Avian Monitoring On Private Ranches in Montana, Nebraska, and South Dakota: 2015 Field Season Report

January 2016

Connecting People, Birds and Land

Bird Conservancy of the Rockies
14500 Lark Bunting Lane
Brighton, CO 80603
303.659.4348
www.birdconservancy.org
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The Bird Conservancy of the Rockies

Connecting people, birds and land

Mission: Conserving birds and their habitats through science, education and land stewardship

Vision: Native bird populations are sustained in healthy ecosystems

Bird Conservancy of the Rockies conserves birds and their habitats through an integrated approach of science, education and land stewardship. Our work radiates from the Rockies to the Great Plains, Mexico and beyond. Our mission is advanced through sound science, achieved through empowering people, realized through stewardship and sustained through partnerships. Together, we are improving native bird populations, the land and the lives of people.

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.

Goals

1. Guide conservation action where it is needed most by conducting scientifically rigorous monitoring and research on birds and their habitats within the context of their full annual cycle.
2. Inspire conservation action in people by developing relationships through community outreach and science-based, experiential education programs.
3. Contribute to bird population viability and help sustain working lands by partnering with landowners and managers to enhance wildlife habitat.
4. Promote conservation and inform land management decisions by disseminating scientific knowledge and developing tools and recommendations.

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Chestnut-collared Longspur by Bill Schmoker (used with permission)

Contact Information:
Nick Van Lanen nick.vanlanen@birdconservancy.org
Duane Pool duane.pool@birdconservancy.org
Bird Conservancy of the Rockies
14500 Lark Bunting Lane
Brighton, CO 80603
(303) 659-4348

EXECUTIVE SUMMARY

Grasslands represent some of the most endangered ecosystems on the planet due to widespread conversion for agricultural use, energy development, and housing. The Northern Great Plains represents one of the last remaining intact temperate grasslands in the world. As such, it provides important habitat for many declining species of grassland birds. The World Wildlife Fund (WWF), and partners, has created a Sustainable Ranching Initiative to increase awareness to the conservation value and provide an economic incentive for sustainably managed ranches. This effort may prevent future conversion of these grasslands for anthropogenic use. The Bird Conservancy of the Rockies (formerly the Rocky Mountain Bird Observatory; hereafter, the Bird Conservancy), in conjunction with the World Wildlife Fund (WWF) and the Intermountain Bird Observatory (IBO), conducted landbird monitoring on private ranches within the Montana portion of Bird Conservation Region (BCR) 11, the Nebraska portion of BCR 19, and the South Dakota portion of BCR 17 to demonstrate the relative habitat value of sustainable private ranches. This landbird monitoring effort used a spatially-balanced sampling design and a survey protocol consistent with a program entitled “Integrated Monitoring in Bird Conservation Regions” (IMBCR). The IMBCR design allows inferences regarding avian species occurrence and population sizes from local to regional scales; including states and Bird Conservation Regions (BCR). By using a design compatible with the IMBCR program, estimates for WWF-affiliated ranches in Montana, Nebraska, and South Dakota can be compared to nearby regional estimates to determine if avian populations on the private WWF-affiliated ranches are similar to regional populations. In this way, the WWF can evaluate the relative habitat value of privately-owned ranches which implement sustainable ranching practices compared to the surrounding landscape. We report population estimates for three unique WWF-affiliated ranch strata. Additionally, we report population estimates for individual strata that were produced via the IMBCR program, are primarily comprised of privately-owned land, and are located in close regional proximity to the WWF-affiliated ranches for comparison. Finally, we report regional population estimates produced via the IMBCR program for the Montana portion of BCR 11, the South Dakota portion of BCR 17, and the area-weighted mean of two sampled strata within the Nebraska portion of BCR 19 to provide other biologically meaningful extents for comparison. In 2015, the Bird Conservancy and IBO surveyed 38 1-km^2 grid cells on WWF-affiliated private ranches across three strata. These surveys resulted in 482 individual point counts between 19 May and 12 July, 2015. Field technicians observed 7,235 individuals of 111 bird species during the surveys on WWF-affiliated ranches.

