AVIAN SURVEY ON EMERALD MOUNTAIN SPECIAL RECREATION MANAGEMENT AREA: 2012 FIELD SEASON REPORT

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ROCKY MOUNTAIN BIRD OBSERVATORY

***Mission**: To conserve birds and their habitats*

***Vision**: Native bird populations are sustained in healthy ecosystems*

***Core Values**:*

1. ***Science** provides the foundation for effective bird conservation.*
2. ***Education** is critical to the success of bird conservation.*
3. ***Stewardship** of birds and their habitats is a shared responsibility.*

RMBO accomplishes its mission by:

- ***Monitoring** long-term bird population trends to provide a scientific foundation for conservation action.*
- ***Researching** bird ecology and population response to anthropogenic and natural processes to evaluate and adjust management and conservation strategies using the best available science.*
- ***Educating** people of all ages through active, experiential programs that create an awareness and appreciation for birds.*
- ***Fostering** good stewardship on private and public lands through voluntary, cooperative partnerships that create win-win situations for wildlife and people.*
- ***Partnering** with state and federal natural resource agencies, private citizens, schools, universities, and other non-governmental organizations to build synergy and consensus for bird conservation.*
- ***Sharing** the latest information on bird populations, land management and conservation practices to create informed publics.*
- ***Delivering** bird conservation at biologically relevant scales by working across political and jurisdictional boundaries in western North America.*

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***Cover Photo**:*

Emerald Mountain Special Recreation Management Area from Bureau of Land Management, Colorado-Little Snake Field Office website

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EXECUTIVE SUMMARY

The Rocky Mountain Bird Observatory (RMBO), in conjunction with the Bureau of Land Management (BLM), conducted landbird monitoring throughout the Emerald Mountain Special Recreation Management Area (EMSRMA) located near Steamboat Springs, CO in 2012. This project used a sampling framework and survey protocol implemented in portions of 12 states as part of a program entitled "Integrated Monitoring in Bird Conservation Regions (IMBCR) to develop a baseline inventory of the breeding bird community on EMSRMA. The IMBCR design allows the estimation of density and occupancy rates for avian species on EMSRMA and establishes the basis for a future monitoring program that would provide managers better information on distribution and abundance of avian species.

In 2012, RMBO completed 20 planned surveys, resulting in 227 point counts conducted. Surveys were conducted between 4 June and 28 June. We observed 2,978 individuals of 88 species. For every bird detected during a six-minute count at each point, observers recorded the species; sex; horizontal distance from the observer; minute and type of detection (e.g., call, song, visual); whether the bird was thought to be a migrant; and whether the observer was able to visually identify each record. Incidental observations of breeding behavior were recorded. Of the 88 species detected, 12 species were confirmed nesting and moderate evidence of breeding was witnessed for an additional 16 species.

Surveyors recorded the primary habitat type that best described the 50 m radius surrounding each point count. Eight of nine primary habitat types occurring on the EMSRMA were represented at the sampling points. Other vegetation data recorded included the percent relative abundance, percent cover and mean height of tree and shrub species in the overstory and shrub layer, and grass height and ground cover types.

Using the RIMBCR package for Program R designed by Paul Lukacs, we estimated densities and occupancy rates of 73 species occurring on the EMSRMA while accounting for the incomplete detection of individuals present. Results can be viewed by visiting the Avian Data Center at http://rmbo.org/v3/avian/ExploretheData.aspx. The following web link leads directly to the Avian Data Center with the appropriate filters already populated for EMSRMA (Stratum - CO-BCR16-EM): Emerald Mountain.

A RMBO staff member conducted a survey on 29 June for the yellow-billed cuckoo (*Coccyzus americanus*) (western population proposed for listing as a threatened species by the U.S. Fish and Wildlife Service) at a 4 km long transect along Cow Creek on the western boundary of the EMSRMA. A recorded yellow-billed cuckoo call was broadcast at 41 point stations spaced every 100 m. No yellow-billed cuckoos were detected.

Continued monitoring on EMSRMA with the IMBCR design is recommended. Using the IMBCR design for future monitoring efforts allows for robust statistical analyses, including the estimation of detectability and population trends. The IMBCR program is well suited for future monitoring on EMSRMA because detections from other surveys in the Colorado portion of BCR 16 can be leveraged when estimating detection probabilities and population trends for individual species. The IMBCR program also readily produces regional occupancy and density estimates for many of the species found on EMSRMA. These regional estimates act as ecologically and geographically relevant regions for comparison providing insight as to whether changes in the avian community within EMSRMA are due to local management actions and habitat changes or driven by large-scale issues such as climate change.

