Brewer's Sparrow (*Spizella breweri*)
Species Assessment

DRAFT

Prepared for the Grand Mesa, Uncompahgre, and Gunnison National Forests
September 2005

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Cover photo: Brewer's sparrow sagebrush habitat on the Grand Mesa, Uncompahgre, and Gunnison National Forests. Photo was taken on Flat Top Mountain, eight miles north of Gunnison Colorado, Gunnison Ranger District.

"When we come upon the Brewer Sparrow, we are ready to wager that here the dame [Nature] has done her utmost to produce a bird of non-committal appearance. Mere brown might have been conspicuous by default, but brownish, broken up by hazy streakings of other brownish or dusky—call it what you will—has given us a bird which, so far as plumage is concerned, may be said to have no mark of distinction whatever—just bird."

William Leon Dawson (1923)

INTRODUCTION

The Brewer's sparrow is a focus of an assessment because it has been identified as a Management Indicator Species (MIS) on the Grand Mesa, Uncompahgre, and Gunnison National Forest (Forest), in addition to multiple national forests in Region 2. The Brewer's sparrow is also listed as a sensitive species by the USFS in Region 2. As a MIS, the Brewer's sparrow serves as a barometer for species viability at the forest level. MIS have a dual functionality: 1) to estimate the effects of planning alternatives on fish and wildlife populations (36 CFR 219.19 (a) (1)) and 2) to monitor the effects of management activities on species via changes in population trends (36 CFR 219.19 (a) (6)).

The Brewer's sparrow was selected as an MIS for sagebrush habitat, replacing the Gunnison Sage-Grouse. The Gunnison Sage-Grouse is not widely distributed on the Forest; their occurrence on the Forest is limited to sagebrush areas on the Gunnison Ranger and Norwood Ranger Districts. There was a need to select a MIS that would be indicative of changes in sagebrush habitat, as influenced by management activities, forest-wide. The Brewer's sparrow is commonly found within sagebrush habitats widely distributed across the Forest.

This report is the first species assessment prepared for the Brewer's sparrow on the Forest. Holmes and Johnson (2005) have written a Technical Conservation Assessment on the Brewer's sparrow that was prepared for Region 2 (USDA Forest Service, Rocky Mountain Region) as part of the Rocky Mountain Region's Species Conservation Project. Detailed information on the species management status and natural history, biology, distribution, abundance, habitat, and ecology at the Regional level is included in the Regional Assessment and summarized in the current report.

This report is tiered to the Technical Conservation Assessment for the Brewer's sparrow (Holmes and Johnson 2005) and is intended to bring the broad-level Regional Assessment down to a local level. The goal of this assessment is to summarize historical and current literature on the Brewer's sparrow to provide land managers and the public with an objective overview of this species on the Forest. Peer reviewed scientific literature and summarized data are the primary information sources used in this report. Local data sources (District wildlife biologists) were consulted to provide information on distribution, localized abundance, and habitat condition. This assessment provides recommendations for the current Forest Plan revision in terms of integrating Brewer's sparrow habitat requirements into forest management planning. This report is a working document that will be updated periodically as new information becomes available from peer-reviewed scientific literature and through monitoring of this species.

SUMMARY OF KEY FINDINGS

The Brewer's sparrow is considered an obligate of sagebrush communities (Braun et al. 1976, Paige and Ritter 1999, Holmes and Johnson 2005). Throughout most of its breeding range, the Brewer's sparrow is most closely associated with landscapes dominated by big sagebrush (Weins and Rotenberry 1981, Rotenberry 1999). Factors that influence Brewer's sparrow occupancy and abundance include the amount of sagebrush cover, sagebrush patch size, spatial distribution of patches, and the extent of disturbance and fragmentation. Holmes and Johnson (2005) provide a detailed description of Brewer's sparrow habitat use in Region 2.

On the Forest, Brewer's sparrow habitat is widely distributed but occurs in small, often isolated habitat patches. Primary habitat includes areas dominated by big sagebrush (*Artemisia tridentata spp.*), encompassing approximately 40,457 acres. Secondary habitat consists of approximately 40,711 acres and is comprised of mountain shrub (willow, mountain mahogany, snowberry, or other woody shrublands other than sagebrush), sagebrush transition areas, and pinyon-juniper woodlands containing large meadows with a shrubby component. Brewer's sparrows are most abundant in ecologically healthy shrub communities consisting of tall shrubs in a clumped distribution.

The Brewer's sparrow is considered globally "secure" by the Natural Heritage Program due to its wide distribution across North America, yet according to the Breeding Bird Survey, Brewer's sparrow

populations have declined by over 50 percent during the past 25 years (Holmes and Johnson 2005). Within Region 2 and the state of Colorado, Brewer's sparrow populations have exhibited similar long-term declines, exceeding national trends. Brewer's sparrows have been detected on seven Breeding Bird Survey routes on the Forest, with an insignificant decline observed within the Uncompahgre Plateau Geographic Area, insignificant increases observed within the North Fork and Grand Mesa Geographic Areas, and an insignificant increase observed within the Gunnison Basin Geographic Area. Single site analysis on Breeding Bird Survey routes within the Forest may not be valid due to low sample size and the amount of suitable Brewer's sparrow habitat sampled by the routes; from 1966-2003, only three percent (3,055 ac) of all sagebrush habitat on the Forest (101,838 ac) was sampled by the Breeding Bird Survey. On the Forest, from 1999 to 2004, the Rocky Mountain Bird Observatory (RMBO) detected 82 Brewer's sparrows on 11 transects, primarily in grassland and sagebrush dominated habitat types. Low detection rates of Brewer's sparrows by the RMBO are likely attributed to a lack of sampling effort in sagebrush habitats.

Brewer's sparrow population viability is likely linked to extensive alteration of sagebrush shrubsteppe habitat (Holmes and Johnson 2005). Primary influences include management activities that have a transformative effect on sagebrush habitat such as livestock grazing, followed by alteration of natural fire regimes and invasion by exotic plants (Holmes and Johnson 2005). Habitat loss and fragmentation due to development also threaten the species. Conservation and management of Brewer's sparrows should focus on creating and maintaining a sagebrush landscape that replicates conditions historically created by natural processes, including fire frequencies.

HABITAT CRITERIA USED IN FOREST-WIDE HABITAT EVALUATION

Habitat modeling parameters for the Brewer's sparrow addressed the sum of all factors affecting the Brewer's sparrows chance to survive and reproduce on the Forest, specifically in terms of primary habitat and secondary habitat. Patton (1997) describes primary habitat as all the combined habitat areas and environmental factors necessary to support a viable population of the species. Secondary habitat comprises the area in which an organism may spend part of its time, but does not meet all its life requirements (Harris 1984). Secondary habitat may be utilized by a species to avoid intraspecific interactions when all primary habitat is saturated; serve as a travel corridor providing connectivity to more suitable habitat; or it may meet a specific habitat need by a species such as food or cover. While a species may spend part of its time in secondary habitat, secondary habitat alone is not capable of meeting all of species life requirements. Thus, a species may utilize a combination of primary and secondary habitat depending on food availability and abundance, time of year, and interspecific or intraspecific interactions.

Brewer's sparrows breed in North America and they have been confirmed breeding in suitable habitat on the Forest. Because they winter primarily south of the US-Mexico border (Williams 1993), we focused on nesting and foraging habitat requirements as a basis for habitat modeling. Habitat parameters used to model Brewer's sparrow habitat is presented in Table 1. Geographic Information System vegetation data, R2-Veg, was used to create a potential habitat distribution map for the Brewer's sparrow (Figure 1). The R2-Veg database was produced by aerial photo interpretation in conjunction with some field verification; this is a working database with updates taking place periodically. At the Forest-level, R2-Veg should reliably depict suitable Brewer's sparrow habitat on the Forest. R2-Veg attributes used for habitat modeling included vegetation cover type, vegetation species mix, shrub size class, slope percent, canopy cover, and patch size. Field verification, particularly for project-level analysis, may be required to determine the reliability of habitat modeling at the stand level.