ACKNOWLEDGEMENTS

We thank the World Wildlife Fund (WWF) for providing the funding for this project. Stratification and allocation of survey effort were determined in collaboration with Kevin Ellison of WWF. Kevin also obtained permission from the private landowners incorporated in this study. Without the cooperation and assistance of the private landowners this project would not have been possible. We also wish to thank the landowners for their hospitality and insight regarding accessing survey locations. We acknowledge the Bird Conservancy of the Rockies IT personnel who managed and updated the secure database where data are stored and created the data entry system used to input data. Rob Sparks of the Bird Conservancy of the Rockies implemented the GRTS sample selection. Brittany Woiderski produced the maps presented in this report. We thank Gary White, professor emeritus of Colorado State University, who wrote the initial SAS code and implemented the multi-scale occupancy model in program MARK and Paul Lukacs of the University of Montana who wrote code in program R to automate data analysis for density and occupancy estimates. We thank Jeff Laake for implementing the multi-scale occupancy model in the RMark package which aided in the automation of the analyses. We thank Kelli Turner and Bob Paulson of The Nature Conservancy for providing excellent new training facilities at the Whitney Preserve for the northern monitoring effort. Staff and Intermountain Bird Observatory, including Christian Meny, oversaw the field data collection effort on private lands in Montana. We also thank all of the field technicians that collected data for this project. Finally, this report benefited from review by staff at Bird Conservancy of the Rockies and the WWF.

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INTRODUCTION

Grasslands represent some of the most endangered ecosystems on the planet (White et al. 2000). The temperate grasslands of the Great Plains are no exception, with less than 4% of tallgrass prairie in the Great Plains estimated to be intact as of 1994 (Samson and Knopf 1994). More than two decades later, that number is likely further reduced. Habitat loss in the Great Plains has been largely linked to agricultural conversion, energy development, and urbanization (Hoekstra et al. 2005).

The Northern Great Plains (NGP) makes up about 25% of the Great Plains and represents one of the last remaining intact temperate grasslands in the world. It remains largely intact due, in part, to the harsh climate, which has made agricultural expansion relatively difficult. Much of the best remaining grassland within the NGP lies on private lands used for cattle ranching operations. Today, ranchers face new challenges resulting from an increasingly complex environment, competing against new crop technologies, significant economic pressures, and a changing climate. These new challenges to ranchers threaten the future of these remaining private, intact, grasslands as ranchers seek economic viability to support themselves and their families.

The World Wildlife Fund (WWF) is currently working with ranchers across the NGP (including Montana, Nebraska, South Dakota, and Alberta) to promote practices that maintain healthy grasslands, viable wildlife populations, and economic and cultural benefits for ranchers in order to prevent the conversion of ranchlands to agriculture, energy development, urbanization, or other anthropogenic uses. To achieve this goal, WWF has created a Sustainable Ranching Initiative to bring awareness to the conservation value of ranchlands. Acknowledging the value of working ranches as wildlife habitat and raising awareness of this fact may result in economic incentives for ranching operations which can help them remain economically viable long-term. In doing so, remaining intact habitat within the NGP may be protected from agricultural conversion or other anthropogenic landscape changes.

Together, with partners, the WWF has chosen to use avian populations as one measure of wildlife habitat quality. Birds have long been considered excellent indicators of biological integrity and ecosystem health (Morrison 1986, Hutto 1998, O'Connell et al. 2000, Rich 2002, US EPA 2002). They 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.

In order for avian population metrics to be used to accurately reflect habitat quality, sound program designs and analytic methods are necessary to produce unbiased population estimates (Sauer and Knutson 2008). At the most fundamental level, reliable knowledge about the status of avian populations requires accounting for spatial variation and incomplete detection of the target species (Pollock et al. 2002, Rosenstock et al. 2002, Thompson 2002). Addressing spatial variation entails the use of probabilistic sampling designs that allow population estimates to be extended over the entire area of interest (Thompson et al. 1998). Adjusting for incomplete detection involves the use of appropriate sampling and analytic methods to address the fact that few, if any, species are so conspicuous that they are detected with certainty during surveys, even when present (Pollock et al. 2002, Thompson 2002). Accounting for these two sources of variation ensures observed trends reflect true population changes rather than artifacts of sampling and observation processes.