ACKNOWLEDGEMENTS

Funding for this project was provided by the Bureau of Land Management (BLM). Gail Martinez of the BLM was instrumental in providing the funding to conduct the monitoring work. Rob Sparks of the Rocky Mountain Bird Observatory (RMBO) implemented sample selection. We also thank field technicians David Pavlacky, Nick Van Lanen and Craig Dodson for collecting the point count data in 2012. Finally, this report benefitted from review by RMBO Staff.

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INTRODUCTION

Birds can be excellent indicators of biological integrity and ecosystem health (Morrison 1986, Hutto 1998, O'Connell et al. 2000, Rich 2002, U.S. EPA 2002, Birdlife International 2003). Birds comprise a diverse group of niche specialists, occupy a broad range of habitats, are relatively easy to monitor and are sensitive to both physical and chemical impacts on the environment. They are useful barometers for environmental change and measuring the sustainability of human activities on ecosystems.

Monitoring is an essential component of wildlife management and conservation science (Witmer 2005, Marsh and Trenham 2008). Common goals of population monitoring are to estimate the population status of target species and to detect changes in populations over time (Thompson et al. 1998, Sauer and Knutson 2008). Effective monitoring programs can identify species that are at-risk due to small or declining populations (Dreitz et al. 2006), provide an understanding of how management actions affect populations (Alexander et al. 2008, Lyons et al. 2008), evaluate population responses to landscape alteration and climate change (Baron et al. 2008, Lindenmayer and Likens 2009) as well as provide basic information on species distributions and occurrence.

The last known study to inventory avian species on or near Emerald Mountain Special Recreation Management Area (hereafter EMSRMA) was conducted in 2003 and 2004 (Western Ecological Resource 2005 and U.S.BLM 2006). A list of migratory birds potentially present in Routt County, Colorado and on the EMSRMA was developed after evaluating the distribution of bird species and their likelihood of occurrence based on information contained in the Colorado Breeding Bird Atlas and on-line at the Colorado Parks and Wildlife Natural Diversity Information Source website.

Changes to the vegetative and bird community are expected to occur over time on the EMSRMA as the result of the spread of exotic plant species, disturbance, natural succession, and resource management. As such, periodic avian monitoring to assess the impacts of landscape changes on the bird community can be particularly instructive. To provide a baseline inventory of the breeding bird community on EMSRMA and to establish the basis for a future monitoring program that would provide managers with better information on distribution and abundance of avian species, Rocky Mountain Bird Observatory (RMBO) conducted point counts using the "Integrated Monitoring in Bird Conservation Regions (IMBCR)" design (White et al. 2013).

Broadcast-point counts were conducted for yellow-billed cuckoo (*Coccyzus americanus*) (western population proposed for listing as a threatened species by the U.S. Fish and Wildlife Service) utilizing a sampling design and protocol based on "Standard Operating Procedures: Conducting Yellow-billed Cuckoo Surveys" (Beason 2010).

METHODS

Study Area

The study area was defined as the area contained by the EMSRMA boundary. EMSRMA is located about 2 miles southwest of Steamboat Springs, Colorado (Figure 1). It spans approximately 4,139 acres (approximately 17 km^2) with an elevation range of 6,720 to 8,240 feet. EMSRMA is in Bird Conservation Region (BCR) 16 (Southern Rockies and Colorado

Plateau) representing one of 37 distinct ecological regions in North America. EMSRMA is inhabited by a mixture of agricultural grassland, sage and mixed shrublands, aspen, lodgepole pine, subalpine fir forest, and riparian-wetland habitats (U.S.BLM 2006).