Figure 1. Brewer's sparrow cover habitat on the Forest as modeled by R2Veg

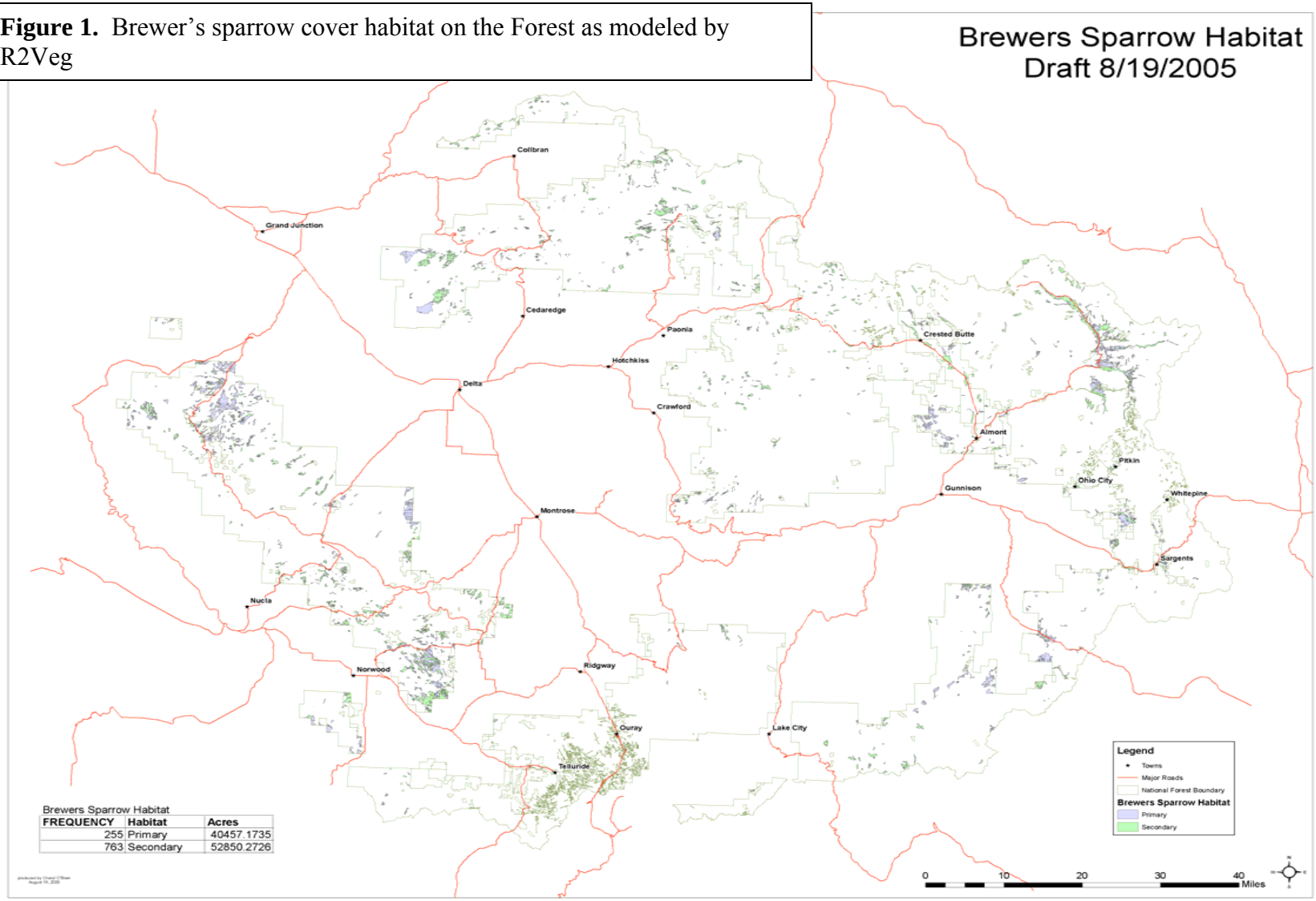

Table 1. Habitat parameters for modeling Brewer's sparrow habitat on the Forest.

Habitat Parameter[1]	Primary Habitat	Secondary Habitat
• Nesting and Foraging Vegetation Types	• SSA (Sagebrush cover type-ARTR spp.) • Contiguous, large unfragmented blocks of sagebrush habitat • Riparian areas or wet, mesic sites within sagebrush habitats	• SHR (shrublands-cover type not identified), SWI (Willow), SMS (Mountain Mahogany), SSN (Snowberry), and TPJ (Pinyon-Juniper) where it is associated w/sagebrush meadows or other shrubby vegetation comprised of the above cover types or shrub species). • Transition areas where big sagebrush (ARTR spp.) is adjacent to, or intermixed with, the above secondary cover types or shrub types. • Fragmented, discontinuous or isolated sagebrush patches <6 ha in size that is not adjacent to larger, contiguous unfragmented sagebrush patches (i. e. small sagebrush patches within a matrix of some other vegetation cover type). • Riparian areas or wet, mesic sites within secondary habitat types.
Nesting and Foraging Habitat Attributes		
• Shrub Canopy Cover	• 13-50%	• 8-13% or >50%
• Shrub Height (Size class)	• >1.6-3.0 ft (small to medium size class)	• 0.8-1.6 ft or >3-6 ft (small to medium size class)
• Shrub Condition	• Primarily live shrubs or shrubs composed primarily of live foliage (>50% live cover within a stand)	• <50% live shrub cover within a stand
• Territory Size[2]	• 0.5-2.0 ha	• 0.5-2.0 ha
• Minimum Size of Habitat Patches[3]	• ≥6 ha for sagebrush patches within a matrix of sagebrush habitat. Must be adjacent to large, contiguous blocks of unfragmented sagebrush habitat	• ≥6 ha for isolated suitable habitat within a matrix of unsuitable habitat[4]
• Topography	• Slope ≤30 degrees, primarily well-drained soils lacking rocky outcrops	• Slope ≤30 degrees, rocky outcrops more prominent

[1] Habitat parameters for brewer's sparrow were delineated for the FOREST based on literature review. Primary literature sources include: 1) Holmes and Johnson 2005-Brewer's Sparrow (*Spizella breweri*): A Technical Conservation Assessment 2) Walker 2004-Effects of Management Practices on Grassland Birds: Brewer's Sparrow 3) Vander Haegen et al. 2002-Predation on Real and Artificial Nests in Shrubsteppe Landscapes Fragmented by Agriculture 4) Paige et al. 1999-The Nature Conservancy: Species Management Abstract Brewer's Sparrow (*Spizella breweri*) 5) Petersen and Best 1985-Brewer's Sparrow Nest-Site Characteristics in a Sagebrush Community 6) Paige and Ritter 1999-Birds in Sagebrush Sea: Managing Sagebrush Habitats for Bird Communities 7) Sarell and McGuiness 1996-Status of the Brewer's Sparrow (*breweri* subspecies) in British Columbia and 8) Short 1984-Habitat Suitability Index Models: Brewer's Sparrow.

[2] Territory size decreases with increased density of pairs and increases in unsaturated habitats. In the literature, territory density has been documented at 0.34 to 2.5 males (or pairs) per hectare.

[3] Optimum patch sizes and many other aspects of landscape ecology are unknown for the brewer's sparrow. Results of a habitat suitability index model indicate that a minimum of 0.46 ac (0.2 ha) of suitable habitat and slope not greater than 30 degrees are needed for successful reproduction (Short 1984); however, this reflects estimated minimum territory size and does not reflect landscape-level characteristics needed for a sustainable population (The Nature Conservancy 1999). Isolated habitat patch size of 6 ha is the smallest patch size reported in the literature that brewer's sparrows have been documented successfully reproducing (Vander Haegen 2002).

[4] Fragmented landscapes may act as population sinks.

(Size class) Excludes primary and secondary nesting and foraging vegetation types that contain a large size class (>6.4 ft tall).

Primary Brewer's sparrow habitat was identified as mature big sagebrush (*Artemisia tridentata spp.*) ranging in height from 1.6 ft to 3 ft, with low to moderate canopy cover, and habitat patches greater than or equal to 15 acres (6 ha). Mesic sites, particularly riparian areas within sagebrush habitats, were also identified as an important primary habitat component. The terrestrial substrate composition must be comprised of relatively well-drained soils, rather than rocky outcrops. There is 40,457 acres of primary habitat on the Forest.

Secondary habitat was identified as shrubland dominated habitat other than sagebrush, including woody shrubs such as willow, mountain mahogany, and snowberry. Pinyon-juniper, where it is associated with large sagebrush meadows or other shrubby vegetation, was also identified as secondary habitat. Additional secondary habitat characteristics include sagebrush transition areas and fragmented sagebrush patches, especially where sagebrush patches are less than 15 acres in size. To be considered secondary habitat, sagebrush patches less than 15 acres in size must be contained within a matrix of unsuitable habitat, such as a woodland environment. In addition, rocky outcrops may be more prominent in secondary habitat. There is 52,850 acres of secondary habitat on the Forest.

Rationale for Habitat Criteria Selection

The Brewer's sparrow is a sagebrush obligate that is often the most abundant songbird in sagebrush shrubsteppe habitats (Holmes and Johnson 2005). They also occur in shrubby openings in pinyon-juniper and mountain mahogany woodlands (Sedgewick 1987) and large shrubby park lands within coniferous forests. On the Forest, Brewer's sparrows have been observed frequently in sagebrush dominated habitats. They have also been identified infrequently on the Forest during neotropical migrant bird surveys in large (>15 ac) shrubby park lands within coniferous forests; these shrubby park lands are approximately 11,000 ft in elevation and are composed of low growing willow and shrubby cinquefoil. In addition, the literature supports that the Brewer's sparrow is a fairly common nester in sagebrush and mountain shrub habitat in Colorado and throughout Region 2 (Andrews and Righter 1992, Busby and Zimmerman 2001, Kingery 1998, Oakleaf et al. 1992, and Holmes and Johnson 2005).

MANAGEMENT STATUS AND NATURAL HISTORY

The following is paraphrased from the Regional Technical Conservation Assessment for the Brewer's sparrow (Holmes and Johnson 2005):

Management Status

- **Migratory Bird Treaty Act:** species is protected from "take" (U.S. Department of Interior 2002a).
- **U.S. Fish and Wildlife Service (USFWS) Birds of Conservation Concern:** species is considered a bird of conservation concern throughout its breeding and wintering ranges (U.S. Department of Interior 2002b).
- **USFS Rocky Mountain Region:** species is designated as a sensitive species (U.S. Department of Agriculture 2003). Along with the Forest, the Brewer's sparrow is also categorized as a MIS on the Shoshone, Bighorn, and White River National Forests.
- **National Audubon Society:** species is considered a yellow Watchlist species (species is declining but at a slower rate than those in the red category. Yellow Watchlist species are typically species of national conservation concern) (National Audubon Society 2002).
- **Natural Heritage Program (NHP) Conservation Status:** global rank of G5; it is demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery.
- **State of Colorado Natural Heritage Program Conservation Status:** species is ranked S4B; apparently secure across the state, though it may be quite rare in parts of its range, especially at the periphery (www.natureserve.org).
- **Partners in Flight (PIF) Bird Conservation Plans:**
    - Colorado Land Bird Conservation Plan (Biedleman 2000): Priority species for the Colorado Plateau and the Southern Rocky Mountain Physiographic Areas in the Priority Habitat Sagebrush Shrubland.

Existing Regulatory Mechanisms, Management Plans, and Conservation Strategies

The Brewer's sparrow is protected under the Migratory Bird Treaty Act of 1918, which prohibits "take" of migratory birds unless permitted by regulations (Holmes and Johnson 2005).