In order to provide the WWF and Sustainable Ranching Initiative with unbiased and reliable information regarding avian communities on ranchlands and the surrounding landscape, the Bird Conservancy of the Rockies (formerly the Rocky Mountain Bird Observatory; hereafter the Bird Conservancy) utilized a probabilistic sampling design based on the "Integrated Monitoring in Bird Conservation Regions (IMBCR)" (White et al. 2014) program for this study. Important properties of the IMBCR design and program that relate to this study are:

- Samples are placed on the landscape irrespective of roadways and other landscape features.
- Sampling methods and analytical procedures account for the incomplete detection of individuals on the landscape.
- Local population estimates and trends can be directly compared to regional scales.
- Leveraging data from the entire IMBCR program increases the number of species for which robust population estimates can be derived.
- Population estimates produced while leveraging data from the IMBCR program are more precise than what could be estimated with an isolated, stand-alone, monitoring effort due to the extensive data set incorporated in analyses.

In order to evaluate the relative importance of private ranchlands within the NGP region in relation to the surrounding landscape, the Bird Conservancy conducted avian monitoring on private ranches using a design and methods consistent with, and in conjunction with, the annual monitoring efforts of the IMBCR program. The goals of this effort are to:

1) Directly compare species density and occupancy rates on private ranches to those of the surrounding landscape.
2) Provide the raw data necessary to compare variation in habitat variables and avian populations across ranches.
3) Provide the raw avian and habitat data necessary to develop habitat relationship models and predictive distribution maps.

METHODS

Study Area

Private ranchlands were surveyed in three counties of Montana (Blaine, Phillips, and Valley), two counties in Nebraska (Cherry and Hooker), and four counties in South Dakota (Harding, Perkins, Butte, and Meade). Surveyed lands within each state fell within a distinct Bird Conservation Region (BCR):

Montana ranches occurred within BCR 11 (Prairie Potholes), which consists of mixed grass prairie in the west, tall grass prairie in the east and thousands of small wetlands scattered across its geographical extent (US North American Bird Conservation Initiative 2000). About 70% of BCR 11's original grasslands have been converted to agriculture, but large tracts of grassland still exist on larger ranches and on preserved land (Prairie Pothole Joint Venture 2005). BCR 11 covers portions of Montana, North Dakota, South Dakota, Minnesota, Nebraska, Iowa, Alberta, Saskatchewan and Manitoba.

Nebraska ranches occurred within BCR 19 (Central Mixed-grass Prairie). BCR 19 lies between shortgrass prairie to the west and tallgrass prairie to the east (US North American Bird Conservation Initiative 2000). This region consists of a mixture of shortgrass and tallgrass prairie habitats, with some native and hand-planted Ponderosa Pine forests in northwestern Nebraska. BCR 19 runs north-south from the southern border of South Dakota through Nebraska, Kansas and Oklahoma down into north-central Texas.

South Dakota ranches occurred within BCR 17 (Badlands and Prairies) which is characterized by rolling plains and mixed-grass prairie that contain large, continuous, tracts of intact dry grassland managed predominately as ranchland (US North American Bird Conservation Initiative 2000). The Black Hills and western portions of BCR 17 contain pine and spruce forests at higher elevations. BCR 17 covers portions of five states: Montana; North Dakota; South Dakota; Wyoming, and Nebraska.

The Montana portion of BCR 11, Nebraska portion of BCR 19, and South Dakota portion of BCR 17 have moderate to extensive on-going sampling under the IMBCR program.

Sampling Design

Sampling Frame and Stratification

Using a design consistent with the IMBCR program, the Bird Conservancy identified three distinct strata for songbird monitoring on WWF-affiliated ranches. Each stratum represented private ranches that were available for sampling within a single Bird Conservation Region and state. The Montana stratum (MT-WWFRA-WT) represented ranchlands available for sampling within Bird Conservation Region 11 (Prairie Potholes). The South Dakota stratum (SD-WWFRA-SW) represented ranchlands available for sampling within Bird Conservation Region 17 (Badlands and Prairies). The Nebraska stratum (NE-WWFRA-NW) represented ranchlands available for sampling within Bird Conservation Region 19 (Central Mixed-grass Prairie). Ranchlands defining the extent for each of these three strata were identified and included in the study on an opportunistic basis through contacts with cattlemen's organizations (Ranchers Stewardship Alliance, Sandhills Task Force, and South Dakota Grassland Coalition) as well as biologists with Pheasants Forever and the Bird Conservancy.