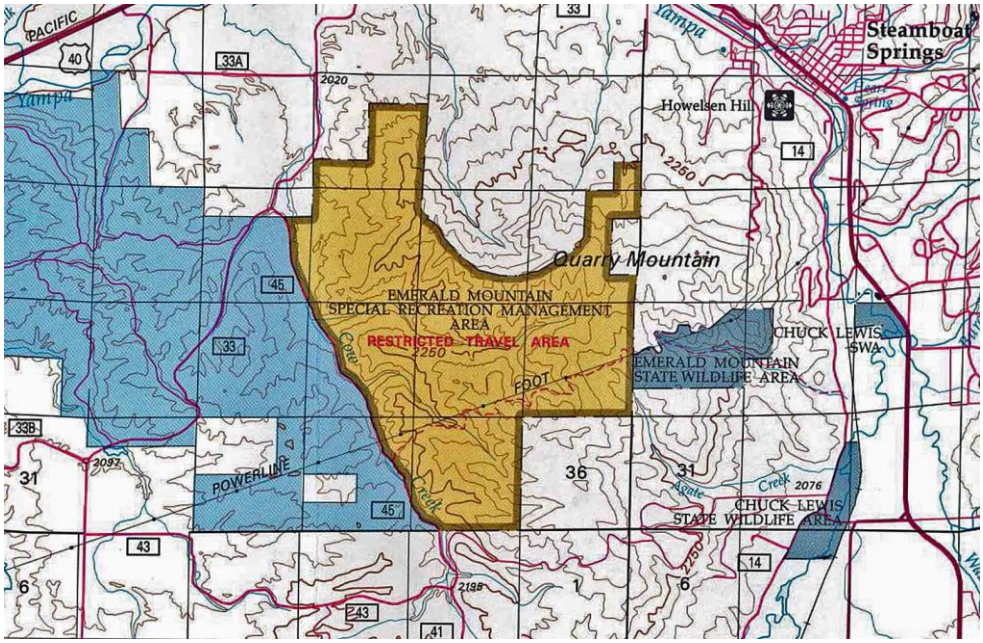

Figure 1. Locality map of Emerald Mountain Special Recreation Management Area

Sampling Design

Avian Surveys

Sampling Units

The IMBCR design defines sampling units as 1-km^2 cells, each containing 16 evenly-spaced sample points, 250 m apart (Figure 2).

Figure 2. Image of an Integrated Monitoring in Bird Conservation Regions (IMBCR) 1-km^2 sample cell containing 16 sample points arranged in a 4 X 4 matrix.

Sampling Frame

We constructed the sampling frame by superimposing a 1-km^2 U. S. National Grid (FGDC 2001) on to the EMSRMA boundary within a Geographic Information System (ESRI 2010). We defined the sampling frame as all 1-km^2 grid cells which were contained within or intersected the EMSRMA boundary (Figure 3).

Sample Selection
We selected all 28 1-km^2 grid cells in the sampling frame for sampling during the 2012 field season. However, only sample points representing point count locations within the EMSRMA boundary were available for surveying (Figure 3).

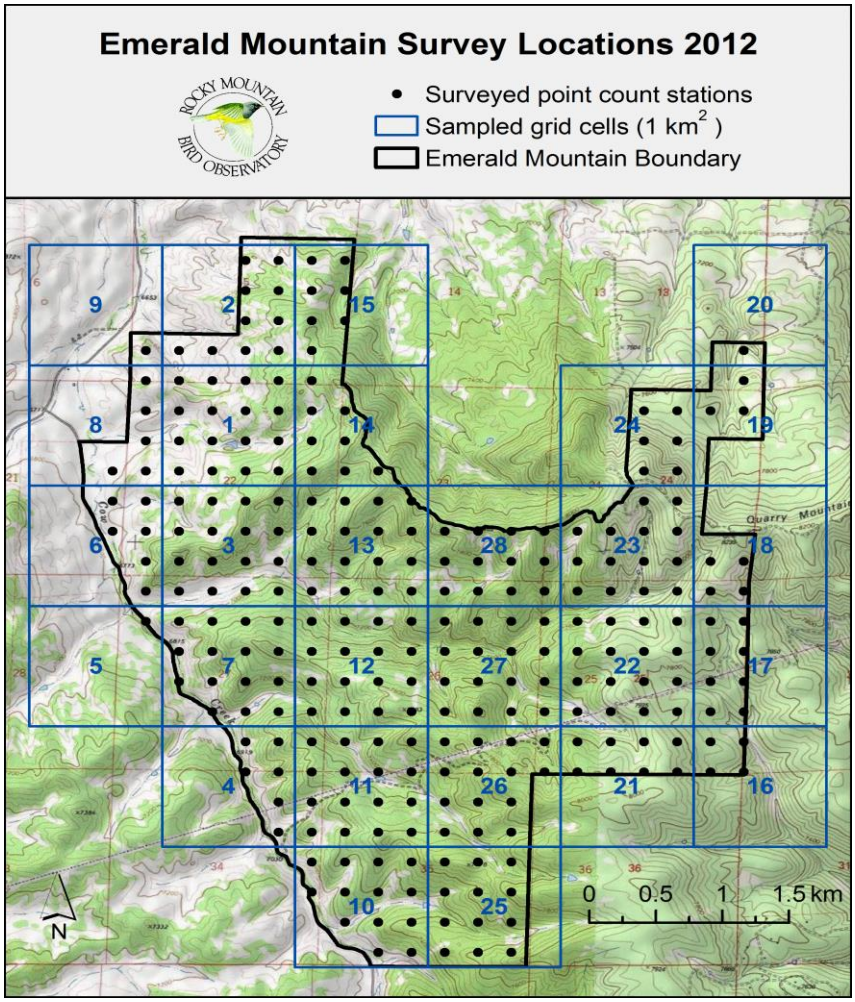

Figure 3. Sample grid cells and individual point count stations surveyed within the Emerald Mountain Special Recreation Management Area during the 2012 field season.