The USFS Rocky Mountain Region includes the Brewer's sparrow on the Regional Forester's sensitive species list. Under Region 2's sensitive species policy (http://www.fs.fed.us/im/directives/field/r2/fsm/2600/2670.doc), conservation strategies are to be developed and implemented for sensitive species and their habitats, in

coordination with other USFS units, managing agencies, and landowners (USDA 2003). At the forest and project levels, design criteria are incorporated for the maintenance of sensitive species habitat on the Forest. In addition, the U.S. Department of Agriculture (2003) specifies that appropriate inventories and monitoring of sensitive species are to be conducted to improve our knowledge of the species' distribution, status, and responses to management activities, coordinating efforts within Region 2 and with other agencies and partners where feasible (USDA 2003). Neotropical migrant bird surveys are conducted annually on portions of the Forest, whereby sensitive and Management Indicator Species are inventoried. In conjunction with surveys conducted by forest service personnel, available data is utilized from the Breeding Bird Survey and the Rocky Mountain Bird Observatory.

Partners in Flight (PIF) have identified the Brewer's sparrow and its habitats within USFS Region 2 as priorities for conservation. The Colorado Land Bird Conservation Plan (Biedleman 2000) lists the Brewer's sparrow as a Priority Species for the Colorado Plateau Physiographic Area in the Priority Habitat Sagebrush Shrubland, and the Southern Rocky Mountain Physiographic Area in the Priority Habitat Sagebrush Shrubland (Holmes and Johnson 2005). For Brewer's sparrows and their associated habitat of sagebrush shrubland, the Plan calls for monitoring this species to document distribution, population trends, and abundance; they propose using Breeding Bird Survey data and incorporating Monitoring Colorado Bird (MCB) data from the Rocky Mountain Bird Observatory as it becomes available (Holmes and Johnson 2005).

In their publication entitled "Birds in a Sagebrush Sea", Paige and Ritter (1999) developed a list of "Best Management Practices" for shrublands to benefit birds, which are promoted by the Colorado Land Bird Conservation Plan. The Colorado Division of Wildlife has completed a range-wide conservation plan for the Gunnison Sage-Grouse, a species that may use sagebrush habitats in a similar way as the Brewer's sparrow and/or respond similarly to threats, management, and conservation activities (Biedleman 2000). The Brewer's sparrow was selected as an MIS due to its narrow range of habitat requirements, specifically in terms of its special habitat needs in sagebrush shrub steppe habitats. Additionally, the Brewer's sparrow exhibits similar habitat requirements as other sagebrush obligates such as the Gunnison Sage-Grouse and the sage sparrow. The Land and Resource Management Plan for the Forest includes standards and guidelines for management of habitat for MIS, which are summarized in Table 2.

Table 2. 1991 Amended Land and Resource Management Plan general standards and guidelines for MIS.

Management Activities	General Direction	Standards and Guidelines
Aquatic and Terrestrial Habitat Management	Manage for habitat needs of indicator species (FP III-24).	
	Manage habitat for viable populations of all existing vertebrate wildlife species (FP-III-26).	Maintain habitat capability at a level at least 40% of potential capability[1]

[1] This standard and guideline varies with specific Management Area direction.

Biology and Ecology

Systematics and General Species Description

There are two recognized subspecies of Brewer's sparrow (*Spizella breweri*):

- Brewer's sparrow: *S. b. breweri* (Cassin 1856)
- Timberline sparrow: *S. b. taverneri* (Swarth and Brookes 1925)

These two subspecies differ in morphology, song, breeding habitat, and geographic range (Swarth and Brooks 1925, Oberholser 1974, Pyle and Howell 1996, Doyle 1997, Rotenberry et al. 1999). *S. b. breweri* is found on the Forest and occurs in all states within Region 2. The timberline sparrow is not found in the area.

As is common with the *Spizella* sparrows, Brewer's sparrows are small, slim, and long-tailed, with a thin conical bill and a notched tail (Holmes and Johnson 2005). On average, Brewer's sparrows are 5½ inches in length from head to tip of tail, with a buffy brown back and crown, finely streaked with black. Key distinguishing field marks include a faint eye-ring, a narrow white streak above the eye, clear-grayish underparts, and a long narrow tail. Males and females are very similar in plumage and size characteristics, although there is some slight sexual dimorphism.

Distribution and Abundance

The Forest is well within the distribution range of the Brewer's sparrow. The distribution of the Brewer's sparrow is largely determined by the distribution of sagebrush (Holmes and Johnson 2005). They breed regularly within sagebrush shrubsteppe habitats and less commonly in mountain shrub habitats on the Forest and throughout the western, central, and eastern portions of Colorado. The current distribution of the Brewer's sparrow in all of North America is assumed to be similar to the historical distribution (Dobkin and Sauder 2004). Figure 2 shows the relative breeding season abundances for the Brewer's sparrow within their regional distribution, based on Breeding Bird Survey (BBS) data.

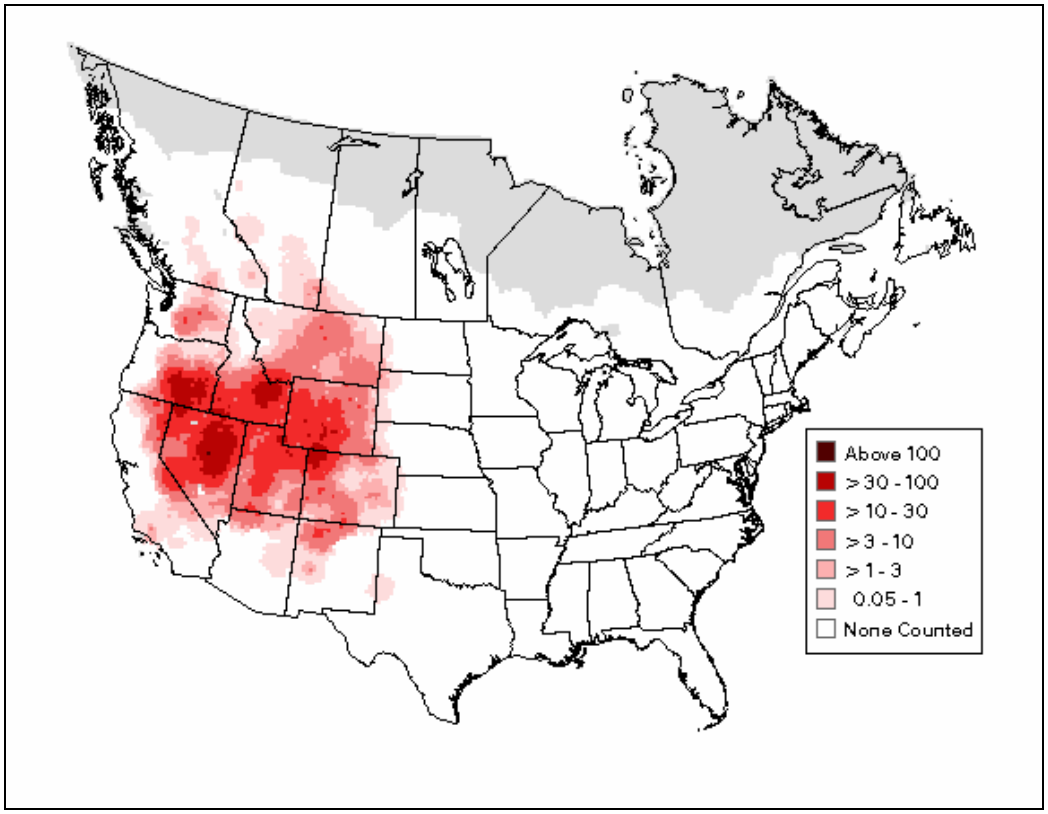

Figure 2. Relative breeding season abundance of the Brewer's sparrow based on average number of birds per route, obtained from Breeding Bird Survey data (Sauer et al. 2004).

The USGS Patuxent Wildlife Research Center, the Canadian Wildlife Service and National Wildlife Research Center conduct the Breeding Bird Survey (BBS) along roads during the avian breeding season each year. These surveys are completed over large geographic areas and are intended to track status and trend of North American bird populations. The BBS is intended to provide general information on relative abundance and population trends at state, regional or national scales. BBS surveys provide limited population data at finer scales such as at the Forest or Regional levels. Each route is 24.5 miles long with stops at 0.5-mi intervals, totaling 50 point-count stations per route. A three-minute point count is conducted at each station, whereby every bird heard or seen within a 0.25-mi radius is recorded.

Bird surveys during the breeding season have revealed that Brewer's sparrows are often the most abundant species on their nesting grounds (Holmes and Johnson 2005). In some areas they can reach densities of 150 to 300 birds per km^2 and they have exceeded 500 birds per km^2 in some locations (Reynolds 1981, Rotenberry and Wiens 1989). Breeding populations of the Brewer's sparrow appear mostly contiguously distributed, although relative abundance differs across the species' range and densities can be highly variable from year to year (Rotenberry et al. 1999). Data collected through BBS on the Forest, average from one to less than 10 Brewer's sparrows per route each year.

The Rocky Mountain Bird Observatory has developed a program entitled Monitoring Colorado's Birds (MCB), which they have implemented on a yearly basis since 1998 to obtain density estimates for bird species in Colorado. MCB surveys are different than BBS in that routes are not limited to roads and the types of habitats birds utilize are also collected. Population estimates collected using MCB surveys provide population estimates and trends at a more localized scale (e.g. State-wide or National Forest). To provide for statistically valid results MCB surveys have to be obtained over a sufficient number of years, which could be as little as 12 years. MCB data indicate relative abundance of Brewer's sparrows in Colorado range from 0.02 – 16.04 birds per hectare. Brewer's sparrows have been detected on 11 MCB point-count bird transects on the Forest. Table 3 displays estimated densities of Brewer's sparrows for the state of Colorado by habitat type.

