

Wolford Mountain Travel Management Plan Migratory Bird Monitoring

2006 Final Report



Submitted to:

Bureau of Land Management
Kremmling Field Office



Prepared by:

Alison Banks Cariveau
Research Division Director
Rocky Mountain Bird Observatory
14500 Lark Bunting Lane
Brighton, Colorado 80603



ROCKY MOUNTAIN BIRD OBSERVATORY

The mission of the Rocky Mountain Bird Observatory (RMBO) is to conserve birds of the Rocky Mountains, Great Plains, and Intermountain West and the habitats on which they depend through research, monitoring, education, and outreach. RMBO practices a multi-faceted approach to bird conservation that integrates scientific research and monitoring studies with education and outreach programs to bring bird conservation issues to the public and other conservation partners. RMBO works closely with state and federal natural resource agencies, private landowners, schools, and other nonprofit organizations. RMBO accomplishes its mission by working in four areas:

- Research: RMBO studies avian responses to habitat conditions, ecological processes, and management actions to provide scientific information that guides bird conservation actions.
- Monitoring: RMBO monitors the distribution and abundance of birds through long-term, broad-scale monitoring programs that track population trends for birds of the region.
- Education: RMBO provides active, experiential, education programs for K-12 students in order to create an awareness and appreciation for birds, with the goal of understanding the need for bird conservation.
- Outreach: RMBO shares the latest information in land management and bird conservation practices with private landowners, land managers, and resource professionals at natural resource agencies. RMBO develops voluntary, working partnerships with these individuals and groups for habitat conservation throughout the region.

Suggested Citation:

Cariveau, A.B. 2007. Wolford Mountain Travel Management Plan Migratory Bird Monitoring: 2006 Final Report, Rocky Mountain Bird Observatory, Brighton, CO, 22 pp.

Photos:

All photos courtesy of RMBO.

Contact Information:

Alison Banks Cariveau
alison.cariveau@rmbo.org
Rocky Mountain Bird Observatory
230 Cherry Street
Fort Collins, CO, 80521
970.482.1707

ACKNOWLEDGEMENTS

We thank Chuck Cesar with the Kremmling Field Office of the Bureau of Land Management (BLM) for developing the project concept and providing agency support in accomplishing this study. Megan McGuire, also at the Kremmling Field Office, provided GIS mapping support for the project. We thank the BLM for funding this project. We also thank Mike Crosby and the Colorado Division of Wildlife for providing matching funding in the form of housing and subsistence costs in 2005. Alison Cariveau, Tony Leukering, Matthew South, John Walsh, and Walter Wilson conducted field surveys for birds. Bonnie Koblitz, Matthew South, Rachel Rilling, and John Walsh collected vegetation data. Luke Caldwell, Matthew South, John Walsh, and Deneb Woods assisted with data entry and data quality assurance. Jennifer Blakesley provided assistance with statistical analysis and comments on the draft report. Lacreacia Haynie provided editorial comments on the draft report.



EXECUTIVE SUMMARY

Due to high natural resource values and increasing motorized recreational use, the Bureau of Land Management (BLM) completed a Travel Management Plan (TMP) for the Wolford Mountain Area in Middle Park, Colorado, to improve soil, vegetation, and wildlife habitat conditions. To assess impacts of travel management on breeding bird species, Rocky Mountain Bird Observatory (RMBO) initiated a study in 2005 comparing bird densities in areas with road closures to areas where roads remain open. In 2006, RMBO completed a second year of surveys to strengthen the baseline assessment. This report gives the analysis of 2006 data and provides a comparison to 2005 data.

RMBO established bird survey locations in sagebrush habitat, to compare bird abundance along county roads, open local roads, local roads closed under the TMP, and interior areas greater than 125 m from all roads. Because the BLM is also interested in avian use of their riparian areas, RMBO also established twenty bird survey points along Muddy Creek and seven points in Cow Gulch. RMBO also measured vegetation at bird survey points, because differences in vegetation affect bird use.

In 2005, RMBO conducted 208 point-count surveys at 146 survey points, detecting 1468 individual birds of 72 species. In 2006, RMBO conducted 257 point-count surveys at 144 points, counting 1856 birds of 67 species. In 2006, eleven avian species were added to the species list compiled in 2005. RMBO measured vegetation at 37 points in 2005 and 54 points in 2006.

The overall numbers and species richness of birds at survey points was slightly greater in 2006 than in 2005. However, the densities of the Green-tailed Towhee, Sage Thrasher, and Vesper Sparrow in sagebrush were slightly lower than in 2005. There was no effect due to road type or distance from roads on avian species richness and densities of the four most common sagebrush species in either year. The Horned Lark was found to be more abundant near all road types in comparison to points located away from roads. The average number of birds surveyed, avian species richness, and three of four bird species were negatively associated with rocky areas. In addition, each focal species showed a unique response to shrub characteristics, suggesting habitat partitioning among the primary sagebrush species.

Sagebrush was the dominant shrub found, representing an average of 70-89% cover (2005-2006, respectively). The ground layer was comprised of litter (32%), grass (24%), bare ground (21%), shrubs less than 0.2 m tall (11%), forbs (8%), and rock (5%).

This baseline survey provides a solid foundation for the monitoring of bird responses to travel management in the Wolford Mountain Project Area.



TABLE OF CONTENTS

| | |
|---|-----|
| ACKNOWLEDGEMENTS | i |
| EXECUTIVE SUMMARY | ii |
| INTRODUCTION | 1 |
| STUDY BACKGROUND | 2 |
| THE ROLE OF RMBO | 2 |
| STUDY OBJECTIVES | 3 |
| STUDY DESIGN | 4 |
| METHODS | 6 |
| <i>Birds</i> | 6 |
| <i>Habitat</i> | 6 |
| <i>Analytic Methods</i> | 7 |
| RESULTS | 9 |
| <i>Birds</i> | 9 |
| <i>Habitat</i> | 12 |
| <i>Avian Habitat Relationships</i> | 15 |
| DISCUSSION | 16 |
| FUTURE DIRECTION | 18 |
| LITERATURE CITED | 19 |
| APPENDIX A. Locations in latitude and longitude for all bird survey points within the Wolford Mountain Project Area, 2005-2006. | A-1 |
| APPENDIX B. List of birds observed in the Wolford Mountain Project Area, May-July 2005-2006. Species listed in taxonomic order. | B-1 |
| APPENDIX C. List of plants observed in the Wolford Mountain Project Area, May-July 2005-2006. Species listed alphabetically by common name. | C-1 |

LIST OF FIGURES

| | |
|---|----|
| FIGURE 1. Project Map indicating location of bird survey points within the Wolford Mountain Study Area, indicating road and habitat types. | 5 |
| FIGURE 2. Average number of birds (+/- SE) per point-count in the Wolford Mountain Project Area, 2005 and 2006. | 9 |
| FIGURE 3. Average number of species (+/- SE) observed per point-count in the Wolford Mountain Study Area, 2005 and 2006. | 10 |
| FIGURE 4. Density estimates of the four most abundant species in habitat at Wolford Mountain in 2006, comparing four road types. Error bars indicate 95% confidence intervals. | 11 |
| FIGURE 5. Percent of ground cover by types, at bird survey points in sagebrush in the Wolford Mountain study area, 2005 and 2006. | 14 |



LIST OF TABLES

| | | |
|----------|---|----|
| TABLE 1. | Density estimates for the four most abundant species using sagebrush habitat at Wolford Mountain Project Area, 2005 and 2006, where D=estimated density (birds/ha), followed by confidence limits, coefficient of variation, and the number of birds in the analysis..... | 11 |
| TABLE 2. | Shrub characteristics at bird survey points, Wolford Mountain study area, 2005-2006. Mean heights (m) and cover (%) are followed by standard error in parentheses..... | 13 |
| TABLE 3. | Shrub species composition recorded at bird survey points in Wolford Mountain study area, 2005-2006 (percent cover, height in meters, and standard error of height)..... | 13 |
| TABLE 4. | Species composition of grasses found in bird survey plots, Wolford Mountain study area, 2005-2006..... | 14 |
| TABLE 5. | Species composition of forbs found in bird survey plots, Wolford Mountain study area, 2005-2006..... | 15 |
| TABLE 6. | Habitat factors explaining significant variation (all $p < 0.15$) in bird variables at Wolford Mountain Study Area, 2006, based on stepwise regression..... | 15 |



INTRODUCTION

Sagebrush ecosystems cover over 150 million acres of the arid west and have undergone extensive change in the past century, affected by human settlement, agricultural conversion, livestock grazing, altered fire regimes, and widespread weed invasions (Knick 1999). This habitat has experienced steep declines of many sagebrush-obligate species and noted losses in critical wintering habitat for pronghorn antelope, elk, and mule deer (Knick et al. 2003). An estimated sixty-three percent of shrubland birds are declining continentally (Paige and Ritter 1999), and several sage-dependent bird species are imperiled. Greater Sage-Grouse and Gunnison Sage-Grouse have both faced severe rangewide declines, and continentally Brewer's Sparrow has been declining persistently at a rate of 3.7% annually (Paige and Ritter 1999; Sauer et al. 1997). These wildlife declines are occurring amidst sustained use for agriculture, recreation, and energy development, and have caused conservation concern for the sagebrush ecosystem. In response to these conservation needs, the Bureau of Land Management (BLM) developed a National Sage-Grouse Habitat Conservation Strategy to guide future actions for the conservation of sagebrush habitats (Department of Interior 2004). An estimated 50% of sagebrush habitat occurs on lands managed by the BLM, and the agency has taken an increasingly active role in its management for natural resource health (U.S. Fish and Wildlife Service 2004).

Roads are a source of habitat fragmentation as well as a source for animal mortality and the movement of exotic plant species, among other impacts (Trombulak and Frissell 2000). Birds have been found to avoid roads with heavy traffic volumes (Reijnen et al. 1996) as well as low traffic volumes along dirt roads (Ingelfinger and Anderson 2004). The proliferation of roads due to unrestricted off-highway vehicle use is a management concern for public lands agencies (e.g., Kremmling Field Office 2005). Restoration of roadways and motorized trails is a strategy that may be used to mitigate recreational uses and to improve the health of sagebrush ecosystems. In this study, the Rocky Mountain Bird Observatory (RMBO) documented the response of birds to road closures and habitat rehabilitation implemented by the BLM in high elevation sagebrush steppe in Middle Park, Colorado.