> A key component of the IMBCR design is the ability to infer across spatial scales, from small management units, such as individual national forests or BLM field offices, to entire states and BCRs. This is accomplished through hierarchical (nested) stratification, which allows data from smaller-order strata to be combined to make inferences about higher-order strata. (White et al. 2015)

For example, data from each individual stratum within the South Dakota portion of BCR 17 can be combined to produce avian population estimates for that geographic extent.

We defined IMBCR strata based on areas to which IMBCR partners wanted to make inferences. Smaller-order strata within BCRs were identified using fixed attributes such as land ownership boundaries, elevation zones, major river systems, and wilderness/roadless designations.
We combined smaller-order strata within a BCR (BCR 17), the intersection of BCR and state (the Montana portion of BCR 11), or sampled strata within the intersection of BCR and state (Samuel R. McKelvie National Forest and Nebraska National Forest – Bessey District) to provide regional geographic area for comparison.

We considered two individual strata (All Other Lands in SD BCR 17 and MT BCR 11) to be reasonable strata for comparison to the Montana and South Dakota WWF-affiliated ranch strata because they are largely representative of private lands within the respective regions. Unfortunately, no stratum representing private lands was sampled within the Nebraska portion of BCR 19.

Sampling Units

The IMBCR design defined sampling units as 1 km^2 cells, each containing 16 evenly-spaced sample points, 250 meters apart (Figure 1). We defined potential sampling units by superimposing a uniform grid of cells over each state in the study area, then we assigned each cell to a stratum using ARCGIS versions 9.2 and higher (Environmental Systems Research Institute 2006). (White et al. 2015)

Sample Selection

Within IMBCR strata and the three WWF ranchland strata, the Bird Conservancy used generalized random-tessellation stratification (GRTS), a spatially-balanced sampling algorithm, to select sample units (Stevens and Olsen 2004). The GRTS design has several appealing properties with respect to long-term monitoring of birds at large spatial scales:

Figure 1. IMBCR 1- km^2 sample cell containing 16 survey points arranged in a 4 X 4 matrix.

- Spatially-balanced sampling is generally more efficient than simple random sampling of natural resources (Stevens and Olsen 2004). Incorporating information about spatial autocorrelation in the data can increase precision in density estimates; (White et al. 2015)

- All sample units in the sampling frame are ordered, such that any set of consecutively numbered units is a spatially well-balanced sample (Stevens and Olsen 2004). In the case of fluctuating budgets, IMBCR partners can adjust the sampling effort among years within each stratum while still preserving a random, spatially-balanced sampling design. (White et al. 2015)

Sampling Methods

Observers with excellent aural and visual bird-identification skills conducted field work. Prior to conducting surveys, surveyors completed an intensive training program to ensure they had a complete understanding of field protocols and sufficient knowledge of bird identification. Observers attempted to survey all points within a grid cell each morning; however, not all 16 points were surveyed within every grid cell. Inclement weather, no access to private land and decreased bird activity during the survey window were the most common reasons for all 16 points not being visited during a survey.

Point counts (Buckland et al. 2001) were conducted following protocol established by IMBCR partners (Hanni et al. 2015). Observers conducted surveys in the morning, beginning 30 minutes before local sunrise and concluding no later than 5 hours after local sunrise. For every bird detected during the six-minute count period, observers recorded the species, sex, horizontal distance from the observer, minute and type of detection (e.g., call, song, visual). Observers measured distances to each bird using laser rangefinders. When it was not possible to measure the distance to a bird, observers estimated the distance by measuring to a nearby object. Observers recorded birds flying over but not using the immediate surrounding landscape. While observers traveled between points within a grid cell they recorded the presence of any species that had not been previously detected during one of the six-minute counts that morning. The opportunistic detections of these species were used for the creation of a species inventory and distribution mapping purposes. Opportunistic detections between point count stations were not included in the occupancy and density analyses.