Table 3. Estimated densities of Brewer's sparrows for the state of Colorado. Data obtained from Monitoring Colorado's Birds (MCB), Rocky Mountain Bird Observatory.

Year	D	LCL	UCL	CV%	P	K	n
Sagebrush Habitat							
1999	7.130	a	a	22.00	a	21	354
2000	0.820	a	a	7.30	a	18	364
2001	0.815	0.618	1.074	14.10	0.21	a	362
2002	0.428	0.336	0.546	12.40	0.15	24	304
2003	0.627	0.526	0.747	9.00	0.24	24	515
2004	1.294	0.912	1.838	17.60	0.20	22	377
Semi-desert Shrubland							
1999	4.500	a	a	24.30	a	19	198
2000	0.490	a	a	14.10	a	21	203
2001	0.260	0.200	0.338	13.40	0.20	a	175
2002	0.272	0.194	0.380	17.20	0.19	12	206
2003	0.304	0.229	0.404	14.60	0.13	19	213
2004	0.301	0.147	0.617	36.80	0.26	16	153
Grassland Habitat							
1999	0.840	a	a	41.40	a	9	24
2000	0.070	a	a	28.70	a	7	56
2001	0.041	0.025	0.066	25.20	0.37	a	41
2002	0.033	0.016	0.067	36.40	0.17	8	26
2003	0.040	0.024	0.067	25.80	0.42	6	48
2004	0.073	0.025	0.211	55.30	0.34	5	30
Pinyon-juniper Habitat							
1999	1.150	a	a	23.80	a	14	40
2000	0.020	a	a	36.50	a	7	19
2001	0.041	0.025	0.066	25.20	0.37	a	41
2002	0.032	0.016	0.061	34.10	0.24	10	26
2003	0.053	0.035	0.082	21.90	0.12	11	43
2004	0.108	0.050	0.234	39.30	0.38	9	39
Montane Shrubland							
1999	16.040	a	a	92.70	a	19	80
2000	0.120	a	a	50.40	a	5	16

2002	0.117	0.065	0.210	31.00	0.22	7	37
2004	0.068	0.022	0.213	61.70	0.28	7	30
High Elevation Riparian							
2000	0.02	a	a	51.9	a	3	16

D = density in birds/hectare; **LCL** = lower and upper 95% confidence limits on D; **CV** = coefficient of variation of D; **P** = probability of detection; **K** = number of transects on which the species was recorded; **n** = number of observations used to estimate D; **a** = no data.

Population Status

North American Breeding Bird Survey (reference period 1966 to 2003)

Brewer's sparrows have been detected on 33 routes throughout the Southern Rocky Mountain ecosystem, and detections have occurred on 71 routes throughout Colorado. According to the BBS, Brewer's sparrow populations in North America have declined by over 50 percent during the past 25 years (Holmes and Johnson 2005). Within Region 2 and the state of Colorado, Brewer's sparrow populations have exhibited similar long-term significant declines, exceeding national trends. Table 4 displays BBS trend data for the Brewer's sparrow at nation-wide and region-wide geographic scales.

Table 4. Breeding Bird Survey trend data for the Brewer's sparrow from 1966 to 2003 (From Sauer et al. 2005).

	1966-2003			1966-1979			1980-2003		
Location	Trend	P value	N routes	Trend	P value	N routes	Trend	P value	N routes
United States	-2.8	0.00	470	-2.3	0.13	125	-2.4	0.00	448
Western Region	-2.7	0.00	401	-2.0	0.25	106	-2.4	0.00	384
Southern Rockies	0.3	0.85	33	18.6	0.41	3	0.4	0.84	33
Colorado	-3.4	0.00	71*	-9.5	0.47	15	-2.8	0.01	68

N routes = number of routes this bird was detected on.
* Average count per route in Colorado was 8.23.

Brewer's sparrows have been detected on seven BBS routes on the Forest, with an insignificant decline observed within the Uncompahgre Plateau Geographic Area, insignificant increases observed within the North Fork and Grand Mesa Geographic Areas, and an insignificant increase observed within the Gunnison Basin Geographic Area (Table 5).

Table 5. Breeding Bird Survey trend data for the Brewer's sparrow for all routes that occur on the Forest

		Trend Period 1966-2003					
Geographic Area	Route Name	Trend Estimate	P value	N Years	Variance	Average Count/Year	Total Count for all Years Combined
North Fork Valley/Grand Mesa	Ragged Mnt.	14.31	0.18183	10	10.7167	7.7	77
Uncompahgre Plateau	Colona	-0.52	0.89261	32	3.8789	8.31	266
	Delta	-8.23	0.0504	22	4.2046	1.5	33
	Uncompahgre	a	a	8	a	0.375	3
Gunnison Basin	Castleton	28.77	0.1588	10	20.4168	3.9	39
	Parlin	0.64	0.93807	25	8.2108	0.8	20
	Tincup	217.18	0.09432	7	129.8149	2	14

a = no data.

Table 6 shows an analysis of primary Brewer's sparrow habitat sampled on the Forest by the BBS. From 1966-2003, only three percent (3,055 ac) of all sagebrush habitat on the Forest (101,838 ac) was sampled by the BBS.

Table 6. Proportion of sagebrush habitats within individual Geographic Areas relative to representation of sagebrush habitats sampled on Breeding Bird Survey routes. Includes routes sampled from 1966-2003.

			Breeding Bird Survey Routes					
Geographic Area	National Forest (NF) area (ac)	Area of Sagebrush ac (% of NF area)	No. of BBS Routes	BBS Route Length (mi)	No. of Routes that include sagebrush	Length of Routes that include sagebrush (mi)	Area of NF sampled by all BBS Routes ac (%)[1]	Sagebrush area sampled by BBS Routes ac (% of total sagebrush area)
Uncompahgre Plateau	570,932	21,041 (3.7)	4	67	2	0.4	13,595 (2.4)	109 (0.52)
San Juan	298,465	617 (0.2)	0	0	0	0.0	0	0
Gunnison Basin	1,281,118	68,260 (5.3)	4	53	3	11.7	10,124 (0.8)	2,184 (3.2)
North Fork Valley	483,094	8,509 (1.8)	2	14	1[2]	4.4	2,901 (0.6)	752 (8.8)
Grand Mesa	317,828	2,363 (0.7)	1	10	1[2]	0.1	1,634 (0.5)	11 (0.5)
Totals for the GMUG NF	2,951,437	101,838 (3.5)	11	144	6	16.6	28,254 (1)	3,055 (3)

[1] Estimated by buffering each Breeding Bird Survey route by 250 m along each side of transects that fell within the FOREST.
[2] Same route occurs on both the Grand Mesa and North Fork Valley Geographic Areas.

It is important to note that the BBS trend data for the Forest may not be statistically valid, and may only represent conditions associated with road corridors. Local trends are often difficult to interpret and can be quite different from trends predicted using BBS data (Peterjohn 1989). Examination of population trends at the national, regional or state-wide levels is the most appropriate use of BBS data.

Despite the limitations of BBS data to accurately track Brewer's sparrow population trends at a level other than at gross geographic scales and over long time intervals, the above data suggest that Brewer's sparrow populations are declining at the national, regional, and possible at the state level.

Monitoring Colorado's Birds (MCB), Rocky Mountain Bird Observatory

Monitoring Colorado's Birds (MCB) surveys have been completed in Colorado from 1999 to 2004 for Brewer's sparrow in all habitat types. MCB data suggests that Brewer's sparrow populations throughout Colorado may be stable or in an upward trend, although a six year period is not sufficient to determine population trend estimates (Figure 4).

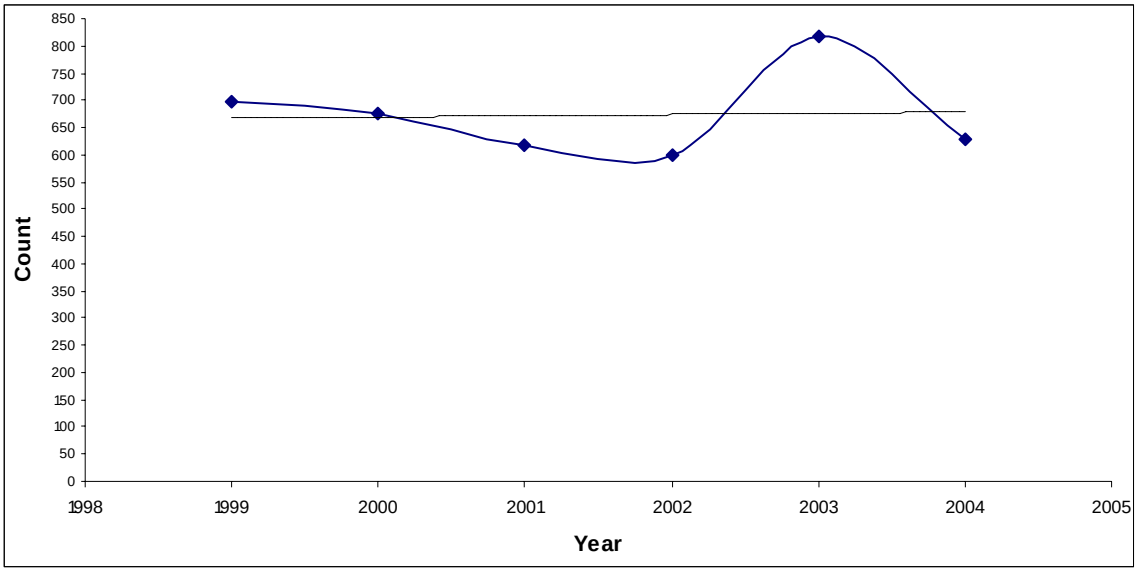

Figure 4. Brewer's sparrow counts from MCB point-count transects in Colorado. Counts are from point-counts in all habitat types where Brewer's sparrows were detected.