WOLFORD MOUNTAIN TRAVEL MANAGEMENT PLAN



The Wolford Mountain Area comprises 42,600 acres north of Kremmling, Colorado in the Middle Park area of the Rocky Mountains. Approximately 33,150 acres are managed by the BLM. Ranging from 7350 to 9360 feet in elevation, the area is dominated (92%) by sagebrush steppe, characterized by big sagebrush (*Artemisia tridentata*), with small amounts of bitterbrush (*Purshia tridentata*), greasewood (*Sarcobatus vermiculatus*), rabbitbrush (*Chrysothamnus* sp.), serviceberry (*Amelanchier*

alnifolia), and snowberry (*Symphoricarpos oreophilus*) (Kremmling Field Office 2005). Because of high natural resource values and increasing motorized recreational use, in 1984 the area was designated for off-road vehicle use “Limited to Designated Roads and Trails.” In addition, the BLM completed a Travel Management Plan (TMP) for the Wolford Mountain Area to “improve soil, vegetation, and wildlife habitat conditions throughout the project area” (Kremmling Field Office 2005). The TMP provides for 167 miles of roads to remain open for motorized use and for the closure of 69 miles of routes. Under the TMP, the area will be closed to motorized use in winter to protect winter range for mule deer, elk, and pronghorn. Some road closures are designed to protect Greater Sage-Grouse lek areas, including the Mitchell lek, the largest in Middle Park. Migratory birds are listed as a resource of concern in the area, and Rocky Mountain Bird Observatory (formerly “Colorado Bird Observatory”) is indicated for “monitoring migratory species of concern that depend on the sagebrush ecosystem” (Kremmling Field Office 2005).

ROCKY MOUNTAIN BIRD OBSERVATORY BIRD STUDY

RMBO conducted a study of birds nesting in sagebrush in Wolford Mountain and surrounding areas during the mid 1990’s. In 2005, RMBO assisted the BLM in determining the impact of their management plan on bird use of the area. RMBO repeated surveys in 2006 to build a robust baseline assessment of bird use in the area. This baseline provides the platform to repeat monitoring over time (e.g. the next ten years) to determine the effects of the TMP on breeding birds of the area. This report gives the analysis of 2006 data and provides a comparison of the data collected in both years.



STUDY OBJECTIVES

The main objective of this study was to determine the effects of travel management on breeding bird species by comparing their density in areas with road closures to areas where roads will remain open. This project focuses on migratory bird species; the Colorado Division of Wildlife has an ongoing program tracking the Greater Sage-Grouse in the area.

The BLM was also interested in bird use in the riparian habitat along Muddy Creek downstream from the Wolford Mountain Reservoir. Bird surveys were conducted there in 1993-1994 prior to the creation of the reservoir in 1995. The BLM is interested in documenting use in the area and comparing the information to the surveys done in the 1990's.

To determine the effects of travel management on breeding bird species densities RMBO and the BLM initiated a study in the Wolford Mountain area with the following study objectives:

- Document use of the Wolford Mountain area by birds during the breeding season.
- Compare bird use among road types: county roads, local roads, local roads closed by the TMP, and in interior locations (at least 125 m away from all roadways).
- Provide density estimates for the most common species along each of the road types
- Establish baseline avian abundance information to facilitate the tracking of trends in bird use of sagebrush habitat in response to road closures (could be followed annually or at other intervals, such as ten years).
- Document bird use of the riparian habitat along Muddy Creek.



STUDY DESIGN

The study area was defined as the Wolford Mountain Area bounded by Muddy Creek and Wolford Reservoir on the west and restricted to contiguous BLM parcels to the south and east (see Figure 1). For the sagebrush points, two vegetation types, "sagebrush" and "sagebrush-grass mix," were selected and combined for sampling, using vegetation maps provided by the BLM. Roads were classified as county roads, local roads, or local roads closed by the TMP. The road layers were split into segments 250 m long and segments were selected randomly for sampling. Interior points (at least 125 m away from all roadways) were generated in GIS and randomly selected. In each stratum (the 3 road types and interior locations), RMBO initially selected 30 point-survey locations and several alternates. This selection was based upon preliminary analyses that indicated this sampling effort would provide reliable estimates of bird density for several of the most abundant bird species. In 2006, we randomly dropped sampling points to sample 28 points in each stratum, a sample size that ensured we could sample most points twice in the season (Figure 1; Appendix A).

In the field, we verified points as being located in sagebrush or sagebrush-grass mix and when appropriate at least 125 m from roads. Ten points were re-located in 2006 to better align with road locations (denoted "-06" in Appendix A). These discrepancies were likely caused by differences in GPS settings and do not reflect different sampling strata between years. "Road" points were placed at various distances up to 15 m from the center of the roadway. Point locations were recorded with a Garmin Etrex GPS unit and marked with wooden stakes when vegetation plots were measured (83 of 122 points established).

In addition to the sagebrush points, twenty point locations were established every 250 m along the Muddy Creek corridor (Figure 1) and marked with wooden stakes. In addition, seven points were located in the Cow Gulch area, where the BLM had special interest in monitoring (Figure 1).



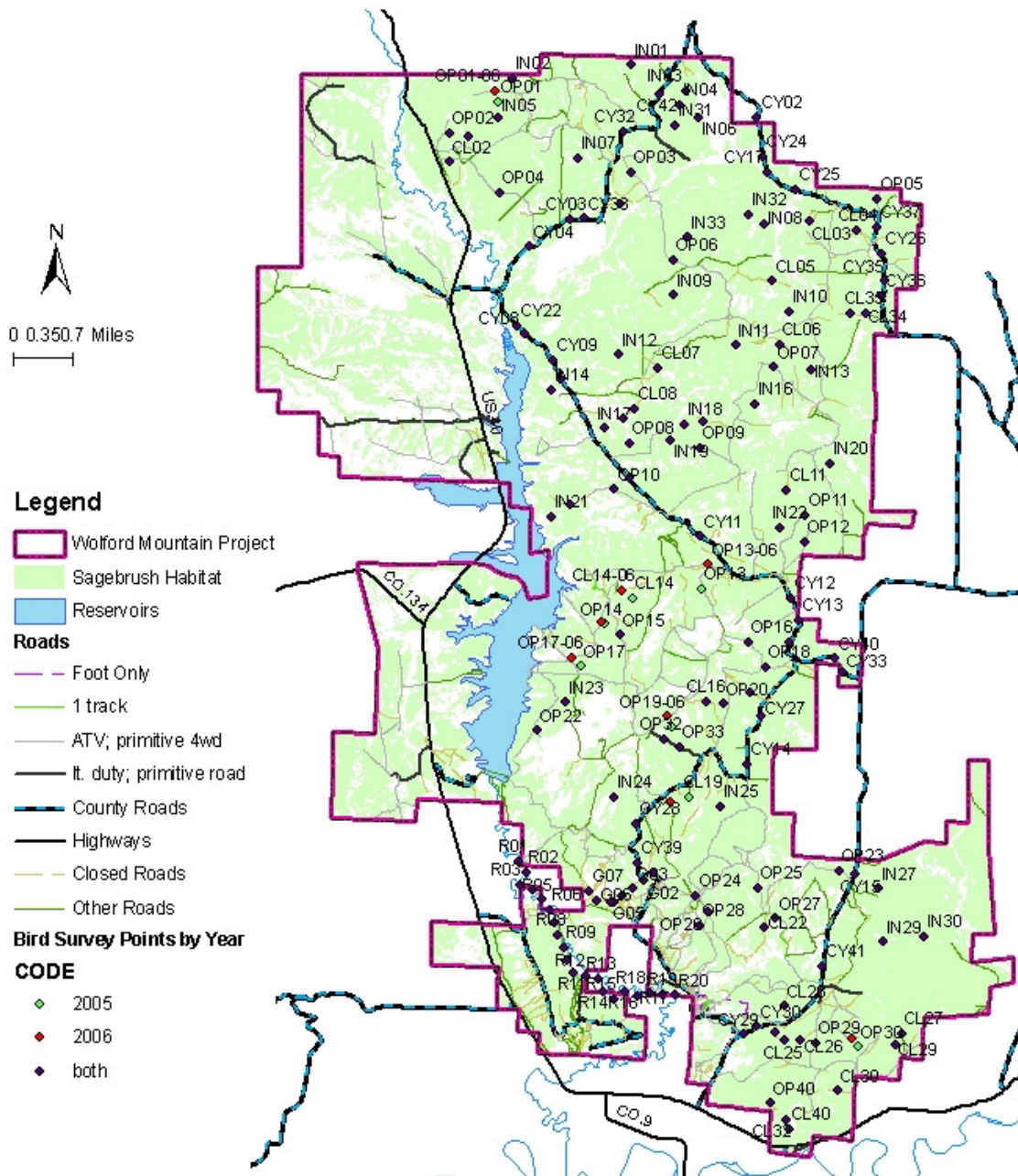


Figure 1. Project Map indicating location of bird survey points within the Wolford Mountain Study Area, indicating road and habitat types. Points moved between years are depicted in green and red.



METHODS

Birds

Point-count bird surveys were conducted according to RMBO *Monitoring Colorado's Birds* Program protocol (Leukering and Levad 2000). Observers recorded all birds seen or heard at a point location for five minutes, and estimated the distance to each bird using a Bushnell Yardage Pro 500 laser rangefinder. Observers also noted breeding behaviors using Breeding Bird Atlas codes (after Kingery 1998). Bird survey dates ranged from June 8-July 4, 2005 and May 31-July 1, 2006. Bird surveys were initiated within one-half hour of sunrise and were completed by 11:00 a.m. Bird surveys were only conducted without precipitation and with wind speeds of less than 12 mph. In 2005, 146 point-count stations were visited once and 62 of the point-count stations were visited a second time. In 2006, we surveyed 116 points twice, one point three times, and Muddy Creek riparian and two sagebrush points once each.



Habitat

Vegetation was measured at survey points in sagebrush to determine if bird abundance varied with habitat conditions or if habitat conditions varied among road types. We collected a number of qualitative descriptive data to describe the road and other habitat parameters that might affect bird distribution. We measured the width of the road closest to the sample point and noted whether roads were gravel, dirt, or two-track (vegetation growing down centerline). We noted if shrubs appeared to be taller directly adjacent to the road, and tallied any trees or shrubs taller than 1.0 m (excluding sagebrush) that occurred within 100 m of the point. We also noted whether each of the following were present within 100 m of the point: fence, utility line, rock outcrop, drainage, and flowing water.