Observers 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. They 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, observers recorded time, ambient temperature, cloud cover, precipitation and wind speed. Observers navigated to each point using hand-held Global Positioning System (GPS) units. Before beginning each six-minute count, observers recorded vegetation data within a 50-meter radius of the point. Vegetation data included the dominant habitat type; structural stage and the relative abundance; percent cover and mean height of trees and shrubs by species; grass height; and ground cover types. Observers recorded additional vegetation data on ranches for the WWF including absolute groundcover abundances for select non-native grasses (crested wheatgrass *Agropyron cristatum*, cheat grass bromes *Bromus spp.*, smooth brome *B. inermis*) and Prairie Spikemoss (*Selaginella densa*). Observers differentiated sagebrush cover between big sagebrush (*Artemisia tridentata*) and silver sagebrush (*A. cana*) and recorded their absolute abundances. Observers recorded vegetation data quietly to allow birds the time to return to normal habits prior to beginning each avian point count. For more detailed information about survey methods, refer to the Bird Conservancy of the Rockies' Field Protocol for Spatially Balanced Sampling of Landbird Populations on the Rocky Mountain Avian Data Center website: http://rmbo.org/v3/Portals/5/Protocols/2015%20Field_protocol_for_spacially_balanced_sampling.pdf (White et al. 2015)

Analysis Procedures

Density Analysis

Density analysis procedures were consistent with those of the IMBCR program:

> Distance sampling theory was developed to account for the decreasing probability of detecting an object of interest (e.g., a bird) with increasing distance from the observer to the object (Buckland et al. 2001). The detection probability is used to adjust the count of birds to account for birds that were present but undetected. Application of distance theory requires that five critical assumptions be met: 1) all birds at and near the sampling location (distance = 0) are detected; 2) distances to birds are measured accurately; 3) birds do not move in response to the observer's presence; 4) cluster sizes are recorded without error; and 5) the sampling units are representative of the entire survey region (Buckland et al. 2001, Thomas et al. 2010).
>
> Analysis of distance data includes fitting a detection function to the distribution of recorded distances (Buckland et al. 2001). The distribution of distances can be a function of characteristics of the object (e.g., for birds, size and color, movement, volume of song or call and frequency of call), the surrounding environment (e.g., density of vegetation) and observer ability. Because detectability varies among species, we analyzed these data separately for each species. We attempted to estimate densities of all species detected. The development of robust density estimates typically requires 80 or more independent detections ($n \geq 80$) within the entire sampling area. We excluded birds flying over, but not using the immediate surrounding landscape, birds detected

while migrating (not breeding), juvenile birds, and birds detected between points from analyses.

We estimated density for each species using a sequential framework where 1) year specific detection functions were applied to species with greater than or equal to 80 detections per year ($n \geq 80$), 2) global detection functions were applied to species with less than 80 detections per year ($n < 80$) and greater than or equal to 80 detections over the life of the project ($n \geq 80$), and 3) remedial measures were used for species with moderate departures from the assumptions of distance sampling (Buckland et al. 2001).

We fit models with no series expansions to all species using the recommended 10% truncation for point transects. For the year specific detection functions, we fit Conventional Distance Sampling models using the half-normal and hazard-rate key functions with no series expansions (Thomas et al. 2010). We fit the two models described above, in addition to Multiple-Covariate Distance Sampling models using half-normal and hazard-rate key function with a categorical year covariate and no series expansions (Thomas et al. 2010). We selected the most parsimonious detection function for each species using Akaike's Information Criterion adjusted for sample size ($AIC_{c,}$ Burnham and Anderson 2002; Thomas et al. 2010), and considered the most parsimonious model as the estimation model. We estimated population size N for each stratum as N = D*A, where D was the estimated population density and A was the number of 1 km^2 sampling units in each stratum. We calculated Satterthwaite 90% Confidence Intervals (CI) for the estimates of density and population size for each stratum (Buckland et al. 2001). In addition, we combined the stratum-level density estimates at various spatial scales, such as the intersection of BCR and State using an area-weighted mean. For the combined density estimates, we estimated the variance for detection and cluster size using the delta method (Powell 2007, Thomas et al. 2010) and variance for the encounter rate using the design-based estimator of Fewster et al. (2009).

We reviewed the highest ranking detection function for each species to check the shape criteria, evaluate the fit of the model and identify species with moderate departure from the assumptions of distance sampling (Buckland et al. 2001). First, we checked the shape criteria of the histogram to ensure the detection data exhibited a "shoulder" that fell away at increasing distances from the observer. Second, we evaluated the fit of the model using the Kolmogorov-Smirnov goodness-of-fit test. Finally, we visually inspected the detection histograms to identify species that demonstrated evasive movement and/or measurement errors. We looked for a type of measurement error involving the heaping of detections at certain distances that occurs when observers round detection distances. We also looked for histograms with detections that were highly skewed to the right, potentially indicating a pattern of evasive movement (Buckland et al. 2001).