Statewide, MCB data reveals the highest Brewer's sparrow density estimates and counts occurred in sagebrush habitats with estimated densities in 2004 at 1.3 birds per hectare (Table 3). From 1999 to 2004, Brewer's sparrows have been detected on an average of 22 sagebrush transects per year (range: 18-24), with an average of 379 individuals counted each year. Counts ranged from 304 individuals in 2002 to 515 individuals in 2003. Figure 5 displays annual Brewer's sparrow counts in sagebrush habitats in Colorado.

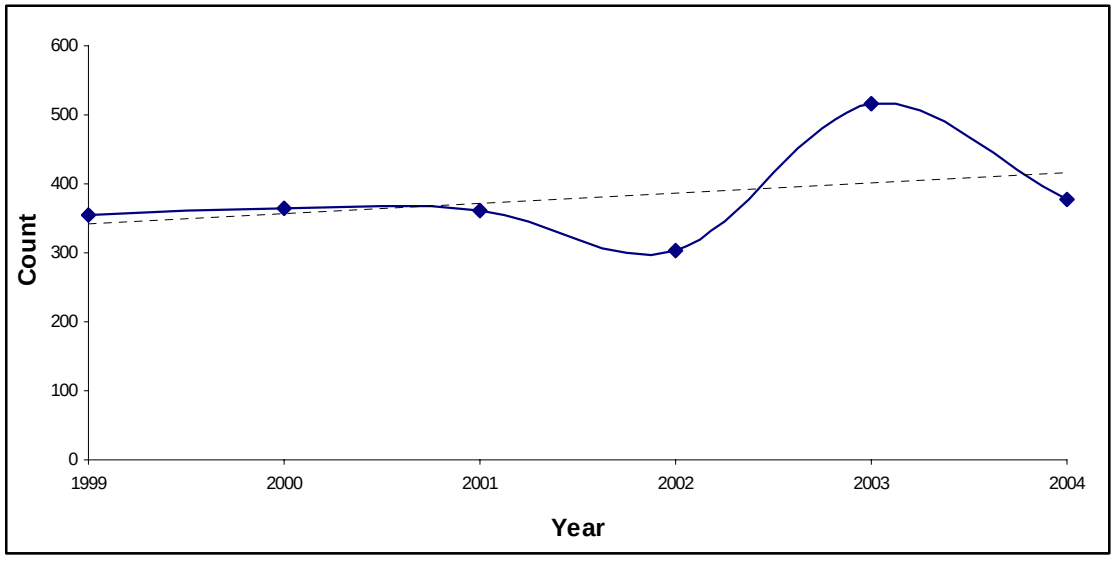

Figure 5. Brewer's sparrow counts from MCB point-count transects in sagebrush habitats in Colorado.

At this time, MCB data from the Forest is insufficient to provide trend estimates. From 1998 to 2004, 20 transects that occur on National Forests, BLM, State, and private land within the five Geographic Areas encompassing the Forest, have been sampled annually (Table 7). A total of 303 Brewer's sparrows were detected on these transects within the Geographic Areas (Table 7).

Table 7. Monitoring Colorado's Birds (MCB), Rocky Mountain Bird Observatory Brewer's sparrow data for all transects that occur on National Forest, BLM, State, or private land within the Geographic Areas.

	Time Period 1998 - 2004			
Geographic Area	No. of Transects	No. of Years	Average Count/Year	Total Count For All Years Combined
Gunnison Basin	9	6	20.3	122
Grand Mesa	3	4	9.25	37
North Fork Valley	4	5	3.4	17
Uncompahgre Plateau	1	1	2	2
San Juan	a	a	a	a
No designated Geographic Area[1]	2	5	23.6	118

[1] These transect points are located in the area between the Uncompahgre Plateau, San Juan, North Fork Valley, and Grand Mesa Geographic Areas.
a = no data.

On National Forest lands with the Geographic Areas, 82 Brewer's sparrows on 11 transects, have been detected by MCB surveys (Table 8). Most of the detections were in grassland and sagebrush dominated habitats. The low detection rates for Brewer's sparrow on the Forest is likely attributed to a lack of sampling effort in sagebrush habitats. Forest-wide, the RMBO has sampled approximately 1,742 acres, which was estimated by buffering each point-count transect by 250 meters.

Table 8. Monitoring Colorado's Birds (MCB), Rocky Mountain Bird Observatory Brewer's sparrow data for all transects that occur on lands administered by the Forest in each Geographic Area.

	Time Period 1998 - 2004			
Geographic Area	No. of Transects	No. of Years	Average Count/Year	Total Count For All Years Combined
Gunnison Basin	6	5	8.2	41
Grand Mesa	2	5	4.2	21
North Fork Valley	2	5	2.8	14
Uncompahgre Plateau	1	1	2	2
San Juan	a	a	a	a

a = no data.

In addition to conducting an analysis by Geographic Area for the Forest, Brewer's sparrow data was also summarized by year from 1998 to 2004 (Table 9). The MCB detected approximately 11.7 Brewer's sparrows per year, totaling 82 detections in seven years. These 82 detections occurred at 46 different locations, encompassing 11 point-count bird transects. An average of 2.9 Brewer's sparrows were detected on each transect each year. Based on these data, populations appear to be in an upward trend on the Forest (Figure 6). However caution should be used when interpreting the data until counts have been conducted and relative abundance estimated for a sufficient time period to provide statistically valid results for trend detection.

Table 9. Monitoring Colorado's Birds (MCB), Rocky Mountain Bird Observatory Brewer's sparrow (BRSP) data by year for all transects that occur on the Forest.

Year	Count	No. of Points BRSP Were Detected On	No. of Transects BRSP Were Detected On	Average No. of BRSP per Transect
1998	2	1	1	2
1999	4	4	3	1.33
2000	11	9	5	2.2
2001	18	14	4	4.5
2002	25	16	6	4.167
2003	7	6	3	2.33
2004	15	9	4	3.75

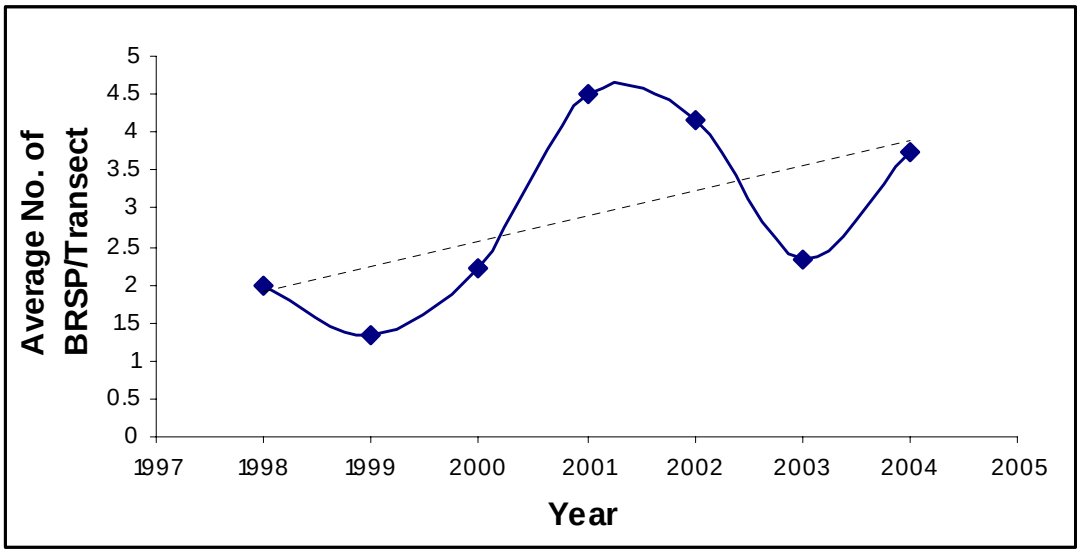

Figure 6. Average number of Brewer's sparrows (BRSP) per transect (total of 11 transects on the Forest) from 1998 to 2004 on the Forest. Monitoring Colorado's Birds (MCB), Rocky Mountain Bird Observatory.

Activity Pattern and Movements

Brewer's sparrows are a neoarctic-neotropical migrant with a circannual activity pattern in which they are an early spring migrant (Holmes and Johnson 2005). Males arrive on the breeding grounds several days before females and begin to establish territories (Holmes and Johnson 2005). In Colorado, Brewer's sparrows begin to arrive in mid-April, with full numbers at the end of the month (Andrews and Righter 1992, Lambeth 1998). Average temperatures in late April may influence the timing of territory establishment and pair formation, with colder temperatures delaying these activities (Best and Petersen 1985). Following territory establishment and pair formation, the nesting season extends from mid-April to early August, with most nesting activity concentrated between mid-May and late July (Rotenberry et al. 1999).

Fall migration takes place from mid-August through October (Holmes and Johnson 2005). The northernmost populations begin migrating in August, with all individuals gone by late September (Semechuck 1992, Rotenberry et al. 1999). The primary migratory route is through the intermountain west (Rotenberry et al. 1999). Refer to Holmes and Johnson (2005) for a detailed description on activity pattern and movements for the Brewer's sparrow.

Food Habits

The Brewer's sparrow forages primarily in shrubs; this species selects shrubs that are larger and more vigorous than the average of shrub size and condition within a stand. Shrub species utilized are predominantly sagebrush. Brewer's sparrows uncommonly forage on open ground between shrubs or at the base of bunchgrasses (Wiens et al. 1987, Rotenberry et al. 1999).

Food items consumed during the breeding season consist mostly of small insects gleaned from the foliage and bark of shrubs or dwarf trees (Rotenberry et al. 1999). Brewer's sparrows will occasionally eat seeds, taken mainly from the ground (Rotenberry et al. 1999). This bird also preys on arthropods from sagebrush in proportion to their availability (Stephens 1985). In studies of nestling diet in southeastern Idaho, nestlings were fed butterfly and moth larvae, spiders, true bugs, and leaf hoppers (Holmes and Johnson 2005). According to Rotenberry et al. (1999), Brewer's sparrows are well-adapted to arid environments and appear to adjust readily to water restriction, although they do drink free water when it is available.