Yellow-billed Cuckoo Surveys
A 4 km long transect with 41 broadcast-point stations spaced every 100 m was established along Cow Creek and Road 45 on the western boundary of EMSRMA based on a survey design described in (Beason 2010). The start and end points on the transect were roughly 390 m south of the junction of Roads 33 and 45 and 500 m north of the junction of Roads 45 and 43, respectively.

Sampling Methods

Avian Surveys
Surveyors with excellent aural and visual bird identification skills conducted field work between 4 June 2012 and 28 June 2012. Of the 270 point count locations available to be sampled within the EMSRMA boundary, the field technicians surveyed 227 points (84%). When a grid cell contained 16 point count stations we attempted to collect data at all points within the cell in a single morning. At times, multiple grid cells with less than 16 point count stations were surveyed in a single morning. Of 270 point count locations available for sampling, 43 points were not visited due to time restraints or decreased bird activity.

We conducted point counts using a Distance sampling framework (Buckland et al. 2001) following a field protocol for spatially balanced sampling of landbird populations established by IMBCR partners (Hanni et al. 2012). We conducted avian counts in the morning, beginning ½-hour before sunrise and concluding no later than 5 hours after sunrise. We recorded the start time for every point count conducted. The count duration was six minutes. For every bird detected during the six-minute period, we recorded the species; sex; horizontal distance from the observer; minute and type of detection (e.g., call, song, visual); whether the bird was thought to be a migrant; and whether the observer was able to make a visual identification. Incidental observations of breeding behavior were also recorded.

Distance to each bird was measured using laser rangefinders. When it was not possible to measure the distance to a bird, we estimated the distance by measuring to some nearby object. We recorded birds flying over but not using the immediate surrounding landscape. Birds detected by field technicians while traveling between points within a sample cell were recorded. These opportunistic observations were used for the development of a species inventory for the EMSRMA and distribution mapping purposes.

We considered all non-independent detections of birds (i.e., flocks or pairs of conspecific birds together in close proximity) as part of a “cluster” rather than as independent observations. We recorded the number of birds detected within each cluster along with a letter code to distinguish between multiple clusters.

At the start and end of each survey, we recorded time, ambient temperature, cloud cover, precipitation and wind speed. We navigated to each point using hand-held Global Positioning System units. Before beginning each six-minute point count, we recorded vegetation data represented within a 50 m radius of the point. Vegetation data included the primary habitat type that best described the 50 m radius surrounding the point; percent relative abundance, percent canopy cover and mean height of tree species in the overstory; total percent coverage, mean height and percent relative abundance of woody species in the shrub layer; as well as grass height and ground cover types. We recorded vegetation data quietly to allow time for birds to return to their normal habits prior to beginning each count.

For more detailed information about survey methods and vegetation data collection protocols, refer to the Integrated Monitoring of Bird Conservation Regions Field Protocol on the Avian Data Center website at http://rmbo.org/v3/avian/DataCollection.aspx.

Yellow-billed Cuckoo Surveys
A RMBO staff member conducted a yellow-billed cuckoo survey at the Cow Creek transect on 29 June 2012. Broadcast-point counts were conducted at 41 points following a field protocol and call-playback technique recommended for the detection of secretive species described in

Beason (2010). Following a one minute waiting period after arriving at each point to listen for unsolicited cuckoo calls, five recorded cuckoo *kowlp* calls each spaced one minute apart were broadcasted to elicit a vocal response and to lure cuckoos closer to the observer so they could be seen. In the intervening minute after each broadcasted call the surveyor listened and watched for cuckoos responding to the broadcast.

Broadcast-point counts were conducted in the morning, beginning at 0525 hr. (15 minutes before sunrise) and concluding at 1157 hr. We recorded the start time, point number and the Universal Transverse Mercator (UTM) coordinates for every broadcast-point count conducted. At the start and end of each survey, we recorded time, ambient temperature, cloud cover, precipitation and wind speed. The observer navigated to each point using a hand-held Global Positioning System unit.