In addition to the above qualitative measures, we sampled vegetation along two 50 m transects laid perpendicular to the roadway or at a random bearing for interior points, starting at a distance of 15 m from the point-count center. We employed methods commonly used by avian researchers in sagebrush habitats to quantify vegetation cover and height (Ingelfinger and Anderson 2004, Holmes et al. 2003, Vander Haegen et al. 2000). We used the line-intercept



method to quantify percent cover of shrubs (Canfield 1941). Cover was measured to a minimum unit of 0.1 m. We used a meter stick to measure maximum heights of shrubs along the line. In 2006, because we were interested in vegetation structure that would relate to bird habitat requirements, we restricted the line-intercept estimates to shrubs at least 0.2 m in height. We employed Daubenmire plots (Daubenmire 1959) to estimate canopy cover of grasses, forbs, litter (dead plant material), cryptogamic crust, rock, and bare ground. We estimated Daubenmire cover to the nearest 5% (using 2% for trace cover). In 2006, we included shrubs less than 0.2 m tall in the ground cover plot estimates. Because of inconsistencies in the method for recording shrub cover in the plot estimates in 2005, we restrict our summary of Daubenmire data to those plots measured in 2006.



We measured vegetation at 37 points in 2005 and 54 points in 2006. Three points were sampled in both years; five points were excluded from analysis due to incomplete data. We present vegetation data for a total of 18 closed local road, 19 county road, 21 interior, and 25 open local road points.

Analytic Methods

We present species richness and abundances (raw numbers counted/point) for birds encountered during point counts along each of the road types, in Cow Gulch, and in the Muddy Creek riparian area. For points surveyed more than once, we analyzed the means of those counts per year. For comparisons between years, we restricted our analysis only to points counted in both years (and not relocated). A paired T-test was employed to determine if the numbers of birds and species detected varied between years. Means across habitat and road types were compared nonparametrically using a Kruskal-Wallis Rank-Sum Test appropriate for small sample sizes. A Tukey-Kramer HSD test was used to determine pairwise differences among habitat and road types. For the vegetation data, we analyzed the influence of road effects while controlling for the effect of year (protocol), by using an Analysis of Variance. Analyses were conducted in *Microsoft Access*, *Microsoft Excel*, *JMPIn*® (SAS Institute Inc. 2001).

For the species with sufficient sample sizes, we present estimates of bird



densities (birds/ha) generated using distance sampling (Buckland et al. 1993) and Program Distance (version 5.0 Beta 5; Thomas et al. 2005). This method uses the distances from observer to the birds surveyed to fit detection curves, which are then used to generate estimates of bird densities that may be compared among species and habitats (Rosenstock et al. 2002). The distributions of detections varied substantially by year/observer, so we modeled densities separately for each year. For 2005, we binned all observations into five distance categories for analysis; truncation points were 195 m for all species except for Vesper Sparrow, which was 245 m. For 2006, we visually determined either a 5% or 10% truncation point (excluding the furthest 5-10% of detections). The best-fit model for each species was selected using the Akaike Information Criterion (AIC) from among the following models: half-normal key function with a cosine series expansion, half-normal key function with a hermite polynomial expansion, hazard rate key function with cosine series expansion, hazard rate key function with simple polynomial expansion, and a uniform function with cosine expansion.

To model avian habitat relationships, we analyzed only the points with vegetation data collected in 2006. First we used mixed models to examine the effect of road type (fixed effect), shrub height, and percent cover of sagebrush greater than 20 cm tall, shrubs less than 20 cm tall, grass and forbs, litter, and rock and bare ground (random effects) on average all birds counted per point, average species richness per count per point, and the densities of Brewer's Sparrow, Green-tailed Towhee, Sage Thrasher, and Vesper Sparrow. We modeled each of the dependent variables in separate models. Mixed model results indicated that road type did not influence any of the measures of bird abundance. Next, we used a stepwise linear regression to determine the effect of sagebrush height, non-sagebrush shrub height, and percent cover of sagebrush greater than 20 cm tall, non-sagebrush shrubs greater than 20 cm tall, shrubs less than 20 cm tall, grass, forbs, litter, rock, and bare ground to model the same avian variables as above. Analyses were conducted in SAS (SAS Institute, 2005).



RESULTS

Birds

In 2005, we counted 1468 individual birds of 72 species. In 2006, we counted 1856 birds of 67 species. Across both years, we recorded 3324 birds of 83 species.

Birds per point

This analysis was restricted to the 101 sagebrush points surveyed in both years. In 2005, a mean of 5.63 birds (Standard Error (SE) = 0.18) was counted per point-count, and in 2006, 6.98 birds (SE = 0.16) were recorded per point-count. These differed ($p < 0.001$), so we analyze each year separately in successive analyses (see Figure 2).

2005: In sagebrush habitat, an average of 5.69 (SE = 0.17) birds were counted per point-count. In riparian habitat along Muddy Creek, an average of 10.48 (SE = 1.05) birds were counted per point-count (see Figure 2). An intermediate number of birds were observed in Cow Gulch, with an average of 7.0 birds (SE = 1.35) per point-count. The number of birds per point differed among the four road types, Cow Gulch, and Muddy Creek areas ($\chi^2 = 30.62$, $p < 0.0001$), due to higher bird numbers at Muddy Creek (all pairwise comparisons $p < 0.01$). The number of birds counted did not vary among the road types surveyed within sagebrush habitat ($\chi^2 = 0.96$; $p = 0.81$).

2006: In sagebrush habitat, an average of 6.91 (SE = 0.15) birds were counted per point-count. In riparian habitat along Muddy Creek, an average of 12.5 (SE = 0.46) birds were counted per point-count. Fewer birds were observed in Cow Gulch, with an average of 4.5 birds (SE = 0.78) per point-count. The number of birds per point differed among the habitat types ($\chi^2 = 30.62$, $p < 0.0001$), due to higher bird numbers at Muddy Creek (all pairwise comparisons $p < 0.05$). In addition, the bird numbers in Cow Gulch were fewer than found at the county road points and interior points ($p < 0.05$). Within sagebrush, the numbers of birds did not differ among road types ($\chi^2 = 4.88$, $p < 0.1808$).

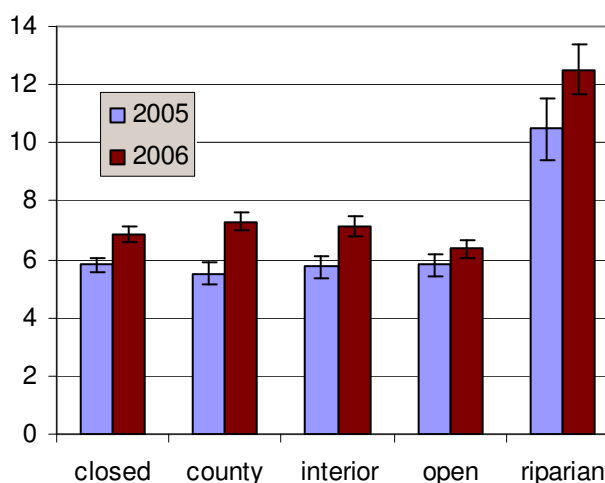


Figure 2. Average number of birds (+/- SE) observed per point-count in the Wolford Mountain Study Area, 2005 and 2006.



Species Richness

The average number of species per point-count (species richness) differed between years ($p = 0.001$), with an average of 3.54 species (SE = 0.10) recorded in 2005 and 3.91 species (SE = 0.10) in 2006 (see Figure 3). Please refer to Appendix B for a full species list of birds by habitat, road type, and year.

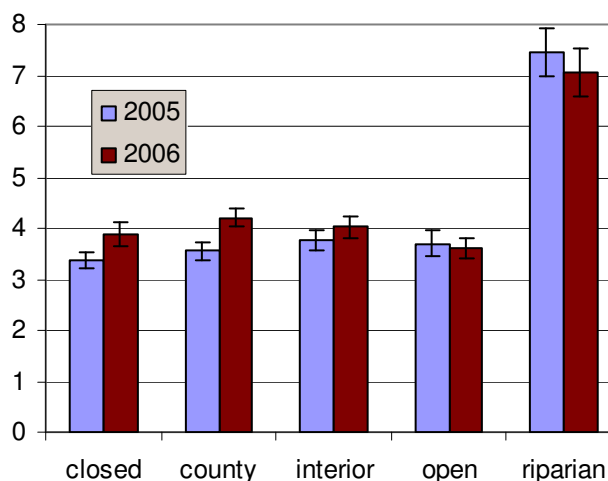


Figure 3. Average number of species (+/- SE) observed per point-count in the Wolford Mountain Study Area, 2005 and 2006.

2005: Forty-two bird species were detected at sagebrush points; 21

species were detected in Cow Gulch and 58 species at Muddy Creek. Average avian species richness per point-count was 3.60 (SE = 0.10) in sagebrush, 5.28 (SE = 0.61) in Cow Gulch and 7.45 (SE = 0.46) at Muddy Creek (see Figure 4). Species richness differed among habitats ($\chi^2 = 51.91$; $p < 0.0001$). Muddy Creek had more species than Cow Gulch ($\chi^2 = 45.00$; $p < 0.0001$) and both supported more species than the sagebrush (Muddy Creek: $\chi^2 = 45.00$; $p < 0.0001$ and Cow Gulch: $\chi^2 = 8.54$; $p = 0.0035$). Species richness did not vary among road types within sagebrush ($\chi^2 = 1.53$; $p = 0.67$).

2006: In sagebrush we detected 50 bird species; we detected 20 species in Cow Gulch and 43 species at Muddy Creek. The average species richness per point-count was 3.93 (SE = 0.10) in sagebrush, 3.92 (SE = 0.48) in Cow Gulch, and 7.05 (SE = 0.28) at Muddy Creek. Species richness differed among habitat types ($\chi^2 = 35.11$; $p < 0.0001$), with more species at Muddy Creek than all other types ($p < 0.05$). Within sagebrush, species richness did not vary among the road types ($\chi^2 = 6.56$; $p = 0.09$), although there was a trend for more species along county roads.

Density Estimates

For the four most abundant species in sagebrush habitat, we estimated densities (birds/ha; Table 1). The density of Brewer's Sparrows did not differ between years (t-ratio = -0.59; $p = 0.56$). However, densities were different for the remaining three species, with higher densities of birds estimated for 2005 (Green-tailed Towhee t-ratio = -5.49, Sage Thrasher t-ratio = -5.21, Vesper Sparrow t-ratio = -7.81, all p 's < 0.001).