For species with moderate departures from the assumptions and shape criteria, we used two sequential remedial measures. First, we truncated the data to the point where detection probability was approximately 0.1 [$g(w) \sim 0.1$] and included key functions with second order cosine series-expansion terms in the candidate set of models (Buckland et al. 2001). We did not include detection function models with a single cosine expansion term because the half-normal and hazard-rate models require the order of the terms are >1 (Buckland et al. 2001). Second, when the goodness-of-fit test and/or inspection of the detection histogram continued to suggest evasive movement and/or measurement errors, we grouped the distance data into four to eight bins, and applied custom

> truncation and second order expansion terms. These remedial measures can ameliorate problems associated with moderate levels of evasive movement and/or distance measurement errors (Buckland et al. 2001). (White et al. 2015)

Density results to accompany this report will be completed hereafter. Results from those analyses will be appended to a later version of this final report.

Occupancy Analysis

Occupancy analysis procedures were consistent with those of the IMBCR program:

> Occupancy estimation is most commonly used to quantify the proportion of sample units (i.e., 1-km^2 cells) occupied by an organism (MacKenzie et al. 2002). The application of occupancy modeling requires multiple surveys of the sample unit in space or time to estimate a detection probability (MacKenzie et al. 2006). The detection probability adjusts the proportion of sites occupied to account for species that were present but undetected (MacKenzie et al. 2002). We used a removal design (MacKenzie et al. 2006), to estimate a detection probability for each species, in which we binned minutes one and two, minutes three and four and minutes five and six to meet the assumption of a monotonic decline in the detection rates through time. After the target species was detected at a point, we set all subsequent sampling intervals at that point to "missing data" (MacKenzie et al. 2006).
>
> The 16 points in each sampling unit served as spatial replicates for estimating the proportion of points occupied within the sampled sampling units. We used a multi-scale occupancy model to estimate 1) the probability of detecting a species given presence (*p*), 2) the proportion of points occupied by a species given presence within sampled sampling units (ϴ,Theta) and 3) the proportion of sampling units occupied by a species (Ψ, Psi).
>
> We truncated the data, using only detections less than 125m from the sample points. Truncating the data at less than 125m allowed us to use bird detections over a consistent plot size and ensured that the points were independent (points were spread 250m apart), which in turn allowed us to estimate Theta (the proportion of points occupied within each sampling unit) (Pavlacky et al. 2012).
>
> We expected that regional differences in the behavior, habitat use and local abundance of species would correspond to regional variation in detection and the fraction of occupied points. Therefore, we estimated the proportion of sampling units occupied (Psi) for each stratum by evaluating four models with different structure for detection (*p*) and availability (represented by the proportion of points occupied within a grid cell) (Theta). Within these models, the estimates of *p* and Theta were held constant across the BCRs and/or allowed to vary by BCR. Models are defined as follows:
>
> Model 1: Constrained *p* and Theta by holding these parameters constant across BCRs;
> Model 2: Held *p* constant, but allowed Theta to vary across BCRs;
> Model 3: Allowed *p* to vary across BCRs, but held Theta constant across BCRs;
> Model 4: Allowed both *p* and Theta to vary across BCRs.
>
> We ran model 1 for species with less than 10 detections in all BCRs or less than 10 detections in all but 1 BCR. We ran models 1 through 4 for species with greater than 10 detections in more than 1 BCR. For the purpose of estimating regional variation in detection (*p*) and availability (Theta), we pooled data for BCRs with fewer than 10

detections into adjacent BCRs with sufficient numbers of detections. We used AIC corrected for small sample size (AIC_c) and model selection theory to evaluate models from which estimates of Psi were derived for each species (Burnham and Anderson 2002). We model averaged the estimates of Psi from models 1 through 4 and calculated unconditional standard errors (Burnham and Anderson 2002).

Our application of the multi-scale model was analogous to a within-season robust design (Pollock 1982) where the two-minute intervals at each point were the secondary samples for estimating *p* and the points were the primary samples for estimating Theta (Nichols et al. 2008, Pavlacky et al. 2012). We considered both *p* and Theta to be nuisance variables that were important for generating unbiased estimates of Psi. Theta can be considered an availability parameter or the probability a species was present and available for sampling at the points (Nichols et al. 2008, Pavlacky et al. 2012). (White et al. 2015)

Occupancy results to accompany this report will be completed hereafter. Results from those analyses will be appended to a later version of this final report.