Data Analysis

Raw counts of individuals by species from the point count surveys including birds detected between point count stations within a grid cell were totaled for EMSRMA. Breeding behavioral data for avian species detected on EMSRMA were compiled from the field data sheets. The primary habitat type represented at each point count on EMSRMA was queried out from raw vegetation data recorded at each point count.

Although not an objective of this study, we estimated density and occupancy for 73 species detected within EMSRMA using the new RIMBCR package in Program R (R Core Team 2012) developed by Paul Lukacs of the University of Montana for the IMBCR program. The data analysis methodology can be found in White et al. (2013).

RESULTS

We completed 20 planned surveys, with 227 point counts conducted. We observed 2,978 individual birds of 88 species (Table 1). The five most common species detected were Warbling Vireo (*Vireo gilvus*), Green-tailed Towhee (*Pipilo chlorurus*), House Wren (*Troglodytes aedon*), Dusky Flycatcher (*Empidonax oberholseri*), and Dark-eyed Junco (*Junco hyemalis*). Of the 88 species detected, 11 species are considered species of concern by Partner's In Flight in BCR 16 (Partners In Flight 2012) or are designated by the U.S. Fish and Wildlife Service as species of conservation concern in BCR16 (U.S.FWS 2008). Two species are considered sensitive species in Colorado by the BLM (U.S.BLM 2000) (Table 1).

Table 1. Number of individual birds detected by species at Emerald Mountain Special Recreation Management Area during the 2012 field season. Bird Conservation Region (BCR) 16 species of concern designated by Partner's In Flight (PIF) or U.S. Fish and Wildlife Service (USFWS) species of conservation concern in BCR16 are bolded.

Species	2012 Count	Species	2012 Count
Warbling Vireo	259	Turkey Vulture	9
Green-tailed Towhee	245	**Brewer's Sparrow[b] (PIF)**	8
House Wren	193	Brewer's Blackbird	7
Dusky Flycatcher	139	Hairy Woodpecker	7
Dark-eyed Junco	132	Red-tailed Hawk	7
Yellow Warbler	123	Red-winged Blackbird	7

Species	2012 Count	Species	2012 Count
American Robin	116	White-breasted Nuthatch	7
Western Wood-Pewee	107	Brown Creeper	6
Mountain Chickadee	101	**Cassin's Finch (PIF,USFWS)**	6
Yellow-rumped Warbler	98	Cordilleran Flycatcher	6
Orange-crowned Warbler	92	Black-billed Magpie	5
Western Tanager	91	Blue-gray Gnatcatcher	5
Brown-headed Cowbird	82	Hammond's Flycatcher	5
Mourning Dove	78	Sandhill Crane	5
Violet-green Swallow	73	Cedar Waxwing	4
Ruby-crowned Kinglet	72	Gray Jay	4
American Goldfinch	69	Red Crossbill	4
Red-breasted Nuthatch	54	Swainson's Hawk	4
Broad-tailed Hummingbird	53	Bullock's Oriole	3
MacGillivray's Warbler	48	**Common Nighthawk (PIF)**	3
Black-capped Chickadee	47	Western Kingbird	3
Chipping Sparrow	46	Band-tailed Pigeon	2
Hermit Thrush	45	Cooper's Hawk	2
Northern Flicker	42	Gray Catbird	2
Veery (USFWS)	38	Green-winged Teal[a]	2
Swainson's Thrush	35	Lark Sparrow	2
Lincoln's Sparrow	34	Rufous Hummingbird (migrant)	2
Spotted Towhee	34	Say's Phoebe	2
American Crow	26	Song Sparrow	2
Steller's Jay	26	Townsend's Solitaire	2
Tree Swallow	26	American Kestrel	1
Pine Siskin (PIF)	23	American Three-toed Woodpecker	1
Red-naped Sapsucker	23	Belted Kingfisher	1
Western Meadowlark	23	**Black-throated Gray Warbler (PIF)**	1
Common Raven	17	**Common Poorwill (PIF)**	1
Olive-sided Flycatcher (PIF)	16	**Lewis's Woodpecker (PIF,USFWS)**	1
Black-headed Grosbeak	15	Mallard	1
Evening Grosbeak	13	Northern Goshawk[a,b]	1
Vesper Sparrow	13	Northern Rough-winged Swallow[a]	1
Downy Woodpecker	12	Savannah Sparrow[a]	1
Lazuli Bunting (PIF)	12	White-throated Swift	1
Plumbeous Vireo	12	Wilson's Snipe[a]	1
Dusky Grouse	10	Williamson's Sapsucker	1
White-crowned Sparrow	10	Total Number of Individuals	2978
Mountain Bluebird (PIF)	9		

[a] Incidental observation between points within a grid cell
[b] BLM sensitive species in Colorado

To view interactive maps and tables showing survey and detection locations, species counts, and density and occupancy results, please visit RMBO's Avian Data Center (ADC) at http://rmbo.org/v3/avian/ExploretheData.aspx. The ADC enables comparisons of density and occupancy estimates of bird species for EMSRMA to the Colorado portion of BCR 16. Instructions for using the Avian Data Center are available on the Avian Data Center at http://rmbo.org/v3/avian/ExploretheData/UsageTips.aspx. The following web link leads directly to the Avian Data Center with the appropriate data fields already populated for EMSRMA (Stratum - CO-BCR16-EM): Emerald Mountain.