Table 1. Density estimates for the four most abundant species in sagebrush at Wolford Mountain, 2005 and 2006, where D=estimated density (birds/ha), followed by lower and upper confidence limits (LCL and UCL), coefficient of variation (CV), and the number of birds in the analysis.

| Name | Year | D | LCL | UCL | CV | N |
|---------------------|------|------|------|------|------|-----|
| Brewer's Sparrow | 2005 | 0.45 | 0.37 | 0.55 | 0.10 | 222 |
| | 2006 | 0.43 | 0.35 | 0.54 | 0.11 | 481 |
| Green-tailed Towhee | 2005 | 0.37 | 0.28 | 0.50 | 0.14 | 154 |
| | 2006 | 0.16 | 0.12 | 0.21 | 0.14 | 185 |
| Vesper Sparrow | 2005 | 0.23 | 0.18 | 0.30 | 0.12 | 171 |
| | 2006 | 0.07 | 0.05 | 0.11 | 0.18 | 129 |
| Sage Thrasher | 2005 | 0.14 | 0.11 | 0.18 | 0.13 | 94 |
| | 2006 | 0.07 | 0.04 | 0.16 | 0.39 | 171 |

In both years, densities did not differ among road types (all p's > 0.05), although there was some evidence that Brewer's Sparrows and Green-tailed Towhees were more abundant in interior points (Figures 4a and 4b).

Figure 4a. 2005.

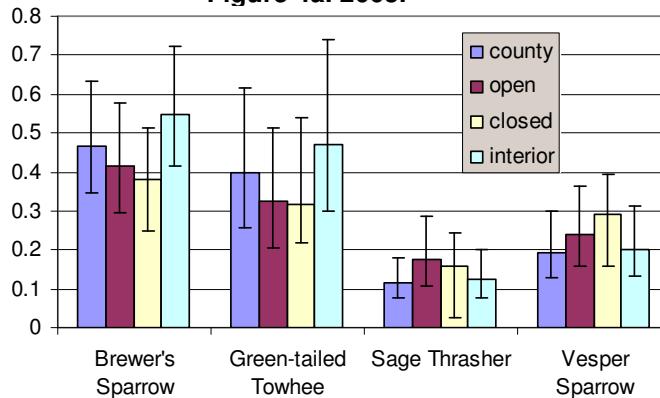
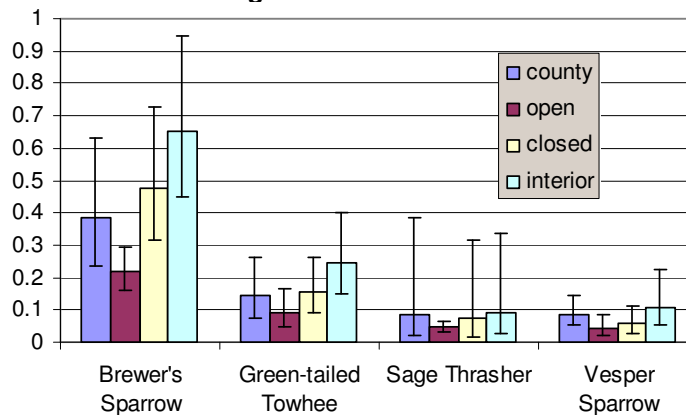


Figure 4b. 2006.



Figures 4a and 4b. Density estimates of the four most abundant species in habitat at Wolford Mountain in 2005 and 2006, respectively, comparing four road types. Error bars indicate 95% confidence intervals.



Species of Interest

In 2006, we documented three Greater Sage-Grouse, one of which was detected along Cow Gulch. This was the only BLM Sensitive Species documented in our surveys. We also documented Bald Eagle, Golden Eagle, Cooper's Hawk, Sharp-shinned Hawk, and Red-tailed Hawk. Along Muddy Creek, perhaps due to high water levels in 2006, we added several wetland-dependent species to the overall species list, including American Coot, Canada Goose, Green-winged Teal, Northern Shoveler, and Wilson's Phalarope.

Seventeen Brown-headed Cowbirds were detected throughout the study area in 2006, at five points in the Muddy Creek riparian area, two county road points, two open road points, one closed local road point, and four interior points. Brown-headed Cowbirds can decrease the reproductive success of other birds, primarily songbirds, by laying eggs in the nests of other species.

Habitat

Roads

The average road width was greater on the county roads, averaging 6.65 m (SE = 0.36) as compared to open local roads at 2.55 m (SE = 0.17) and closed local roads averaging 2.50 m (SE = 0.13). The road surfaces varied as well. Most (90%) of the closed local roads were two-tracks, 67% of the open local roads were two-tracks (1 was gravel, 1 was a single-track, and 6 points were dirt). County roads were primarily dirt (68%), with 16% of points sampled covered by gravel and 16% by asphalt.

Habitat Features

Taller shrubs adjacent to the road were reported at sixteen points, twelve of which were adjacent to county roads. Fences were noted at 35% of the points, dispersed among all point types. Rock outcrops were reported at seven points and a utility line at three points. Drainages were noted at 48% of the points, also dispersed among all road types; water was reported as flowing at the time of the survey at only one point.

Shrubs

A change in protocol between years (restricting the line intercept measure of shrub cover to shrubs at least 0.2 m tall) caused some measures to differ between years. Average shrub heights (all species combined), average percent cover of all shrubs, and average percent cover of sagebrush all varied between 2005 and 2006 ($\chi^2 = 4.82$, $\chi^2 = 20.83$, $\chi^2 = 5.66$, $p = 0.03$, $p < 0.01$, $p = 0.01$, respectively; Table 2). Average height of sagebrush shrubs did not vary between years.



Table 2. Shrub characteristics at bird survey points, Wolford Mountain study area, 2005-2006. Mean heights (m) and cover (%) are followed by standard error in parentheses.

| Year | shrub height | shrub cover | sagebrush height | sagebrush cover |
|------|--------------|--------------|------------------|-----------------|
| 2005 | 0.38 (0.02) | 35.02 (2.14) | 0.43 (0.02) | 24.40 (1.82) |
| 2006 | 0.44 (0.01) | 21.05 (1.51) | 0.44 (0.01) | 18.62 (1.29) |

When controlling for the effect of year, average shrub height, shrub cover, sagebrush height, or sagebrush cover did not differ by road types (F-ratios = 0.24, 0.73, 0.20, 1.34, $p=0.87$, 0.54, 0.89, 0.27, respectively).

Shrub species composition was dominated by sagebrush, followed by rabbitbrush and snowberry (Table 3; see Appendix C for a list of all species). In 2005, we did not distinguish snakeweed from rabbitbrush; in 2006 we noted that both species were present. The higher cover by rabbitbrush in 2005 is explained by the change in protocol; its average height was less than the 0.2 m minimum imposed for sampling in 2006.

Table 3. Shrub species composition recorded at bird survey points in Wolford Mountain study area, 2005-2006 (percent cover, height in meters, and standard error of height).

| Species | Cover | Mean Height | SE (Height) |
|----------------------|-------|-------------|-------------|
| 2005 | | | |
| sagebrush | 70.35 | 0.41 | 0.01 |
| rabbitbrush | 16.36 | 0.17 | 0.00 |
| snowberry | 6.24 | 0.35 | 0.01 |
| mountain mahogany | 2.92 | 0.45 | 0.05 |
| serviceberry | 2.50 | 0.61 | 0.07 |
| juniper | 1.25 | 1.05 | 0.49 |
| 2006 | | | |
| sagebrush | 88.53 | 0.46 | 0.00 |
| snowberry | 4.23 | 0.43 | 0.02 |
| rabbitbrush | 3.44 | 0.31 | 0.01 |
| snakeweed | 1.14 | 0.33 | 0.02 |
| antelope bitterbrush | 1.05 | 0.37 | 0.02 |
| serviceberry | 0.72 | 0.63 | 0.12 |

Ground Layer

Litter (dead plant material) comprised the majority of the ground layer, followed by grass and bare ground (see Figure 5). The average cover values for the ground cover types did not vary among road types with the exception of rock ($\chi^2 = 13.10$; $p = 0.004$), which accounted for more cover near open local roads than near closed and county roads (p 's < 0.05).



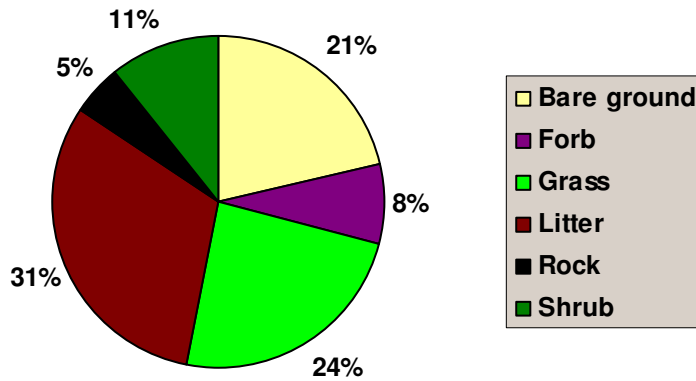


Figure 5. Percent of ground cover by types, at bird survey points in sagebrush in the Wolford Mountain study area, 2005 and 2006.

The species composition of grasses was dominated by western wheatgrass, although 50% of the cover by grasses was not identified to species (Table 4). Grasses averaged 0.20 m in height (SE = 0.27).

Table 4. Species composition of grasses found in bird survey plots, Wolford Mountain study area, 2005-2006.

| Grass Species | N plots | %total cover | mean height (m) |
|--------------------------|---------|--------------|-----------------|
| Unknown | 962 | 0.50 | 0.22 |
| Western wheatgrass | 589 | 0.38 | 0.17 |
| Blue grama | 69 | 0.03 | 0.13 |
| Crested wheatgrass | 34 | 0.03 | 0.18 |
| Idaho fescue | 42 | 0.02 | 0.17 |
| Bluebunch wheatgrass | 33 | 0.02 | 0.18 |
| Poa species | 15 | 0.01 | 0.17 |
| Reed canary grass | 4 | 0.01 | 0.6 |
| Bottlebrush squirreltail | 7 | 0.00 | 0.19 |
| Elk sedge | 5 | 0.00 | 0.13 |
| Indian rice grass | 1 | 0.00 | -- |
| Sulphur buckwheat | 1 | 0.00 | -- |

The species composition of forbs was dominated by *Penstemon* species and moss phlox, with a high proportion of unidentified forbs (Table 5).