Sagebrush reduction may result in a reduction in habitat and food availability, particularly insects. In response to reduced insect availability Brewer's sparrows will shift their diet from insects to seeds (Paige and Ritter 1999). The effects of management activities on Brewer's sparrows, including effects on foraging habitat, will be discussed further in the Conservation section of this document.

Breeding Biology

Brewer's sparrows are generally thought to be monogamous, although polygyny has been observed in closely related species including chipping sparrows and field sparrows (Holmes and Johnson 2005). Pair formation and nest site selection occurs within several days of the arrival of the females (Best and Petersen 1985, Nordin et al. 1988, Rotenberry et al. 1999). Nest construction takes approximately four to five days to complete (Holmes and Johnson 2005), with initiation of egg laying observed less than one day after nest completion (Rotenberry et al. 1999). Brewer's sparrows lay one egg per day, typically in the morning (Rotenberry et al. 1999). Clutch size is usually three to four eggs, occasionally two and rarely five (Rotenberry et al. 1999). After the last egg is laid, incubation begins and lasts 10 to 12 days, with the female doing all the incubating (Holmes and Johnson 2005). On the Forest and on BLM land adjacent to the Forest, Brewer's sparrows have been observed incubating in mid-May, with clutch sizes of 4 eggs (n = 2). The male forages mostly within 50 meters of the nest site and frequently remains within 10 meters of the nest (Holmes and Johnson 2005).

Based on data collected in Oregon over a four year period, hatch dates range from late May to late July (Holmes and Johnson 2005). Both parents brood and feed the nestlings, with fledging taking place at six to

nine days of age Rotenberry et al. 1999). On the Forest, earliest fledging is estimated to occur in early June, based on observations of females incubating in mid-May. Following nest departure, the fledglings are almost fully feathered but unable to fly, and the parents continue to feed the chicks for several days (Rotenberry et al. 1999). If a nest fails, Brewer's sparrows will produce replacement clutches, with renesting beginning soon after the first nest fails (Holmes and Johnson 2005). Brewer's sparrows frequently produce more than one clutch within a breeding season. Second broods are initiated approximately 10 days after the first brood fledges (Holmes and Johnson 2005).

Demography

Territory Size

During the breeding season male Brewer's sparrows are highly territorial, defending their territory for both breeding and feeding although feeding transgressions are more tolerated (Rotenberry et al. 1999). Average breeding territory size may range from 0.10 ha (.25 ac.) to 2.36 ha (5.8 ac.) (Rotenberry et al. 1999). Territory size may vary significantly among sites, between plots within sites, and among years (Rotenberry et al. 1999). Territories are typically contiguous with adjacent territories, oftentimes tightly packed (Rotenberry et al. 1999). Territory size decreases with increased density of breeding pairs and increases in unsaturated habitats, and territory density has been documented at 0.34 to 2.5 pairs per hectare.

Reproductive Success

Brewer's sparrows breed annually, starting at one year of age, and they typically breed each year until death (Rotenberry et al. 1999). The probability of nest success, defined as greater than one fledgling produced, varies geographically and temporally (Holmes and Johnson 2005). Researchers have identified predation of eggs and nestlings as the primary factor affecting nest success and the primary cause influencing temporal variation in nest success (Rotenberry and Wiens 1989, Rotenberry et al. 1999). In central Oregon, Rotenberry et al. (1999) found that the proportion of total females that rear at least one brood to fledging or independence may vary annually from 60 to 90 percent, but the proportion may be near zero in areas or years with high nest predation. Holmes and Johnson (2005) conducted a sensitivity analysis for the Brewer's sparrow as part of a two-stage matrix population model. From their sensitivity analysis, they concluded that survival rates, specifically first-year survival rates, are most important to population viability.

Ecological influences, such as weather, may affect Brewer's sparrow productivity in some populations but may have no significant affect in other populations. Rotenberry and Wiens (1991) found that reproductive variables such as clutch size, brood size, and fledging mass were not sensitive to short-term weather events that were experienced at each nest, however large scale variation in precipitation that occurred during the preceding winter did significantly influence reproductive variables. They concluded that winters with high precipitation increases ecosystem productivity in the following spring, leading to increased clutch sizes. Based on the results of a five-year study in Oregon, Rotenberry and Wiens (1991) and Rotenberry et al. (1999) suggest that Brewer's sparrows respond opportunistically by increasing their initial reproductive investment when food is more abundant. Conversely, a six year study in Idaho found no significant annual variation in the number of fledglings produced per nest, despite variations in weather conditions during that time period (Petersen and Best 1987, Rotenberry et al. 1999).

Reproductive success of Brewer's sparrows is largely determined by nest predation (Rotenberry et al. 1999), and predation rates may be largely influenced by the degree of fragmentation of sagebrush shrubsteppe habitat (Holmes and Johnson 2005). A likely frequent predator of Brewer's sparrow eggs and nestlings are corvids. Corvid populations appear to be increasing on the Forest, especially in the Gunnison Basin area, and they are often associated with fragmented sites. In eastern Washington, predation on artificial and natural nests of sagebrush shrubsteppe birds was higher in fragmented sites than in continuous sagebrush shrubsteppe habitats (Vander Haegen et al. 2002). Vander Haegen et al. (2002) suggested that higher predation rates were likely due to an increase in corvid populations associated with agricultural and other human-modified habitats. In addition, predators might find nests more easily in fragmented sagebrush habitats compared to extensive sagebrush stands at unfragmented sites (Vander Haegen et al.

2002). The effects of management activities on Brewer's sparrows, including the effects of predation as influenced by fragmentation resulting from management activities, will be discussed further in the Conservation section of this document.

Wildlife-Habitat Relationships

General Habitat Use

Throughout its breeding range, the Brewer's sparrow is most closely associated with landscapes dominated by big sagebrush (*Artemisia tridentata spp*.) (Wiens and Rotenberry 1981, Rotenberry et al. 1999) and is considered an obligate of sagebrush communities (Braun et al. 1976, Paige and Ritter 1999). This bird has a maximum shrub canopy height threshold, typically utilizing shrubs with an average height of less than 5 ft (Rotenberry et al. 1999). Petersen and Best (1985) and Sarell and McGuinness (1996) reported that Brewer's sparrows rarely used shrubs less than 20 inches tall. Brewer's sparrows occur less frequently in shrubby openings in pinyon-juniper and mountain mahogany woodlands (Sedgewick1987) and large shrubby parklands within coniferous forests (Rotenberry et al. 1999). They have also been found at high elevations above timberline and in shrubby montane valleys dominated by low-growing willow and shrubs (Doyle 1997, Rotenberry et al. 1999). Observations and detections of Brewer's sparrows on the Forest have been consistent with reports documented in the literature.

Macrohabitat

At a broad, regional scale, Brewer's sparrow abundances have been correlated with shrub cover (Wiens and Rotenberry 1980, 1981), with the highest density of singing males found to be greatest in unfragmented shrubland habitats (Knick and Rotenberry 1995, 1999, 2002). Local densities are negatively influenced by landscape-level habitat changes that increase fragmentation in shrubland habitats (Rotenberry et al. 1999, Knick and Rotenberry 2000). Rotenberry et al. (1999) and Knick and Rotenberry (2000) hypothesized that Brewer's sparrows may be more sensitive to variation in landscape-level attributes than in local-scale habitat attributes.

Landscape-level attributes that are positively associated with Brewer's sparrow density include high shrub cover, large patch size, little fragmentation, low disturbance, and habitat heterogeneity (Knick and Rotenberry 1995). Knick and Rotenberry (2002) concluded that the occurrence of Brewer's sparrows increased with increasing area of sagebrush patches and decreasing fragmentation. In Montana, Brewer's sparrows preferred sagebrush sites averaging 13 percent sagebrush cover (Bock and Bock 1987). The minimum patch size and the degree of patch isolation required for breeding have not been determined, but Knick and Rotenberry (1995) suggest that isolated stands of sagebrush smaller than 2 ha are not likely to be nesting habitat.

In Colorado, 75 percent of Brewer's sparrow detections were in sagebrush habitat (Lambeth 1998). Based on MCB data from the Rocky Mountain Bird Observatory (RMBO) collected on the Forest, 27 percent (n = 22) of Brewer's sparrow detections (n = 82) occurred in sagebrush habitat, and 41 percent (n = 34) of detections were in grassland habitat. Shrubby vegetation was still an important habitat component within grassland habitat types where Brewer's sparrows were detected. Brewer's sparrow detections in grassland habitat contained a shrub cover percent ranging from 14 to 40 percent, with a mean of 26 percent. It is important to note that on the Forest only two RMBO point-count transects occurred in sagebrush habitat types, compared to 6 transects that occurred in grassland habitat types. Lower detection rates of Brewer's sparrows in sagebrush compared to grassland may be attributed to a lack of sampling effort in sagebrush habitats. Table 10 summarizes landscape-level habitat characteristics for Brewer's sparrow detections on the Forest.

Table 10. Vegetation cover type, habitat structural stage, and landscape-level habitat characteristics for Brewer's sparrow detections on the Forest. Brewer's sparrows were detected by the Rocky Mountain Bird Observatory on point-count bird transects conducted from 1998 to 2004.