Automated Analysis

Both density and occupancy estimation was completed with the use of a modified version of the RIMBCR package (R Core Team 2014; Paul Lukacs, University of Montana, Missoula). The RIMBCR package streamlined analyses by calling the raw data from the IMBCR Structured Query Language (SQL) server database and incorporating the R code created in previous years. We allowed the input of all data collected in a manner consistent with the IMBCR design to increase the number of detections available for estimating *p* and Theta. The RIMBCR package used package mrds (Thomas et al. 2010, R Core Team 2014) to fit the point transect distance sampling model, the program MARK (White and Burnham 1999) and package RMark (Laake 2013, R Core Team 2014) to fit the multi-scale occupancy model. The RIMBCR package provided an automated framework for combining strata-level estimates, as well as corresponding standard errors and confidence intervals, of population density and site occupancy at multiple spatial scales.

RESULTS

Due to the sensitive nature of avian data on private lands, counts of avian individuals by species, ranch, and strata will be provided to the WWF separate from this report.

WWF-Affiliated Ranch Strata

Observers conducted avian point counts within 38 distinct grid cells resulting in a total of 482 individual point count stations surveyed across the three strata (Table 1). The number of point counts that were not completed, and the accompanying reason why, are shown in Table 2. Surveys were completed between 30 May and 7 July, 2015. Figures 2, 3, and 4 show the survey locations visited in 2015 in the MT-WWFRA-WT, NE-WWFRA-NW, and SD-WWFRA-SW respectively. Collectively, the point counts resulted in a total of 7,235 observed individuals of 111 species.

Table 1. The number of grid cells visited, number of point counts conducted, average number of point counts conducted per grid, and the survey date range for each of the three strata surveyed in 2015.

Stratum	Grid Cells	Point Counts	Average Counts/Grid	Survey Date Range
MT-WWFRA-WT	15	214	14.3	5/30 – 6/23/2015
NE-WWFRA-NW	15	186	12.4	6/19 – 7/7/2015
SD-WWFRA-SW	8	82	10.3	6/19 – 6/27/2015

Table 2. The number of point counts that were not surveyed in 2015 by strata and the accompanying reason why the point count was not surveyed. N = No contact with private landowner, O = Other, R = Could not cross river, T = Ran out of time, U = Terrain was unsafe, and W = Inclement weather.

Strata	N	O	R	T	U	W	Grand Total
MT-WWFRA-WT	13	4	3	1	1	4	26
NE-WWFRA-NW	6	7		9		32	54
SD-WWFRA-SW	3	7		3		33	46
Grand Total	22	18	3	13	1	69	126

The Bird Conservancy estimated densities and population sizes for 64 species within the MT-WWFRA-WT stratum. The data yielded robust density estimates (CV < 50%) for 15 of these species. The Bird Conservancy estimated the proportion of 1 km^2 sampling units occupied (Psi) within the MT-WWFRA-WT stratum for 57 species. The data yielded robust occupancy estimates (CV < 50%) for 18 of these species. Counts of individual birds by species, occupancy and density estimates for the MT-WWFRA-WT can be viewed on the Rocky Mountain Avian Data Center by clicking here and then clicking on the “Run Query” button highlighted in red near the top of the page.

The Bird Conservancy estimated densities and population sizes for 53 species within the NE-WWFRA-NW stratum. The data yielded robust density estimates (CV < 50%) for 10 of these species. The Bird Conservancy estimated the proportion of 1 km^2 sampling units occupied (Psi) within the NE-WWFRA-NW stratum for 41 species. The data yielded robust occupancy estimates (CV < 50%) for 11 of these species. Counts of individual birds by species, occupancy and density estimates for the NE-WWFRA-NW can be viewed on the Rocky Mountain Avian Data Center by clicking here and then clicking on the “Run Query” button highlighted in red near the top of the page.

The Bird Conservancy estimated densities and population sizes for 52 species within the SD-WWFRA-SW stratum. The data yielded robust density estimates (CV < 50%) for 12 of these species. The Bird Conservancy estimated the proportion of 1 km^2 sampling units occupied (Psi) within the SD-WWFRA-SW stratum for 40 species. The data yielded robust occupancy estimates (CV < 50%) for 16 of these species. Counts of individual birds by species, occupancy and density estimates for the SD-WWFRA-SW can be viewed on the Rocky Mountain Avian Data Center by clicking here and then clicking on the “Run Query” button highlighted in red near the top of the page.

