68503-0370
402-471-5440
402-471-5528 fax
jdinan@ngpsun.ngpc.state.ne.us

John B. ("Barny") Dunning Jr.
 Dept. of Forestry
 & Natural Resources
 Purdue University
 West Lafayette, IN 47907
 765-494-3565
 bdunning@fnr.purdue.edu

Aaron Flesch (contractor)
 Buenos Aires
 National Wildlife Refuge
 P.O. Box 109
 Sasabe, AZ 85633
 520-823-4251
 520-823-4247 fax
 Adflesch@aol.com

Ken Giesen
 Colorado Division of Wildlife
 317 W. Prospect
 Fort Collins, CO 80526
 970-472-4359
 ken.giesen@state.co.us

Caleb Gordon
 Dept. of Ecology &
 Evolutionary Biology
 Bioscience West Room 310
 University of Arizona
 Tucson, AZ 85721
 520-621-3458 (lab)
 520-318-0651 (home)
 fax 520-621-9190
 calebg@u.arizona.edu

Joseph A. Grzybowski
 715 Elmwood Dr.
 Norman, OK 73072-6118
 405-360-0182
 grzybow@aix1.ucok.edu

Kevin Gutzwiller
 Associate Professor
 Department of Biology
 Baylor University
 Waco, TX 76798-7388
 254-710-6557
 254-710-2969 fax
 kevin_gutzwiller@baylor.edu

Jerry Horak
 Kansas Department
 of Wildlife & Parks
 Emporia Research & Survey Office
 1830 Merchant, P.O. Box 1525
 Emporia, KS 66802-1525
 316-342-0658 Ext. 211

Bill Howe
 Region 2 Nongame Bird Coordinator
 U.S. Fish & Wildlife Service
 P.O. Box 1306
 Albuquerque, NM 87103
 505-248-6875
 505-248-7885 fax
 bill_howe@fws.gov

Mark Howery
 Natural Resources Section
 Oklahoma Department
 of Wildlife Conservation
 1801 N. Lincoln Blvd.
 Oklahoma City, OK 73105
 405-521-4619
 405-521-6535 fax
 mhowery@odwc.state.ok.us

Chuck Hunter
 Region 4 Nongame Bird Coordinator
 US Fish & Wildlife Service
 1875 Century Blvd.
 Atlanta, GA 30345
 404-679-7130
 fax 404-679-7285
 chuck_hunter@fws.gov

Stephanie L. Jones
 Region 6 Nongame Bird Coordinator
 U.S. Fish & Wildlife Service
 P.O. Box 25486
 Denver Federal Center
 Denver, CO 80225
 303-236-8145 Ext 608 (w)
 303-236-8680 fax
 stephanie_jones@fws.gov

Hugh Kingery
 Colorado
 Breeding Bird Atlas Project
 P.O. Box 584
 Franktown, CO 80116
 303-814-2723
 ouzels@juno.com

Fritz Knopf
 USGS Midcontinent
 Ecological Science Center
 4512 McMurry Ave.
 Fort Collins, CO 80525
 970-226-9462
 970-226-9230 fax
 fritz_knopf@usgs.gov

David J. Krueper
 Avian Senior Technical Specialist
 BLM - San Pedro Project Office
 1763 Paseo San Luis
 Sierra Vista, AZ 85635
 520-458-3559
 dkrueper@az.blm.gov

Bob Leachman
 Ecological Services
 U.S. Fish & Wildlife Service
 764 Horizon Drive, Building B
 Grand Junction, CO 81506-3946
 970-243-2778
 robert_leachman@fws.gov

Steve J. Lewis
 USFWS Region 3
 Nongame Coordinator
 U.S. Fish & Wildlife Service
 Federal Building
 1 Federal Drive
 Fort Snelling, MN 55111-4056
 612-713-5473
 612-713-5286 fax
 steve_j_lewis@fws.gov

Brian Locke
 Fort Bliss
 Directorate of Environment
 Conservation Division
 Bldg. 622, Pleasanton Rd.
 Fort Bliss, TX 79916-5000
 915-568-3016
 915-568-3548 fax
 lockeb@emh10.bliss.army.mil