No. of detections by cover type and habitat structural stage (HSS)				Landscape-level habitat characteristics							
Cover Type	1M	2S	No data	Shrub Cover % Range	Mean Shrub Cover %	Slope % Range	Mean Slope %	Elevation Range (ft)	Mean Elevation	Patch Size Range (ac)	Mean Patch Size (ac)
Forb-land	3 (4%)			9-20	13	18-34	23	11,365-12,013	11,581	28-67	54
Grass-land	34 (41%)			14-40	26	11-83	20	7,757-12,094	9,506	14-962	460
Bare soil/rock	1 (1%)		2 (2%)	5-10	7	28-46	40	11,658-11,981	11,873	33-47	38
Gambel-oak		4 (5%)		60-62	61.5	13-24	16	7,918-7,935	7,931	37-67	45
Sagebrush		22 (27%)		40-50	40.45	14-26	15	8,739-8,853	8,848	495-856	839
Willow		7 (9%)		50-60	56	22-36	24	11,744-11,919	11,843	28-153	89
No data			9 (11%)								
Total:	38	33	11	5-62	34	11-83	20	7,757-12,094	9,628	14-962	482

Brewer's sparrow occupancy and abundance is likely influenced by the amount of shrub cover, primarily sagebrush shrub cover, patch size, spatial distribution of patches, and the extent of disturbance and fragmentation. Forest-wide, the Forest contains approximately 40,457 acres of primary Brewer's sparrow habitat, and approximately 40,711 acres of secondary habitat. Refer to Table 1 for primary and secondary habitat attributes and parameters.

Microhabitat

Within its shrubland breeding habitat, local (within patch) components that have been positively correlated with Brewer's sparrow densities are sagebrush cover, shrub cover, above-average vegetation height, vigor of the shrub patch, and measures of horizontal habitat heterogeneity (Holmes and Johnson 2005). Conversely, densities of Brewer's sparrows have been negatively correlated with grass cover, rock outcrops, hopsage cover, saltbrush cover, budsage cover, and shrub species diversity (Rotenberry and Wiens 1980, Wiens and Rotenberry 1980, Wiens and Rotenberry 1981, Larson and Bock 1984, Knopf et al. 1990, Paige and Ritter 1999). Brewer's sparrow densities were observed to decline on plots where the percent of sagebrush cover had been reduced through either experimental manipulation or wildfire (Bock and Bock 1987, Paige and Ritter 1999, Rotenberry et al. 1999), which indicates that this species tends to select healthy patches within a shrub community (Knopf et al. 1990).

Nest sites are located primarily in big sagebrush (*Artemisia tridentata spp.*), in significantly taller, denser shrubs, with reduced bare ground and herbaceous cover when compared with the surrounding habitat (Petersen and Best 1985, Rotenberry et al. 1999). In Oregon and Nevada, Rotenberry et al. (1999) found that 81 percent of 104 nests were built in big sagebrush, 10 percent were in spiny hopsage, 6 percent were built in antelope bitterbrush, and 3 percent were in green rabbitbrush. Petersen and Best (1985) quantified Brewer's sparrow nesting habitat in Idaho; their findings support that Brewer's sparrows have a preference for taller than average shrubs within a stand. Within their study area, they found that Brewer's sparrows used shrubs with a mean height of 69 cm for nesting; the average shrub height for the area was 43 cm. Seventy percent of the available shrubs were less than 50 cm tall, but only 7 percent of the nest shrubs were less than 50 cm tall. Other studies have documented Brewer's sparrow nest heights of 66.9 cm in Idaho (Rich 1980); 27.9 to 63.5 cm in Montana (Best 1972); and 71.4 cm in Oregon and Nevada (Rotenberry et al. 1999). There appears to be a maximum shrub height threshold for nest sites, with no known documented use in shrubs greater than 190 cm tall. Older, taller shrubs oftentimes contain a spreading, open branch structure (Rotenberry et al. 1999) and may not provide an adequate nesting structure or concealment for Brewer's sparrow nests.

Brewer's sparrows prefer nest shrubs that are entirely alive or mostly alive (Petersen and Best 1985, Rotenberry et al. 1999). Knopf et al. (1990) observed that Brewer's sparrows used shrubs with greater vigor (a higher proportion of live vegetation to dead vegetation) and hypothesized that the primary

significance of shrub vigor as a habitat descriptor may relate to its value as a predictor of food productivity (both insects and seeds) within a patch (Holmes and Johnson 2005). Despite a preference for shrubs with live foliage, there is no preference among live shrubs for denser than average foliage nor is there a preference for shrubs with discontinuous canopies (canopy gaps) versus continuous canopies (Rotenberry et al. 1999).

CONSERVATION

Threats

The primary threat to Brewer's sparrows region-wide and nationally is the conversion of sage shrub steppe habitats to agricultural land, resulting in habitat fragmentation. On the Forest, threats to Brewer's sparrows may be associated with management activities such as prescribed fire or mechanical treatment when design criteria are not implemented to ensure the maintenance of Brewer's sparrow habitat. Specifically, management activities that result in sagebrush reduction may degrade breeding habitat. Reductions in the amount of habitat can also be compounded by reduction in the quality of remaining habitat. Excessive livestock grazing can reduce recruitment of shrubs species and increase the likelihood of invasion of non-native plants. Brewer's sparrows may eventually abandon areas completely as sagebrush is reduced or dies out due to management activities (Schroeder and Sturges 1975, Castrale 1982, Kerley and Anderson 1995). Brewer's sparrows typically return to the same breeding territories each year, and there can be a time-lag in their response to major habitat changes (Wiens and Rotenberry 1985). In their Regional Conservation Assessment, Holmes and Johnson (2005) attempted to prioritize threats to Brewer's sparrows based on their severity. These threats as they relate to the Forest are discussed below.

Habitat Loss, Degradation and Fragmentation

Brewer's sparrow primary habitat is generally continuous in non-forested areas at lower elevations on the margins of the Forest. Some of the secondary habitats and a smaller portion of primary habitat types exist in isolated habitat patches within forested areas. Forest-wide, isolated habitat patches are typically greater than 15 acres in size and are capable of supporting breeding pairs. On the Forest, the smallest known habitat patch size that Brewer's sparrows have been documented in during the breeding season was 14 acres (Table 10). Due to the degree of habitat isolation of Brewer's sparrow habitat on portions of the Forest, fragmentation of existing habitats could potentially reduce shrubland habitat types below a minimum suitable size for Brewer's sparrow occupancy. In addition, Brewer's sparrows are occasional cowbird hosts and their populations are most vulnerable to parasitism where land conversion to agriculture and the fragmentation of sagebrush shrublands provide contact zones between cowbirds and sagebrush breeders (Rich 1978, Paige and Ritter 1999).

Large-scale reduction and fragmentation of shrubland habitat does not appear to be taking place on the Forest (Figure 7). However, management activities that remove sagebrush by burning, herbicide application, or mechanical treatment, with no regard to Brewer's sparrow habitat requirements, could affect Brewer's sparrow distribution and abundance on the Forest. Excessive livestock grazing and the invasion of exotic plants could also degrade Brewer's sparrow habitat.

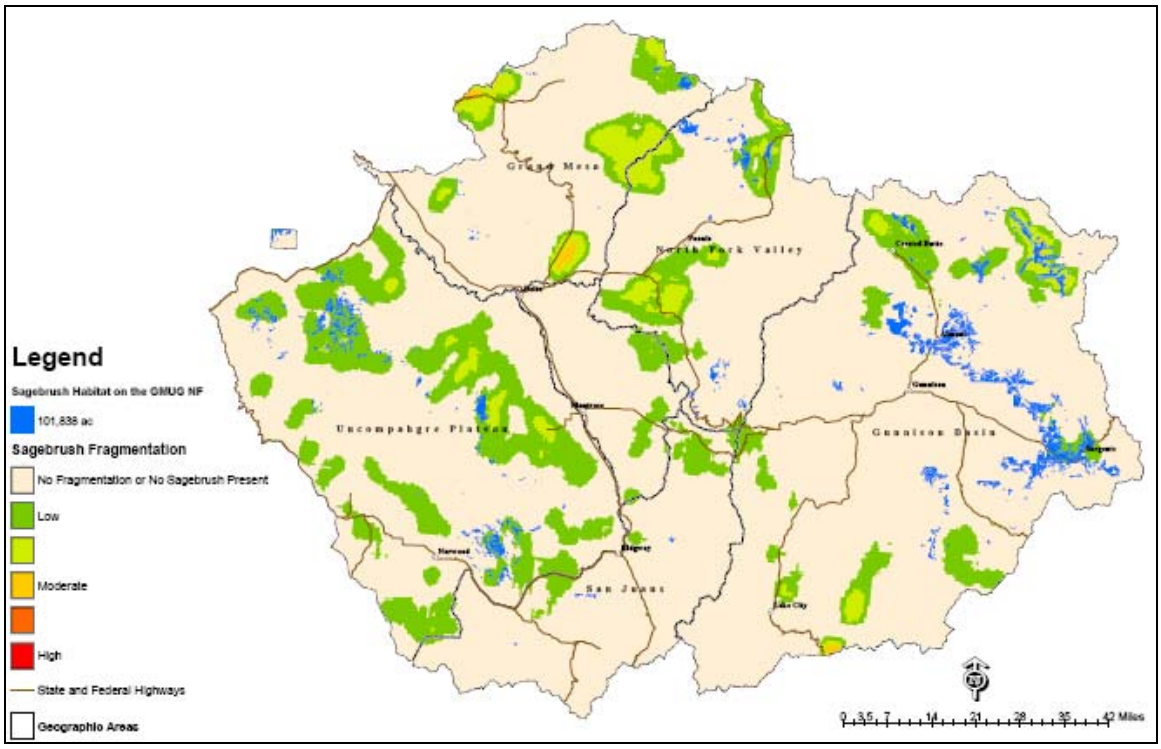

Figure 7. Degree of sagebrush fragmentation on and adjacent to the Forest in relation to sagebrush dominated habitats within the Forest. Sagebrush fragmentation GIS data obtained from http://sagemap.wr.usgs.gov/.