Table 5. Species composition of forbs found in bird survey plots, Wolford Mountain study area, 2005-2006.

| Species | %total cover |
|-----------------------|--------------|
| Unknown | 0.33 |
| <i>Penstemon</i> ssp. | 0.18 |
| Moss phlox | 0.16 |
| Bluebells | 0.08 |
| Wood sage | 0.07 |
| Goldenrod | 0.07 |
| Lupine | 0.04 |
| Rayless tansyaster | 0.02 |

Avian Habitat Relationships

Horned Lark, a bird that forages on bare ground, was more commonly observed on points near roads than interior points (both years combined; $\chi^2=59.14$, $p<0.0001$). Interior points hosted fewer Horned Larks than each of the other road types within sagebrush ($p<0.05$). Only five of 63 records (8%) were at interior points.

Avian species richness was negatively related to the proportion of cover by rock (Table 6). The overall numbers of birds per survey point was negatively related to a combination of bare ground and rock, grass, and shrub height. Densities of Vesper Sparrow and Sage Thrasher also were negatively associated with cover by rock. These two species each responded differently to sagebrush height: Sage Thrasher, positively and Vesper Sparrow, negatively. Green-tailed Towhees increased with cover of non-sagebrush shrubs and decreased with bare ground and grass. Brewer's Sparrows were positively associated with cover of shrubs less than 20 cm tall.

Table 6. Habitat factors explaining significant variation (all $p<0.15$) in bird variables at Wolford Mountain Study Area, 2006, based on stepwise regression.

| Avian Response | Model R ² | Habitat Factor | Partial R ² | Effect |
|-----------------------------|----------------------|----------------------|------------------------|----------|
| Average bird numbers | 0.17 | Rock and bare ground | 0.08 | negative |
| | | Grass | 0.05 | negative |
| | | Shrub height | 0.04 | negative |
| Avian species richness | 0.12 | Rock | 0.12 | negative |
| Brewer's Sparrow density | 0.17 | Short shrub cover | 0.17 | positive |
| Green-tailed Towhee density | 0.18 | Non-sage shrub cover | 0.1 | positive |
| | | Bare ground | 0.05 | negative |
| | | Grass | 0.04 | negative |
| Sage Thrasher density | 0.16 | Rock | 0.11 | negative |
| | | Sage height | 0.04 | positive |
| Vesper Sparrow density | 0.23 | Rock | 0.19 | negative |
| | | Sage height | 0.04 | negative |



DISCUSSION

We did not detect an effect of roads on the overall density of birds, avian species richness, or the density of sagebrush birds within sagebrush habitat in the Wolford Mountain project area within either year. This is similar to a study of sagebrush steppe and grassland in Idaho, which also found no evidence that birds avoided small mostly unpaved roads in the Snake River Birds of Prey Area (Rotenberry and Knick 1995). Other studies have documented bird avoidance of roads with heavy traffic volumes (e.g., Rieijnen et al. 1996; Forman et al. 2002) but not along roads with lower traffic volumes (3000-8000 cars/day; Forman et al. 2002). A study examining the effect of roads associated with natural gas extraction in sagebrush habitat in Wyoming found a 39-60% reduced density of Brewer's Sparrows and Sage Sparrows within 100 m of roads with traffic volumes of 10-700 vehicles per day (Ingelfinger and Anderson 2004). The authors argue that while the reductions in bird numbers on their study sites may be minimal, the cumulative effect of roads at landscape scales may be significant, as road impacts are estimated to affect 15-20% of the land area of the United States (Forman 2000).

We found higher levels of species richness and bird abundances in 2006 than in 2005, but lower estimated densities for Green-tailed Towhee, Sage Thrasher, and Vesper Sparrow. These differences may be attributed to differences in the surveyors between years, may reflect short-term shifts in the distribution of birds relative to the study area, or may depict true declines within the study area. Only future work will be able to determine which is most likely. We recommend using data combined from both years to give the most robust depiction of baseline conditions for tracking the effects of travel management in this study system.

In 2006, we estimated the density of Green-tailed Towhees at 0.16 birds/ha, which is approximately equivalent to 0.075 pairs/ha reported by Winternitz (1976) in Dobbs et al. (1998). Reported densities for Brewer's Sparrow are generally higher (0.5-3.5 birds/ha; Rotenberry et al. 1999) than the 0.43-0.45 birds/ha we observed in this study. Other researchers have found that the densities of Brewer's Sparrows fluctuated heavily from year to year, which contrasts with our result of similar densities each year at Wolford Mountain (Rotenberry et al. 1999). For Sage Thrasher, our density of 0.07-0.14 birds/ha is also at the low end of the reported (0.12 -0.88 birds/ha; mean=0.42; Reynolds et al. 1999). For Vesper Sparrow, the only reported density in shrubland was 1.46 birds/ha from a study in Illinois, nearly ten times greater than the 0.07-0.23 birds/ha we estimated at Wolford Mountain (Graber and Graber 1963 in Jones and Cornely 2002).

Consistent with the findings of other bird-monitoring studies, again in 2006 the number of birds and species using the Muddy Creek riparian area far exceeded



the bird abundance found in the sagebrush habitats. In Colorado, riparian habitat hosts a greater diversity of bird species than any other habitat (Kingery 1998). The high numbers and species diversity supported by riparian habitats reinforces the importance of BLM's high level of care in managing riparian areas.

The variation we observed in shrub measurements between years is likely due to our modification to our vegetation measurement protocol. In 2006, we limited our tallies of shrubs along the line intercept to those greater than 0.2 m tall, to better represent the types of shrubs we believed are important to shrub-steppe birds. Shorter shrubs were recorded within the ground layer in our cover plots. Thus, we see taller average heights and lower shrub cover percentages from the line-intercept measures in 2006. For future re-surveys of these bird survey points, we recommend adopting the 2006 protocol, as it provides biologically relevant vegetation data and clear instructions for recording of data in the field.

We found that Horned Larks prefer habitat near roads, accounting for 92% of our observations of the species. Similarly, in sagebrush habitat in Wyoming, Horned Larks also tended to be more abundant near roads (Ingelfinger and Anderson 2004). Horned Larks are probably utilizing the roadways for foraging habitat; they feed on seeds collected on gravel roads (Beason 1995).

We found a number of avian response metrics indicated an avoidance of habitats with a high proportion of cover by rock. This suggests that the rockier locations within the study area provided less suitable sagebrush habitat for the birds we studied. Green-tailed Towhees and also the average counts of all birds together were also negatively associated with bare ground.

Brewer's Sparrows and Sage Thrashers, both sagebrush obligates, have been found to be positively associated with cover by shrubs and bare ground, and negatively associated with grass cover (Rotenberry and Wiens 1980; Wiens and Rotenberry 1981). In another study, Sage Thrashers were positively associated with higher percent cover of sagebrush (Knick and Rotenberry 1995). We found that Brewer's Sparrow was positively associated with cover by short shrubs. Sage Thrasher was not associated with cover by sagebrush, but was related positively to sagebrush heights.

Green-tailed Towhees are not as dependent on sagebrush, utilizing a variety of other montane shrub habitat types. Consistent with this, we found Green-tailed Towhees to be positively associated with cover by non-sagebrush shrubs.

The varying responses of these species to the primary shrub characteristics in the study area suggest habitat partitioning. Sage Thrashers were more abundant with taller shrubs, while Vespers Sparrows were more abundant where shrubs were shorter. Green-tailed Towhees increased with cover of non-



sagebrush shrubs, while Brewer's Sparrows were positively associated with cover of shrubs less than 20 cm tall.

Sagebrush ecosystems have become highlighted for conservation efforts due to conversion of this habitat type by agriculture, development, and invasive species (Knick et al. 2003). Several of the avian species supported at Wolford Mountain are of conservation concern (e.g., Greater Sage-Grouse) or showing widespread declines (e.g., Brewer's Sparrow). Others, such as Green-tailed Towhee, showed declines along 71% of Breeding Bird Survey (BBS) routes in Colorado from 1982-1991 (Dobbs et al. 1998). The Wolford Mountain TMP is an exemplary effort of the BLM in balancing recreational needs with management for natural values.



FUTURE DIRECTION

Because we detected no differences in bird density or species richness among the road strata in these first two years, it is unlikely that we will be able to detect avian responses to road closures, one of the primary objectives of this project. However, because of the randomized survey design, repeated surveys over time (perhaps in five or ten years) following these protocols will allow the BLM to track changes in general bird species composition and abundances within the Wolford Mountain Travel Management Area. We suggest two to three replicate surveys per year to optimize the precision of density estimates. We also believe it is important to investigate whether birds are responding to roads in ways other than can be measured by density or species richness, such as through alterations in nest placement or reproductive success. Such a study would provide valuable scientific information about productivity for species such as Green-tailed Towhee for which little reproductive information is known and would provide more detailed information about road effects for land managers.



LITERATURE CITED

- Beason, R.C. 1995. Horned Lark (*Eremophila alpestris*). In The Birds of North America, No. 195 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Buckland, S. T., D. R. Anderson, et al. 1993. Distance Sampling: Estimating abundance of biological populations. London, Chapman and Hall.
- Canfield, R.H. 1941. Application of the line interception method in sampling range vegetation. Journal of Forestry 39:386-394.
- Daubenmire, R. 1959. A canopy-coverage method of vegetation analysis. Northwest Science 33:43-64.
- Department of Interior. 2004. Bureau of Land Management National Sage-Grouse Habitat Conservation Strategy.
http://www.blm.gov/nhp/spotlight/sage_grouse/docs/Sage-Grouse_Strategy.pdf
- Dobbs, R.C., P.R. Martin, and T.E. Martin. 1998. Green-tailed Towhee (*Pipilo chlorurus*) In The Birds of North America, No. 368 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Forman, R.T. 2000. Estimate of the area affected ecologically by the road system in the United States. Conservation Biology 14(1):31-35.
- Forman, R.T., B. Reineking, and A.M. Hersperger. 2002. Road traffic and nearby grassland bird patterns in a suburbanizing landscape. Environmental Management 29(6):782-800.
- Graber, R.R. and J.W. Graber. 1963. A comparative study of bird populations in Illinois, 1906-1909 and 1956-1958. Illinois Natural Historical Survey Bulletin 28:3.
- Gutzwiller, K.J. and W.C. Barrow Jr. 2003. Bird communities, roads and development: prospects and constraints of applying empirical models. Biological Conservation 113:239-243.
- Holmes, A.L., D.C. Barton, and A. King. 2003. Sagebrush Bird Monitoring Handbook, Version 2.0. Point Reyes Conservation Science: Stinson Beach, CA.
- Ingelfinger, F., and S. Anderson. 2004. Passerine response to roads associated with natural gas extraction in a sagebrush steppe habitat. Western North American Naturalist 64(3):385-395.
- Jones, S.L., and J.E. Cornely. 2002. Vesper Sparrow (*Pooecetes gramineus*) In The Birds of North America, No. 624 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Kingery, H. E. 1998. Colorado Breeding Bird Atlas. Colorado Bird Atlas Partnership and Colorado Division of Wildlife, Denver.