Cynthia Melcher
 USGS Midcontinent
 Ecological Science Center
 4512 McMurry Ave.
 Fort Collins, CO 80525
 970-226-9258
 cynthia_melcher@usgs.gov

César E. Méndez-González
 Chihuahua, Mexico
 cesarmendez77@hotmail.com

Ray Meyer
 La Tierra Environmental Consulting
 226 W. Willoughby
 Las Cruces, NM 88005
 505-541-5853
 latierra@zianet.com

Arnold S. Moorhouse
 P.O. Box 1023
 Douglas, AZ
 520-364-3178

Jorge Necedal
 c/o Colorado Bird Observatory
 13401 Piccadilly Rd.
 Brighton, CO 80601
 303-659-4348

Dr. Robert D. Ohmart
 Center for Environmental Studies
 Arizona State University
 Tempe, AZ 85287
 602-965-4632

Brent Ortego
 Texas Parks & Wildlife Department
 2601 N. Azalia; Suite 31
 Victoria, TX 77901
 512-576-0022
 borteago@viptx.net

Bruce Peterjohn
 USGS Patuxent
 Wildlife Research Center
 12100 Beech Forest Road, STE 4038
 Laurel, MD 20708-4038
 301-497-5841
 bruce_peterjohn@usgs.gov

Anna Pidgeon
 University of Wisconsin
 College of Agricultural
 & Life Sciences
 Department of Wildlife Ecology
 226 Russell Labs
 1630 Linden Drive
 Madison, WI 53706-1598
 608-265-2665
 apidgeon@facstaff.wisc.edu

Jeff Price
 6525 Gunpark Drive
 Suite 150-146
 Boulder, CO 80301
 303-530-7239
 jprice@mho.net

Dan Reinking
 Sutton Avian Research Center
 P.O. Box 2007
 Bartlesville, OK 74005
 918-336-7778
 918-336-7783
 gmsarc@aol.com

Steve Russell
 2850 N. Camino de Oeste
 Tucson, AZ 85745
 520-743-9707
 srussell@u.arizona.edu

Christopher Rustay
 Hawks Aloft
 P.O. Box 10028
 Albuquerque, NM 87184
 505-892-3354

John R. Sauer
 USGS Patuxent
 Wildlife Research Center
 11510 American Holly Drive
 Laurel, MD 20708-4017
 301-497-5662
 john_r_sauer@usgs.gov

Sabra Schwartz
 Arizona Natural Heritage Program
 602-789-3618

Hart Schwarz
 317 Palomas Drive NE; #9
 Albuquerque, NM 87108
 505-761-4650 Ext. 357 (w)

Dorinda Scott
 Data Manager
 Texas Parks & Wildlife Department
 Austin, TX
 512-912-7023

Chuck Sexton
 Wildlife Biologist
 Balcones Canyonlands NWR
 10711 Burnet Road, Suite 201
 Austin, TX 78758
 512-339-9432
 chuck_sexton@fws.gov

Clifford Shackelford
 Texas Parks
 & Wildlife Department
 4200 Smith School Road
 Austin, TX 78744
 512-389-4970
 512-389-4388 fax
 clifford.shackelford@tpwd.state.tx.us

Tom Shane
 1706 Belmont
 P.O. Box 876
 Garden City, KA 67846
 316-275-4616
 316-275-9476 fax

Susan Skagen
 USGS Midcontinent
 Ecological Science Center
 4512 McMurry Ave.
 Fort Collins, CO 80525
 970-226-0461
 970-226-9230 fax
 susan_skagen@usgs.gov

Sartor (Sandy) O. Williams III
 New Mexico
 Department of Game & Fish
 P.O. Box 25112
 Santa Fe, NM 87504
 505-827-9914

Mike Wunder
 Colorado Natural Heritage Program
 Colorado State University
 254 General Services Building
 Fort Collins, CO 80523
 970-491-2841
 970-491-3349 fax
 mbw@lamar.colostate.edu