No yellow-billed cuckoos were detected during avian point count surveys or the Cow Creek broadcast-point counts within the EMSRMA.

Eight primary habitat types, as defined by RMBO and described in U.S.BLM (2006), were represented within a 50 meter radius surrounding point counts on the EMSRMA (Table 2). Although agricultural grassland occurs on EMSRMA (U.S.BLM 2006), this habitat type was not prominent within a 50 meter radius surrounding point counts. The two most common primary habitat types at point counts were mixed shrubland and aspen.

Table 2. Primary habitat type that best described the 50 m radius surrounding point counts on Emerald Mountain Special Recreation Management Area in 2012.

Primary habitat	No. of point counts
Aspen	52
Insect Infested	2
Lodgepole Pine	3
Mixed Conifer	11
Spruce-Fir	23
Sage Shrubland	3
Mixed Shrubland	119
Riparian	14
Total	227

Aspen - ≥50% aspen with ≥10% canopy (≥3.0 m tall) cover
Insect Infested – forested habitat with ≥10% of the overstory (≥3.0 m tall) dead or sickly (typically referring to pine bark beetle) and canopy cover ≥10%
Lodgepole Pine - ≥10% canopy cover dominated by lodgepole pine
Mixed Conifer – forested habitat with several species of conifers (or if dominated by Douglas-fir) and ≥10% canopy cover
Spruce-Fir – coniferous forest dominated by spruce and fir species with ≥10% canopy (≥3.0 m tall) cover
Sage Shrubland – grasses and shrubs are co-dominant with shrub cover ≥20% and shrub species consisting of ≥30% sagebrush
Mixed Shrubland – co-dominated by grass and shrub species with ≥20% shrub cover and sagebrush <30% of shrub layer
Riparian – stands or strips of trees or shrubs near a permanent or seasonal water source, typical tree and shrub species include cottonwood, box elder, maple, aspen, alder and willow

Aspen grove on Emerald Mountain Special Recreation Management Area, 16 Jun 2012

Of the 88 species documented on the EMSRMA, 11 species were confirmed nesting (either juveniles or nest observed) (Table 3). Moderate evidence of breeding (male and female pair) was recorded for 13 species.

Table 3. Indications of breeding status for avian species detected on Emerald Mountain Special Recreation Management Area in 2012. Behavior codes are as follows: Nst = Active nest observed; Br = Brood observed; and Pr = Pair (male and female). Behaviors leading to the determination of the breeding status are bolded. Habitat = Primary habitat type that best described the 50 m radius surrounding the point count where breeding behavior was detected: AS = Aspen; LP = Lodgepole Pine; MC = Mixed Conifer; MSH = Mixed Shrubland; OR = On Road; RI = Riparian; and SF = Spruce-Fir.

Species	Behavior	Breeding status	Habitat	Date
Cooper's Hawk	**Nst**	Confirmed Nesting	AS	06/28
Dusky Flycatcher	**Nst**	Confirmed Nesting	MSH	06/08
Dusky Grouse	**Br**	Confirmed Nesting	OR	06/27
Green-tailed Towhee	**Nst**	Confirmed Nesting	MSH	06/14
MacGillivary's Warbler	**Nst**	Confirmed Nesting	MC	06/13
Plumbeous Vireo	**Nst**	Confirmed Nesting	RI	06/11
Plumbeous Vireo	**Nst**	Confirmed Nesting	MSH	06/13
Spotted Towhee	**Nst**, Pr	Confirmed Nesting	MSH	06/14
Swainson's Hawk	**Nst**, Pr	Confirmed Nesting	AS	06/05
Violet-green Swallow	**Nst**, Pr	Confirmed Nesting	MSH	06/15
Warbling Vireo	**Nst**	Confirmed Nesting	AS	06/14
Western Wood-Pewee	**Nst**	Confirmed Nesting	RI	06/11
American Goldfinch	**Pr**	Moderate Evidence	AS	06/04
Dark-eyed Junco	**Pr**	Moderate Evidence	LP	06/26