- Knick, S.T., and J.T. Rotenberry. 1995. Landscape characteristics of fragmented shrubsteppe habitats and breeding passerine birds. *Conservation Biology* 9:1059-1071.
- Knick, S.T. 1999. Requiem for a sagebrush ecosystem? *Northwest Science* 73:47-51.
- Knick, S.T., D.S. Dobkin, J.T. Rotenberry, M.A. Schroeder, W.M. Vander Haegen, and C. van Riper III. 2003. Teetering on the edge or too late? Conservation and research issues for avifauna of sagebrush habitats. *Condor*:105:611-634.
- Kremmling Field Office. 2005. Environmental Assessment CO-120-2004-14-EA. Wolford Mountain Travel Management Plan. U.S. Department of Interior Bureau of Land Management: Kremmling, CO.
- Leukering, T., and R. Leivad. 2000. Monitoring Colorado's Birds: Protocols. Unpublished report, Rocky Mountain Bird Observatory, Brighton, CO.
- Paige, C. and S.A. Ritter. 1999. Birds in a sagebrush sea: managing sagebrush habitats for birds. Partners in Flight Western Working Group: Boise, Idaho.
- Reijnen, R., R. Foppen, and H. Meeuwsen. 1996. The effects of traffic on the density of breeding birds in Dutch agricultural grasslands. *Biological Conservation* 75:255-260.
- Reynolds, T.D., T.D. Rich, and D.A. Stevens. 1999. Sage Thrasher (*Oreoscoptes montanus*) In *The Birds of North America*, No. 463 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Rosenstock, S. S., D. R. Anderson, et al. 2002. Landbird Counting Techniques: Current practices and an alternative. *The Auk* 119(1): 46-53.
- Rotenberry, J.T., and S.T. Knick. 1995. Evaluation of bias in roadside point count surveys of passerines in shrubsteppe and grassland habitats in southwestern Idaho. p. 99-101 in C.J. Ralph, R. Sauer, and S. Droege (eds.) *Monitoring bird populations by point count*. USDA Forest Service General Technical Report PSW-GTR-149.
- Rotenberry, J.T., M.A. Patten, and K.L. Preston. 1999. Brewer's Sparrow (*Spizella breweri*). In *The Birds of North America*, No. 390 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.
- Rotenberry, J.T., and J.A. Wiens. 1980. Habitat structure, patchiness, and avian communities in North American steppe vegetation: a multivariate analysis. *Ecology* 61:1228-1250.
- Sauer, J.R., J.E. Hines, G. Gough, I. Thomas, and B.G. Peterjohn. 1997. *The North American Breeding Bird Survey and Analysis*. Version 96:3. Patuxent Wildlife Research Center, Laurel, MD.



- Thomas, L., Laake, J.L., Strindberg, S., Marques, F.F.C., Buckland, S.T., Borchers, D.L., Anderson, D.R., Burnham, K.P., Hedley, S.L., Pollard, J.H., Bishop, J.R.B. and Marques, T.A. 2005. Distance 5.0. Release 2. Research Unit for Wildlife Population Assessment, University of St. Andrews, UK. <http://www.ruwpa.st-and.ac.uk/distance/>.
- Trombulak, S.C., and C.A. Frissell. 2000. Review of the ecological effects of roads on terrestrial and aquatic communities. *Conservation Biology* 14:18-30.
- United States Fish and Wildlife Service. 2004. USFWS to initiate a status review of the Greater Sage-Grouse. USFWS News Release. <http://www.fws.gov>.
- Vander Haegen, W.M., F.C. Dobler, and D.J. Pierce. 2000. Shrubsteppe bird response to habitat and landscape variables in Eastern Washington, U.S.A. *Conservation Biology* 14(4):1145-1160.
- Wiens, J.A., and J.T. Rotenberry. 1981. Habitat associations and community structure of birds in shrubsteppe environments. *Ecological Monographs* 51: 21-41.
- Winternitz, B.L. 1976. Temporal change and habitat preference of some montane breeding birds. *Condor* 78:383-393.



Appendix A. Locations (UTM coordinates) and years sampled for all bird survey points within the Wolford Mountain Project Area, 2005-2006.

| Type | Point | Zone | Easting | Northing | 2005 | | 2006 | |
|-------------|---------|------|---------|----------|-------|------------------|-------|------------------|
| | | | | | Birds | Veg ^a | Birds | Veg ^a |
| Closed Road | CL01 | 13 | 379000 | 4453006 | x | | x | x |
| Closed Road | CL02 | 13 | 378640 | 4452532 | x | | | |
| Closed Road | CL03 | 13 | 385436 | 4451408 | x | | x | |
| Closed Road | CL04 | 13 | 386311 | 4451257 | x | | x | x |
| Closed Road | CL05 | 13 | 384736 | 4450291 | x | | x | x |
| Closed Road | CL06 | 13 | 384869 | 4449089 | x | | x | |
| Closed Road | CL07 | 13 | 382581 | 4448646 | x | | x | |
| Closed Road | CL08 | 13 | 382137 | 4447885 | x | x | x | |
| Closed Road | CL09 | 13 | 381930 | 4447719 | x | | x | x |
| Closed Road | CL10 | 13 | 383431 | 4447651 | x | | x | |
| Closed Road | CL11 | 13 | 384983 | 4446364 | x | | x | x |
| Closed Road | CL12 | 13 | 380932 | 4446090 | x | | x | x |
| Closed Road | CL14 | 13 | 382101 | 4444311 | x | | | |
| Closed Road | CL14-06 | 13 | 381910 | 4444471 | | | x | x |
| Closed Road | CL16 | 13 | 383489 | 4442371 | x | | x | |
| Closed Road | CL19 | 13 | 383160 | 4440568 | x | | | |
| Closed Road | CL19-06 | 13 | 382798 | 4440494 | | | x | x |
| Closed Road | CL21 | 13 | 381737 | 4438590 | x | | | |
| Closed Road | CL22 | 13 | 384592 | 4438126 | x | | x | |
| Closed Road | CL23 | 13 | 384956 | 4436638 | x | x | x | |
| Closed Road | CL24 | 13 | 384798 | 4436161 | x | x | x | |
| Closed Road | CL25 | 13 | 384975 | 4435992 | x | x | x | |
| Closed Road | CL26 | 13 | 385271 | 4436007 | x | x | x | |
| Closed Road | CL27 | 13 | 387172 | 4436122 | x | | x | |
| Closed Road | CL29 | 13 | 387042 | 4435899 | x | x | x | |
| Closed Road | CL30 | 13 | 385964 | 4435045 | x | | x | |
| Closed Road | CL32 | 13 | 384985 | 4434512 | x | | x | x |
| Closed Road | CL33 | 13 | 384306 | 4442544 | x | | x | |
| Closed Road | CL34 | 13 | 386497 | 4449667 | x | x | x | |
| Closed Road | CL35 | 13 | 386202 | 4449688 | x | x | x | |
| Closed Road | CL36* | 13 | | | x | | | |
| Closed Road | CL37 | 13 | 381877 | 4451758 | x | | x | x |
| County Road | CL40 | 13 | 385050 | 4434334 | x | | x | |
| County Road | CY02 | 13 | 384446 | 4453364 | x | | x | |
| County Road | CY03 | 13 | 380934 | 4451457 | x | | x | x |
| County Road | CY04 | 13 | 380164 | 4450935 | x | x | x | x |
| County Road | CY08 | 13 | 380062 | 4449312 | x | x | x | x |
| County Road | CY09 | 13 | 380612 | 4448803 | x | x | x | x |
| County Road | CY10 | 13 | 380732 | 4448435 | x | x | x | x |
| County Road | CY11 | 13 | 383382 | 4445483 | x | | x | x |
| County Road | CY12 | 13 | 385082 | 4444323 | x | | | |
| County Road | CY13 | 13 | 385239 | 4443908 | x | | x | x |



Wolford Mountain Travel Management Plan Migratory Bird Monitoring 2006 Final Report

| Type | Point | Zone | Easting | Northing | 2005 | | 2006 | |
|-------------|-------|------|---------|----------|-------|-------|-------|-------|
| | | | | | Birds | Vege. | Birds | Vege. |
| County Road | CY14 | 13 | 384256 | 4441201 | x | | x | x |
| County Road | CY15 | 13 | 386279 | 4439124 | x | | x | x |
| County Road | CY17 | 13 | 384651 | 4452335 | x | | | |
| County Road | CY22 | 13 | 379917 | 4449445 | x | x | x | |
| County Road | CY23 | 13 | 382039 | 4446579 | x | | x | |
| County Road | CY24 | 13 | 384540 | 4452630 | x | | x | x |
| County Road | CY25 | 13 | 385172 | 4452019 | x | | | |
| County Road | CY26 | 13 | 386786 | 4450797 | x | | x | |
| County Road | CY27 | 13 | 384514 | 4442109 | x | | x | x |
| County Road | CY28 | 13 | 382151 | 4440083 | x | | x | |
| County Road | CY29 | 13 | 384197 | 4436110 | x | | x | |
| County Road | CY30 | 13 | 384417 | 4436253 | x | x | x | |
| County Road | CY32 | 13 | 381921 | 4453106 | x | | x | |
| County Road | CY33 | 13 | 386057 | 4442917 | x | x | x | |
| County Road | CY34 | 13 | 385057 | 4443501 | x | x | x | |
| County Road | CY35 | 13 | 386835 | 4450291 | x | | x | |
| County Road | CY36 | 13 | 386792 | 4450004 | x | | x | |
| County Road | CY37 | 13 | 386688 | 4451301 | x | x | x | |
| County Road | CY38 | 13 | 381180 | 4451469 | x | | x | x |
| County Road | CY39 | 13 | 382205 | 4439337 | x | | | |
| County Road | CY40 | 13 | 385896 | 4443189 | x | x | x | |
| County Road | CY41 | 13 | 385662 | 4437397 | x | x | x | |
| County Road | CY42 | 13 | 382600 | 4453816 | x | | x | |
| Cow Gulch | G01 | 13 | 382493 | 4439171 | x | | x | |
| Cow Gulch | G02 | 13 | 382308 | 4439000 | x | | x | |
| Cow Gulch | G03 | 13 | 382106 | 4438854 | x | | x | |
| Cow Gulch | G04 | 13 | 381901 | 4438709 | x | | x | |
| Cow Gulch | G05 | 13 | 381680 | 4438591 | x | | x | |
| Cow Gulch | G06 | 13 | 381433 | 4438626 | x | | x | |
| Cow Gulch | G07 | 13 | 381272 | 4438817 | x | | x | |
| Interior | IN01 | 13 | 382079 | 4454355 | x | | x | x |
| Interior | IN02 | 13 | 379830 | 4454105 | x | | x | |
| Interior | IN03 | 13 | 383093 | 4453873 | x | | x | |
| Interior | IN04 | 13 | 382982 | 4453605 | x | | x | x |
| Interior | IN05 | 13 | 379579 | 4453354 | x | | x | x |
| Interior | IN06 | 13 | 383329 | 4453354 | x | | x | x |
| Interior | IN07 | 13 | 381076 | 4452608 | x | | x | x |
| Interior | IN08 | 13 | 384585 | 4451359 | x | | | |
| Interior | IN09 | 13 | 382870 | 4450026 | x | x | x | |
| Interior | IN10 | 13 | 385061 | 4449711 | x | | x | |
| Interior | IN11 | 13 | 384034 | 4449078 | x | x | x | |
| Interior | IN12 | 13 | 381841 | 4448902 | x | | x | |
| Interior | IN13 | 13 | 385456 | 4448605 | x | x | x | |
| Interior | IN14 | 13 | 380565 | 4448248 | x | | x | x |
| Interior | IN16 | 13 | 384397 | 4447976 | x | x | x | |