Invasion of Nonnative Grasses

Agricultural development adjacent to the National Forest, livestock grazing, off road vehicle use, and road building disturb the soil, which promotes germination of annual plant seeds (Holmes and Johnson 2005). Consequently, this promotes the invasion of exotic annual plants into otherwise undisturbed areas (Holmes and Johnson 2005). This process can result in the establishment of invasive plants on the Forest, such as cheatgrass, crested wheat grass, Russian knapweed, white top and others. Management activities that facilitate the establishment of cheatgrass into shrublands on the Forest include widespread livestock grazing and activities that disturb the soil surface. Cheatgrass readily invades disturbed sites as livestock churn up soil and graze native bunchgrasses (Paige and Ritter 1999). Cheatgrass also rapidly colonizes disturbed sites and is a persistent resident, replacing native species (Mack 1981, Yensen 1981, Whisenant 1990). Crested wheatgrass is a non-native perennial bunchgrass that was seeded on some areas of the Forest within sagebrush shrublands to provide livestock forage. Crested wheatgrass has had a role in fundamentally altering the native grass-forb community in many areas of sagebrush shrubsteppe (Whisenant 1990, Rotenberry et al. 1999), including sagebrush shrublands on the Forest. McAdoo et al. (1986) found that shrub-dependent non-game bird species were displaced when crested wheatgrass seedlings were established in sagebrush communities. Both cheatgrass and crested wheatgrass are capable of replacing native sagebrush steppe, and the exotic plant-dominated landscapes that replace native vegetation are un-inhabitable for native shrubsteppe-dependent species (Dobkin and Sauder 2004) such as the Brewer's sparrow (Holmes and Johnson 2005). In addition, burning may promote the spread of non-native weeds and convert shrubsteppe to non-native annual grassland (Knick and Rotenberry 1995, 1997, 1999, 2000, 2002).

Effects of Cheatgrass on Fire Frequency and Intensity

Throughout western rangelands, cheatgrass has greatly increased fire frequency, and has substantially and perhaps permanently, altered postfire successional pathways (Whisenant 1990, Rotenberry et al. 1999). Unlike native bunchgrasses, cheatgrass creates a continuous surface cover of relatively fine fuel that carries fire into and over much larger areas than likely occurred historically (Whisenant 1990). Areas dominated

by cheatgrass burn far more frequently than native sagebrush steppe, with fire return intervals of 3 to 5 years (Paige and Ritter 1999). In addition, cheatgrass matures and dries earlier than native bunchgrasses, increasing the chance of fire earlier in the season (Young and Evans 1978, Whisenant 1990, Knick and Rotenberry 1997). Sagebrush shrublands that are infested with cheatgrass are 20 times more likely to burn than those without (Stewart and Hull 1949, Whisenant 1990). Because sagebrush may take several years to mature before producing seed, repeated, frequent fires can eliminate sagebrush entirely (Paige and Ritter 1999).

Fire Suppression

Although cheatgrass and the increased fire frequency associated with its invasion are threats to sagebrush habitats and the species dependent on them, complete fire suppression can also be a threat to healthy sagebrush ecosystems not impacted by exotic plants (Holmes and Johnson 2005). Fire suppression and the loss of fine fuels to excessive livestock grazing have resulted in much longer fire-return intervals, particularly in the sagebrush steppe. Consequently, this has resulted in a loss of mosaic characteristics of sagebrush habitats on many areas of the Forest.

Prescribed Fire

Prescribed burns are commonly used on the Forest in sagebrush habitats to reduce shrub cover for fuels reduction goals, range improvement for livestock, and to create habitat mosaics for other species such as the Gunnison Sage-Grouse. Burning of sagebrush, particularly over large areas, generally decreases the abundance of Brewer's sparrows (Walker 2004) because it removes shrub cover, fragments large tracts of sagebrush, and can reduce patch size to levels not used by Brewer's sparrows (Holmes and Johnson 2005). In shrubsteppe of south-central Wyoming, indices of abundance were four times higher on untreated control plots with 37 percent average sagebrush cover and mean shrub height of 31 cm than on burned areas with six percent average sagebrush cover and mean shrub height of 20 cm (Kerley and Anderson 1995). In south-central Montana, Brewer's sparrows were absent from a site two to three years after a fire eliminated all sagebrush cover, even though grass and forb cover were similar on burned and unburned plots (Bock and Bock 1987). Castrale (1982) found that Brewer's sparrows were absent on a four year old regenerating burn, except in intact remnants of sagebrush within the burn area.

Partial burns may have little or no long-term effects on Brewer's sparrow populations (Walker 2004) and are less detrimental to Brewer's sparrows than complete burns (Walker 2004). In burned mountain big sagebrush (*Artemisia tridentata vaseyana*) communities of western Wyoming, Brewer's sparrows continued to nest in remaining patches of unburned shrubs (McGee 1976). In southeastern Idaho, an incomplete prescribed burn (45% of the area was burned) resulted in significantly lower densities in the two years following the burn, but densities exceeded those on control plots during the third and fourth years after burning (Petersen and Best 1987). Petersen and Best (1987) found that in the four years following the burn, there was no consistent effect of prescribed burning on return rates, mating success, nestling growth rate, reproductive success, or nest survival. After continued monitoring of burned and unburned plots over seven years, Petersen and Best (1987) concluded that partial burning by itself did not have any long-term effects on Brewer's sparrow abundance.

Prescribed fire promotes changes in the vegetative community (Holmes and Johnson 2005). After a fire Brewer's sparrows may nest in large perennial forbs for several years until sagebrush regenerates (Mahony 2003). In southern British Columbia, Mahony (2003) observed that Brewer's sparrows continued to nest in burns that were four years old, but they used a much greater diversity of plant species for nesting, including large perennial forbs. Six years after burning, Brewer's sparrows switched back to nesting in sagebrush that had germinated after fire (Mahony 2003). Burning that maintains a mosaic of vegetative conditions, preferably large blocks of sagebrush greater than 15 acres in size containing tall, clumpy and vigorous sagebrush stands, will likely maintain suitable breeding habitat for Brewer's sparrows.

Livestock Grazing

The effects of livestock grazing in shrubland habitats are complex, depending on grazing intensity, season, and duration and the extent of alteration to native vegetation (Holmes and Johnson 2005). There are indirect and direct effects of livestock grazing on Brewer's sparrows. Indirect effects include alteration of vegetation, which can lead to changes in the plant community (Holmes and Johnson 2005). Alteration of vegetation in sagebrush habitats due to livestock grazing may affect Brewer's sparrow abundance. In the northern Great Plains, Brewer's sparrow abundance in shrubsteppe was highest in lightly grazed areas and lowest in heavily grazed areas (Kantrud and Kologiski 1983). In central Montana, Brewer's sparrows occurred at higher densities and had higher nesting success on ungrazed plots than on adjacent grazed plots (Logan 2001). In the Okanagan Valley of British Columbia, 86 percent of breeding territories were located in areas with greater than 25 percent cover of native, climax vegetation (i.e., those in "fair" to "good" range condition), whereas only 14 percent occurred in areas with less than 25 percent cover of native, climax vegetation (i.e., those in "poor" range condition) (Sarell and McGuinness 1996). In the Columbia River Basin of eastern Washington, indices of Brewer's sparrow abundance were significantly higher on plots with greater than 25 percent cover of native, climax vegetation (Dobler et al. 1996, Vander Haegen et al. 2000). Although livestock grazing may directly affect Brewer's sparrows during nesting, individual-level effects of grazing on Brewer's sparrows are poorly known. Livestock may occasionally trample low-lying nests or dislodge them from nest shrubs, resulting in nest failure (Holmes and Johnson 2005, Walker 2004). Additionally, the presence of livestock, particularly cattle and horses, can increase the abundance of brown-headed cowbirds, potentially impacting Brewer's sparrow productivity (Holmes and Johnson 2005).

Management Recommendations

Paige and Ritter (1999) review specific strategies for managing sagebrush habitat for Brewer's sparrows and other sagebrush-obligate birds, and Walker (2004) provides specific management recommendations for the Brewer's sparrow. Paige and Ritter (1999), Peterson (1995), and Rotenberry (1998) also provide information on managing sagebrush for bird communities, including the Brewer's sparrow. Management recommendations include:

1) Maintain large, intact sagebrush stands with an average shrub cover of 10-30 percent, an average shrub height of 0.4 – 1.5 m (15.7 – 59 inches), and a diverse understory of grasses and forbs native to the local area (Petersen and Best 1985, Petersen and Best 1987, Larson and Bock 1984, Dobler et al. 1996, Rotenberry et al. 1999). Within each stand, maintain areas with relatively dense sagebrush cover (25-40%) and medium-sized shrubs (0.5 – 0.9 m) that Brewer's sparrows prefer for nesting (Walker 2004).

2) Avoid the complete removal of sagebrush, as it eliminates suitable nesting habitat for Brewer's sparrows and may promote the spread of invasive plants (Rotenberry 1998, Paige and Ritter 1999). Management activities such as spraying, chaining, mowing, or burning that result in partial sagebrush removal are preferred as these activities allow faster regeneration of suitable nesting habitat (Braun et al. 1976, Castrale 1982, Winter 1984, Peterson 1995, Walker 2004). When implementing management activities that cause sagebrush reduction, timing restrictions should be enforced that do not allow activities to occur during the breeding/nesting season (approximately mid-April to early August on the Forest).

3) Avoid reseeding areas with non-native grasses, as this further delays recolonization by sagebrush, thereby reducing habitat quality for Brewer's sparrows (Reynolds and Trost 1981, McAdoo et al. 1989, Walker 2004). Identify and control nonnative plants, prioritizing on those that are invasive or highly flammable such as cheatgrass (Walker 2004).

4) Manage livestock grazing to reduce impacts on the grass and forb understory and to reduce soil compaction and disturbance (Saab et al. 1995). Excessive grazing may increase the risk of non-native plant invasions. Maintain rangelands so that they are in a "fair" or "good" range condition, and complete livestock removal or significantly reducing stock rates of livestock may be necessary to improve habitat quality for rangelands that are in "poor" condition.

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