Species	Behavior	Breeding status	Habitat	Date
Dark-eyed Junco	**Pr**	Moderate Evidence	AS	06/27
Dark-eyed Junco	**Pr**	Moderate Evidence	SF	06/17
Green-winged Teal	**Pr**	Moderate Evidence	MSH	06/13
House Wren	**Pr**	Moderate Evidence	RI	06/04
Mountain Bluebird	**Pr**	Moderate Evidence	RI	06/04
Mountain Chickadee	**Pr**	Moderate Evidence	AS	06/28
Mountain Chickadee	**Pr**	Moderate Evidence	AS	06/28
Mourning Dove	**Pr**	Moderate Evidence	MSH	06/14
Orange-crowned Warbler	**Pr**	Moderate Evidence	AS	06/28
Red-breasted Nuthatch	**Pr**	Moderate Evidence	SF	06/19
Red-naped Sapsucker	**Pr**	Moderate Evidence	AS	06/27
Red-winged Blackbird	**Pr**	Moderate Evidence	MSH	06/05
Western Tanager	**Pr**	Moderate Evidence	AS	06/27
Yellow-rumped Warbler	**Pr**	Moderate Evidence	AS	06/17

Swainson's hawk nest in an aspen tree on Emerald Mountain Special Recreation Management Area, 5 Jun 2012

Dusky flycatcher nest in a chokecherry shrub at Emerald Mountain Special Recreation Management Area, 8 June 2012

DISCUSSION

The 88 bird species detected during this project indicates a rich breeding bird community with high species diversity on the EMSRMA. The towhee and sparrow family Emberizidae (7 species), woodpecker family Picidae (7 species), thrush family Turdidae (6 species) and the warbler family Parulidae (5 species) were particularly well represented. In addition to 11 species of concern, we encountered two game species, Dusky Grouse (*Dendragapus obscurus*) and Band-tailed Pigeon (*Patagioenas fasciata*). We observed a high degree of vegetation heterogeneity with eight vegetation types within EMSRMA. The high number of bird species observed in the EMSRMA may be related the high degree of vegetation heterogeneity (Tews et al. 2004). The data collected in this study could be used to determine important keystone vegetation types (Tews et al. 2004) and to manage their configuration and composition. Our results suggest the EMSRMA is an important area for the conservation of avian biodiversity and recreational opportunity in the region.

Given that birds are easy to study, act as excellent indicators of vegetation condition, and readily respond to changes in vegetation structure, we recommend that avian monitoring continue on EMSRMA to better inform managers on the impacts of succession, disturbance, resource management and the introduction of exotic species on the bird community. We recommend the BLM utilize a randomly-selected design that allows for robust statistical analyses, including the estimation of detectability and population trends, for any future monitoring efforts. We believe the IMBCR program is particularly well suited for future monitoring on EMSRMA because detections from other surveys conducted annually in the Colorado portion of the BCR 16 can be leveraged when estimating detection probabilities for individual species. The inclusion of these additional detections from the IMBCR program greatly improves the precision of population estimates. The IMBCR program also readily produces regional occupancy and density estimates for many of the species found on EMSRMA. These

regional estimates can act as ecologically and geographically relevant regions for comparison. The ability to make comparisons of occupancy and density estimates between EMSRMA and surrounding, similar, areas will provide insight as to whether changes in the avian community within EMSRMA are due to local management actions and habitat changes or driven by large-scale issues such as climate change and availability of stop-over and wintering habitat.

LITERATURE CITED

Alexander, J. D., J. L. Stevens, G. R. Geupel, and T. C. Will. 2008. Decision support tools: bridging the gap between science and management. 13 February-16 February, 2008.

Baron, J. S., S. H. Julius, J. M. West, L. A. Joyce, G. Blate, C. H. Peterson, M. Palmer, B. D. Keller, P. Kareiva, J. M. Scott, and B. Griffith. 2008. Some guidelines for helping natural resources adapt to climate change. International Human Dimensions Programme on Global Environmental Change Update 2:46-52.

Beason, J. P. 2010. Standard Operating Procedure (SOP) #3: Conducting Yellow-billed Cuckoo Surveys. Rocky Mountain Bird Observatory, Brighton, Colorado. 11pp.

Birdlife International. 2003. Biodiversity Indicator for Europe: Population Trends of Wild Birds. http://www.birdlife.org/action/science/indicators/pdfs/eur_biodiversity_indicators.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2001. Introduction to distance sampling: estimating abundance of biological populations. Oxford University Press, Oxford, UK.