| Type | Point | Zone | Easting | Northing | 2005 | | 2006 | |
|-----------|---------|------|---------|----------|-------|-------|-------|-------|
| | | | | | Birds | Vege. | Birds | Vege. |
| Interior | IN17 | 13 | 381579 | 4447515 | x | x | x | |
| Interior | IN18 | 13 | 383079 | 4447602 | x | | x | |
| Interior | IN19 | 13 | 382823 | 4447295 | x | | x | |
| Interior | IN20 | 13 | 385831 | 4446851 | x | | x | x |
| Interior | IN21 | 13 | 380578 | 4445853 | x | | x | x |
| Interior | IN22 | 13 | 384869 | 4445641 | x | | x | x |
| Interior | IN23 | 13 | 380831 | 4442355 | x | | x | x |
| Interior | IN24 | 13 | 381747 | 4440571 | x | | x | x |
| Interior | IN25 | 13 | 383748 | 4440405 | x | | x | |
| Interior | IN27 | 13 | 386735 | 4438864 | x | | x | x |
| Interior | IN29 | 13 | 386827 | 4437852 | x | | | |
| Interior | IN30 | 13 | 387596 | 4437955 | x | | x | x |
| Interior | IN31 | 13 | 382891 | 4453224 | x | x | x | |
| Interior | IN32 | 13 | 384275 | 4451544 | x | | x | |
| Interior | IN33 | 13 | 383136 | 4451120 | x | x | x | |
| Open Road | OP01 | 13 | 379565 | 4453669 | x | | | |
| Open Road | OP01-06 | 13 | 379519 | 4453875 | | | x | |
| Open Road | OP02 | 13 | 378647 | 4453068 | x | | | |
| Open Road | OP03 | 13 | 382066 | 4452335 | x | | x | x |
| Open Road | OP04 | 13 | 379592 | 4451958 | x | | x | x |
| Open Road | OP05 | 13 | 386715 | 4451830 | x | | x | x |
| Open Road | OP06 | 13 | 382871 | 4450691 | x | | x | |
| Open Road | OP07 | 13 | 384770 | 4448670 | x | x | x | |
| Open Road | OP08 | 13 | 382033 | 4447245 | x | | | |
| Open Road | OP09 | 13 | 383368 | 4447156 | x | | x | x |
| Open Road | OP10 | 13 | 381760 | 4446366 | x | | x | x |
| Open Road | OP11 | 13 | 385352 | 4445886 | x | | | |
| Open Road | OP12 | 13 | 385344 | 4445380 | x | | x | x |
| Open Road | OP13 | 13 | 383398 | 4444495 | x | | x | |
| Open Road | OP13-06 | | 383524 | 4444954 | | | x | |
| Open Road | OP14 | 13 | 381561 | 4443833 | x | | | |
| Open Road | OP14-06 | 13 | 381512 | 4443866 | | | x | x |
| Open Road | OP15 | 13 | 381855 | 4443624 | x | | x | |
| Open Road | OP16 | 13 | 384285 | 4443500 | x | | x | |
| Open Road | OP17 | 13 | 381127 | 4443042 | x | | x | |
| Open Road | OP17-06 | 13 | 380963 | 4443192 | x | | x | |
| Open Road | OP18 | 13 | 384603 | 4443026 | x | | x | |
| Open Road | OP19 | 13 | 382838 | 4441912 | x | | x | |
| Open Road | OP19-06 | 13 | 382746 | 4442092 | x | | x | |
| Open Road | OP20 | 13 | 383801 | 4442332 | x | | x | |
| Open Road | OP22 | 13 | 380300 | 4441834 | x | | x | |
| Open Road | OP23 | 13 | 385985 | 4439200 | x | | x | |
| Open Road | OP24 | 13 | 383288 | 4438726 | x | | x | |
| Open Road | OP25 | 13 | 384452 | 4438876 | x | | x | |
| Open Road | OP26 | 13 | 383504 | 4438417 | x | | x | |



| Type | Point | Zone | Easting | Northing | 2005 | | 2006 | |
|-------------|---------|------|---------|----------|-------|-------|-------|-------|
| | | | | | Birds | Vege. | Birds | Vege. |
| Open Road | OP27 | 13 | 384797 | 4438289 | x | | x | |
| Open Road | OP28 | 13 | 383368 | 4438150 | x | | x | |
| Open Road | OP29 | 13 | 385544 | 4435951 | x | | x | |
| Open Road | OP30 | 13 | 386337 | 4435877 | x | | x | |
| Open Road | OP30-06 | | 386231 | 4436044 | x | | x | |
| Open Road | OP32 | 13 | 382695 | 4441671 | x | | x | |
| Open Road | OP33 | 13 | 382975 | 4441515 | x | | x | |
| Open Road | OP40 | 13 | 384684 | 4434811 | x | | x | |
| Muddy Creek | R01 | 13 | 379964 | 4439370 | x | | x | |
| Muddy Creek | R02 | 13 | 380090 | 4439155 | x | | x | |
| Muddy Creek | R03 | 13 | 379983 | 4438930 | x | | x | |
| Muddy Creek | R04 | 13 | 380210 | 4438828 | x | | x | |
| Muddy Creek | R05 | 13 | 380383 | 4438648 | x | | x | |
| Muddy Creek | R06 | 13 | 380532 | 4438448 | x | | x | |
| Muddy Creek | R07 | 13 | 380637 | 4438223 | x | | x | |
| Muddy Creek | R08 | 13 | 380702 | 4437983 | x | | x | |
| Muddy Creek | R09 | 13 | 380803 | 4437756 | x | | x | |
| Muddy Creek | R10 | 13 | 380859 | 4437508 | x | | x | |
| Muddy Creek | R11 | 13 | 380974 | 4437284 | x | | x | |
| Muddy Creek | R12 | 13 | 381215 | 4437221 | x | | x | |
| Muddy Creek | R13 | 13 | 381456 | 4437155 | x | | x | |
| Muddy Creek | R14 | 13 | 381542 | 4436920 | x | | x | |
| Muddy Creek | R15 | 13 | 381749 | 4436782 | x | | x | |
| Muddy Creek | R16 | 13 | 381951 | 4436928 | x | | x | |
| Muddy Creek | R17 | 13 | 382178 | 4436823 | x | | x | |
| Muddy Creek | R18 | 13 | 382418 | 4436890 | x | | x | |
| Muddy Creek | R19 | 13 | 382667 | 4436861 | x | | x | |
| Muddy Creek | R20 | 13 | 382901 | 4436844 | x | | x | |

^a Vegetation sampling



Appendix B. Bird species observed in the Wolford Mountain Project Area, May-July 2005 and 2006, listed in taxonomic order. Sage = sagebrush habitat, CG = cow gulch, and MC = Muddy Creek riparian habitat.

| Common Name | Scientific Name | 2005 | | | 2006 | | | Total |
|------------------------|----------------------------------|------|----|----|------|----|----|-------|
| | | Sage | CG | MC | Sage | CG | MC | |
| Canada Goose | <i>Branta canadensis</i> | | | | | | 8 | 8 |
| Gadwall | <i>Anas strepera</i> | | | 12 | | | 12 | 24 |
| American Wigeon | <i>Anas americana</i> | | | 3 | 1 | | 3 | 7 |
| Mallard | <i>Anas platyrhynchos</i> | | | 4 | | | 3 | 7 |
| Cinnamon Teal | <i>Anas cyanoptera</i> | | | 5 | | | 2 | 7 |
| Northern Shoveler | <i>Anas clypeata</i> | | | | | | 2 | 2 |
| Green-winged Teal | <i>Anas crecca</i> | | | | | | 3 | 3 |
| Common Merganser | <i>Mergus merganser</i> | | | 3 | | | 4 | 7 |
| Greater Sage-Grouse | <i>Centrocercus urophasianus</i> | 3 | | | 2 | 1 | | 6 |
| Pied-billed Grebe | <i>Podilymbus podiceps</i> | | | 6 | | | | 6 |
| American White Pelican | <i>Pelecanus erythrorhynchos</i> | | | | 2 | | | 2 |
| Great Blue Heron | <i>Ardea herodias</i> | | | 3 | | | | 3 |
| Turkey Vulture | <i>Cathartes aura</i> | | | | 1 | | | 1 |
| Bald Eagle | <i>Haliaeetus leucocephalus</i> | | | 2 | 2 | | | 4 |
| Sharp-shinned Hawk | <i>Accipiter striatus</i> | | | | 1 | | | 1 |
| Cooper's Hawk | <i>Accipiter cooperii</i> | | | | 1 | | | 1 |
| Red-tailed Hawk | <i>Buteo jamaicensis</i> | 5 | 1 | 6 | 15 | 3 | 3 | 33 |
| Golden Eagle | <i>Aquila chrysaetos</i> | | | 1 | 2 | | | 3 |
| American Kestrel | <i>Falco sparverius</i> | 2 | | 2 | | | | 4 |
| Prairie Falcon | <i>Falco mexicanus</i> | | 1 | 1 | | | | 2 |
| Sora | <i>Porzana carolina</i> | | | 5 | | | 1 | 6 |
| American Coot | <i>Fulica americana</i> | | | | | | 5 | 5 |
| Killdeer | <i>Charadrius vociferus</i> | | | 7 | 2 | | 2 | 11 |
| Spotted Sandpiper | <i>Actitis macularia</i> | | | 1 | | | | 1 |
| Wilson's Snipe | <i>Gallinago delicata</i> | | | 6 | 6 | | 1 | 13 |
| Wilson's Phalarope | <i>Phalaropus tricolor</i> | | | | | | 3 | 3 |
| Mourning Dove | <i>Zenaida macroura</i> | 13 | 3 | 1 | 3 | | 6 | 26 |
| Common Nighthawk | <i>Chordeiles minor</i> | 5 | | | 3 | | | 8 |
| Common Poorwill | <i>Phalaenoptilus nuttallii</i> | | | 1 | 1 | | | 2 |
| Belted Kingfisher | <i>Ceryle alcyon</i> | | | 1 | | | | 1 |
| Northern Flicker | <i>Colaptes auratus</i> | 16 | 1 | 8 | 18 | 4 | 9 | 56 |
| Western Wood-Pewee | <i>Contopus sordidulus</i> | | | 8 | | | 6 | 14 |
| Willow Flycatcher | <i>Empidonax traillii</i> | | | 8 | | | | 8 |
| Gray Flycatcher | <i>Empidonax wrightii</i> | | 1 | 2 | 2 | | 3 | 8 |
| Dusky Flycatcher | <i>Empidonax oberholseri</i> | 1 | | | 10 | 1 | 1 | 13 |
| Western Kingbird | <i>Tyrannus verticalis</i> | | | | 1 | | 1 | 2 |
| Warbling Vireo | <i>Vireo gilvus</i> | 8 | 1 | 11 | 2 | 1 | 3 | 26 |
| Clark's Nutcracker | <i>Nucifraga columbiana</i> | 2 | | | | | | 2 |
| Black-billed Magpie | <i>Pica hudsonia</i> | 18 | 5 | 40 | 38 | 2 | 15 | 118 |
| American Crow | <i>Corvus brachyrhynchos</i> | 3 | | 1 | 2 | | | 6 |