Dreitz, V. J., P. M. Lukacs, and F. L. Knopf. 2006. Monitoring low density avian populations: An example using Mountain Plovers. Condor 108:700-706.

Environmental Systems Research Institute (ESRI). 2010. ArcGIS, version 10.0. Environmental Systems Research Institute, Incorporated, Redlands, California, USA.

Federal Geographic Data Committee (FGDC). 2001. United States National Grid (USNG). Federal Geographic Data Committee, Reston, Virginia, USA.

Hanni, D. J., C. M. White, R.A. Sparks, J. A. Blakesley, J. J. Birek, N.J. Van Lanen, J.A. Fogg, J.M. Berven, and M.A. McLaren. 2012. Integrated Monitoring of Bird Conservation Regions (IMBCR): Field protocol for spatially-balanced sampling of landbird populations. Unpublished report. Rocky Mountain Bird Observatory, Brighton, CO. 39 pp.

Hutto, R. L. 1998. Using landbirds as an indicator species group. Pp. 75-92 in J. M. Marzluff and R. Sallabanks (eds.), Avian Conservation: Research and Management. Island Press, Washington, DC.

Lindenmayer, D. B., and G. E. Likens. 2009. Adaptive monitoring: a new paradigm for long-term research and monitoring. Trends in Ecology and Evolution 24:482-486.

Lyons, J. E., M. C. Runge, H. P. Laskowski, and W. L. Kendall. 2008. Monitoring in the context of structured decision-making and adaptive management. Journal of Wildlife Management 72:1683-1692.

Marsh, D. M., and P. C. Trenham. 2008. Current trends in plant and animal population monitoring. Conservation Biology 22:647-655.

Morrison, M. L. 1986. Bird populations as indicators of environmental change. Current Ornithology 3:429-451.

O'Connell, T. J., L. E. Jackson, and R. P. Brooks. 2000. Bird guilds as indictors of ecological condition in the central Appalachians. Ecological Applications 10:1706-1721. Partners In Flight. 2005. Species Assessment Database. http://www.rmbo.org/pif/pifdb.html

Partners in Flight Science Committee. 2012. Species Assessment Database, version 2012. Available at: http://rmbo.org/pifassessment. [Accessed January 2014].

Rich, T. D. 2002. Using breeding land birds in the assessment of western riparian systems. Wildlife Society Bulletin 30(4):1128-1139.

Sauer, J. R., and M. G. Knutson. 2008. Objectives and metrics for wildlife monitoring. Journal of Wildlife Management 72:1663-1664.

Tews, J., U. Brose, V. Grimm, K. Tielbörger, M. C. Wichmann, M. Schwager, and F. Jeltsch. 2004. Animal species diversity driven by habitat heterogeneity/diversity: the importance of keystone structures. Journal of Biogeography 31:79-92.

Thompson, W. L., G. C. White, and C. Gowan. 1998. Monitoring vertebrate populations. Academic Press, San Diego, California, USA.

U.S. Bureau of Land Management (U.S.BLM). 2000. Colorado BLM State Director's Sensitive Species List (Animals and Plants). <http://www.blm.gov/co/st/en/BLM_Programs/botany/Sensitive_Species_List_.html>. [Accessed January 2014]

_____. 2006. Environmental Assessment: Emerald Mountain Land Exchange. USDI-BLM Website, Little Snake Field Office, Craig, Colorado.

U.S. Fish and Wildlife Service (U.S.FWS). 2008. Birds of Conservation Concern 2008. U.S. Department of Interior, Fish and Wildlife Service, Division of Migratory Bird Management, Arlington, Virginia.

U.S. Environmental Protection Agency (U.S. EPA). 2002. Methods for evaluating wetland condition: biological assessment methods for birds. Office of Water, U.S. Environmental Protection Agency, Washington. D.C. EPA-822-R-02-023.

Western Ecological Resource. 2005. Biological Assessment, Emerald Mountain Land Exchange, Routt and Moffat Counties, Colorado. Prepared for: U.S. Department of the Interior, Bureau of Land Management, Little Snake Field Office, Craig, Colorado.

White, C. M., N. J. Van Lanen, D.C. Pavlacky Jr., J. A. Blakesley, R. A. Sparks, M. F. McLaren, J. J. Birek and D. J. Hanni. 2013. Integrated Monitoring in Bird Conservation Regions (IMBCR): 2012 Annual Report. Rocky Mountain Bird Observatory, Brighton, Colorado, USA.

Witmer, G. W. 2005. Wildlife population monitoring: some practical considerations. Wildlife Research 32:259-263.