Wolford Mountain Travel Management Plan Migratory Bird Monitoring 2006 Final Report

| | | | | | | | | |
|-------------------------------|--------------------------------------|-----|---|----|-----|---|----|-----|
| Common Raven | <i>Corvus corax</i> | 27 | 5 | 3 | 47 | 4 | 4 | 90 |
| Horned Lark | <i>Eremophila alpestris</i> | 19 | | | 65 | | | 84 |
| Tree Swallow | <i>Tachycineta bicolor</i> | | | 2 | | | 1 | 3 |
| Violet-green Swallow | <i>Tachycineta thalassina</i> | 3 | 1 | 27 | 11 | 1 | 3 | 46 |
| Northern Rough-winged Swallow | <i>Stelgidopteryx serripennis</i> | | | 17 | 1 | | 9 | 27 |
| Cliff Swallow | <i>Petrochelidon pyrrhonota</i> | | | 36 | 1 | | 2 | 39 |
| Barn Swallow | <i>Hirundo rustica</i> | | | 1 | 14 | | | 15 |
| Black-capped Chickadee | <i>Poecile atricapillus</i> | | | 1 | | | | 1 |
| Mountain Chickadee | <i>Poecile gambeli</i> | 0 | 1 | 1 | 2 | | | 4 |
| Red-breasted Nuthatch | <i>Sitta canadensis</i> | | | | 1 | | | 1 |
| Rock Wren | <i>Salpinctes obsoletus</i> | 59 | 8 | 15 | 61 | 8 | 4 | 155 |
| House Wren | <i>Troglodytes aedon</i> | 20 | 1 | 10 | 1 | | 4 | 36 |
| Ruby-crowned Kinglet | <i>Regulus calendula</i> | 1 | | | 1 | | | 2 |
| Blue-gray Gnatcatcher | <i>Poliptila caerulea</i> | 1 | 1 | | | | | 2 |
| Mountain Bluebird | <i>Sialia currucoides</i> | 11 | 3 | 1 | 12 | 2 | | 29 |
| Hermit Thrush | <i>Catharus guttatus</i> | 1 | | | | | | 1 |
| American Robin | <i>Turdus migratorius</i> | 14 | 5 | 17 | 6 | 4 | 7 | 53 |
| Gray Catbird | <i>Dumetella carolinensis</i> | | | 1 | | 2 | | 3 |
| Sage Thrasher | <i>Oreoscoptes montanus</i> | 122 | 1 | 4 | 192 | 2 | | 321 |
| European Starling | <i>Sturnus vulgaris</i> | | | 12 | | | 10 | 22 |
| Yellow Warbler | <i>Dendroica petechia</i> | 2 | | 13 | 5 | 1 | 17 | 38 |
| Common Yellowthroat | <i>Geothlypis trichas</i> | | | 6 | 4 | | 4 | 14 |
| Wilson's Warbler | <i>Wilsonia pusilla</i> | | | 1 | | | | 1 |
| Yellow-breasted Chat | <i>Icteria virens</i> | | | | | | 1 | 1 |
| Green-tailed Towhee | <i>Pipilo chlorurus</i> | 162 | | 1 | 214 | 3 | | 380 |
| Chipping Sparrow | <i>Spizella passerina</i> | 1 | 1 | | 1 | | | 3 |
| Brewer's Sparrow | <i>Spizella breweri</i> | 238 | 3 | | 527 | 9 | | 777 |
| Vesper Sparrow | <i>Poocetes gramineus</i> | 179 | | | 141 | 8 | | 328 |
| Savannah Sparrow | <i>Passerculus sandwichensis</i> | 3 | | | 2 | | | 5 |
| Song Sparrow | <i>Melospiza melodia</i> | 2 | 2 | 29 | 2 | | 23 | 58 |
| Lincoln's Sparrow | <i>Melospiza lincolni</i> | | | 1 | | | | 1 |
| Dark-eyed Junco | <i>Junco hyemalis</i> | 1 | | | 2 | 2 | | 5 |
| Black-headed Grosbeak | <i>Pheucticus melanocephalus</i> | | | 1 | | | 1 | 2 |
| Red-winged Blackbird | <i>Agelaius phoeniceus</i> | 5 | | 22 | 7 | | 37 | 71 |
| Western Meadowlark | <i>Sturnella neglecta</i> | 20 | | 7 | 48 | | | 75 |
| Yellow-headed Blackbird | <i>Xanthocephalus xanthocephalus</i> | | | 1 | 2 | | 9 | 12 |
| Brewer's Blackbird | <i>Euphagus cyanocephalus</i> | 6 | | 16 | 31 | 2 | 6 | 61 |
| Common Grackle | <i>Quiscalus quiscula</i> | | | 1 | | | | 1 |
| Brown-headed Cowbird | <i>Molothrus ater</i> | 7 | | 12 | 11 | | 6 | 36 |
| Bullock's Oriole | <i>Icterus bullockii</i> | 1 | | 6 | | | 2 | 9 |
| Pine Siskin | <i>Carduelis pinus</i> | | 1 | 2 | | | | 3 |
| American Goldfinch | <i>Carduelis tristis</i> | | 3 | 1 | | | 2 | 6 |



Appendix C. List of plants observed in the Wolford Mountain Project Area, May-July 2005 and 2006. Nomenclature follows USDA PLANTS database.

| Latin Name | Common Name |
|-------------------------------------|--------------------------|
| <i>Achillea lanulosa</i> | Yarrow |
| <i>Achnatherum hymenoides</i> | Indian rice grass |
| <i>Agropyron cristatum</i> | Crested wheatgrass |
| <i>Agropyron spicatum</i> | Bluebunch wheatgrass |
| <i>Amelanchier alnifolia</i> | Serviceberry |
| <i>Androsace septentrionalis</i> | Rock jasmine |
| <i>Arctostaphylos uva-ursi</i> | Kinnikinnik |
| <i>Artemisia tridentata</i> | Big sagebrush |
| <i>Bouteloua gracilis</i> | Blue grama |
| <i>Brassica sp.</i> | Mustard |
| <i>Bromus tectorum</i> | Cheatgrass |
| <i>Carex garberi</i> | Elk sedge |
| <i>Cercocarpus sp.</i> | Mountain mahogany |
| <i>Chrysohamnus vicidiflorus</i> | Green rabbitbrush |
| <i>Comandra umbellata</i> | Bastard toadflax |
| <i>Cryptantha fulvocanescens</i> | Tawny cryptantha |
| <i>Elymus elymoides</i> | Squirreltail |
| <i>Eriogonum sp.</i> | Buckwheat |
| <i>Eriogonum umbellatum</i> | Sulphur-flower buckwheat |
| <i>Festuca idahoensis</i> | Idaho fescue |
| <i>Geranium sp.</i> | Geranium |
| <i>Gutierrezia sarothrae</i> | Broom snakeweed |
| <i>Juniperus sp.</i> | Juniper |
| <i>Lupinus sp.</i> | Lupine |
| <i>Machaeranthera grindelioides</i> | Rayless tansyaster |
| <i>Mahonia repens</i> | Oregon grape |
| <i>Mertensia lanceolata</i> | Prairie bluebells |
| <i>Mertensia ssp</i> | Bluebells |
| <i>Opuntia sp.</i> | Prickly pear |
| <i>Packera aurea</i> | Golden ragwort |
| <i>Pascopyrum smithii</i> | Western wheatgrass |
| <i>Pediocactus simpsonii</i> | Hedgehog cactus |
| <i>Penstemon caespitosus</i> | Mat penstemon |
| <i>Penstemon sp.</i> | Penstemon |
| <i>Phalaris arundinacea</i> | Reed canary grass |
| <i>Phlox hoodii</i> | Carpet phlox |
| <i>Poa sp.</i> | Bluegrass |
| <i>Populus tremuloides</i> | Aspen |
| <i>Prunus virginiana</i> | Chokecherry |
| <i>Pseudotsuga menzeiesii</i> | Douglas fir |
| <i>Pulsatilla patens</i> | Pasqueflower |
| <i>Purshia tridentata</i> | Antelope bitterbrush |
| <i>Rosa woodsii</i> | Wood's rose |
| <i>Sarcobatus vermiculatus</i> | Greasewood |
| <i>Solidago sp.</i> | Goldenrod |
| <i>Symphoricarpos oreophilus</i> | Mountain snowberry |