Figure 2. Survey locations within the MT-WWFRA-WT stratum in 2015. Survey locations within the same private ranch are shown in the same color.

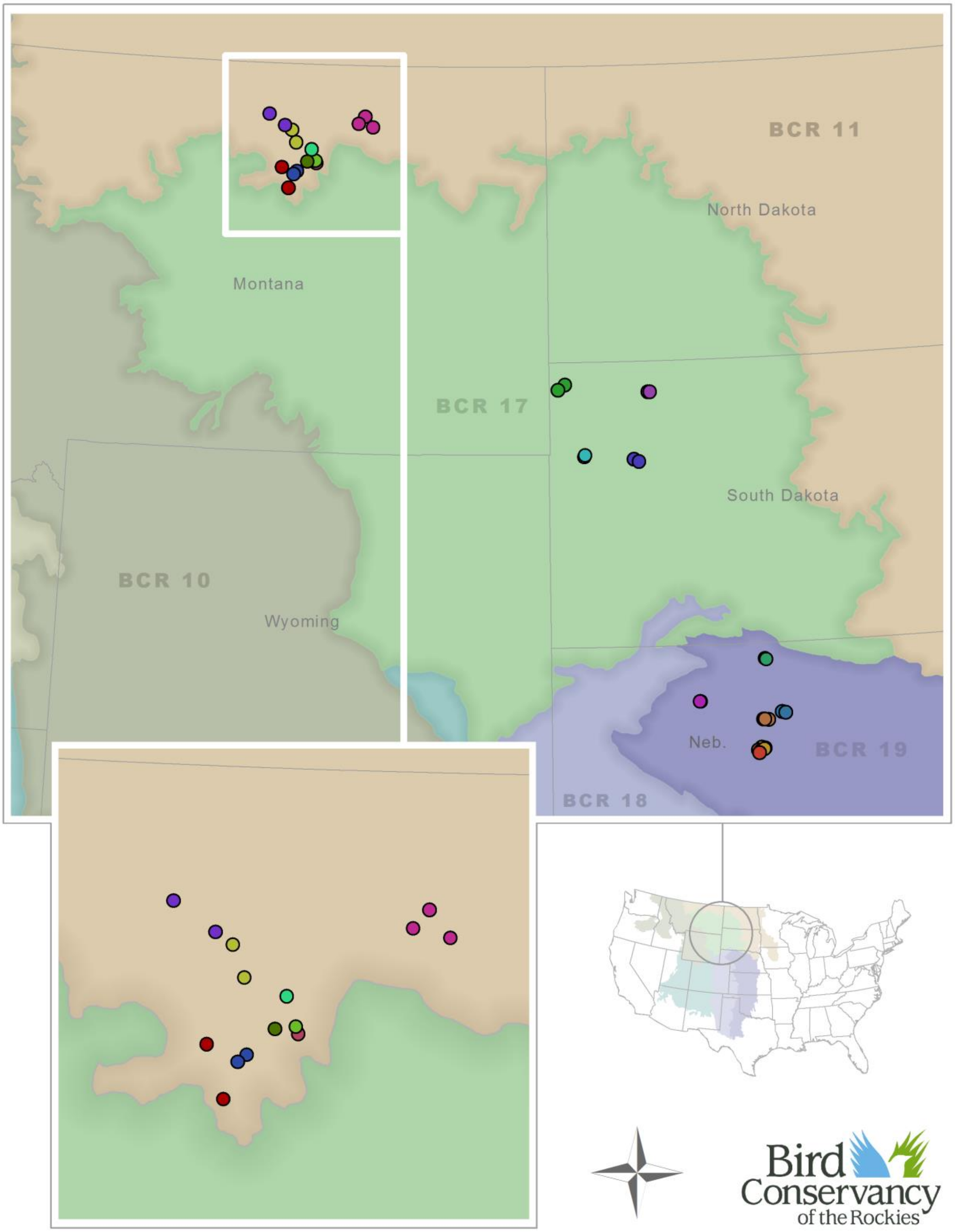


Figure 3. Survey locations within the NE-WWFRA-NW stratum in 2015. Survey locations within the same private ranch are shown in the same color.

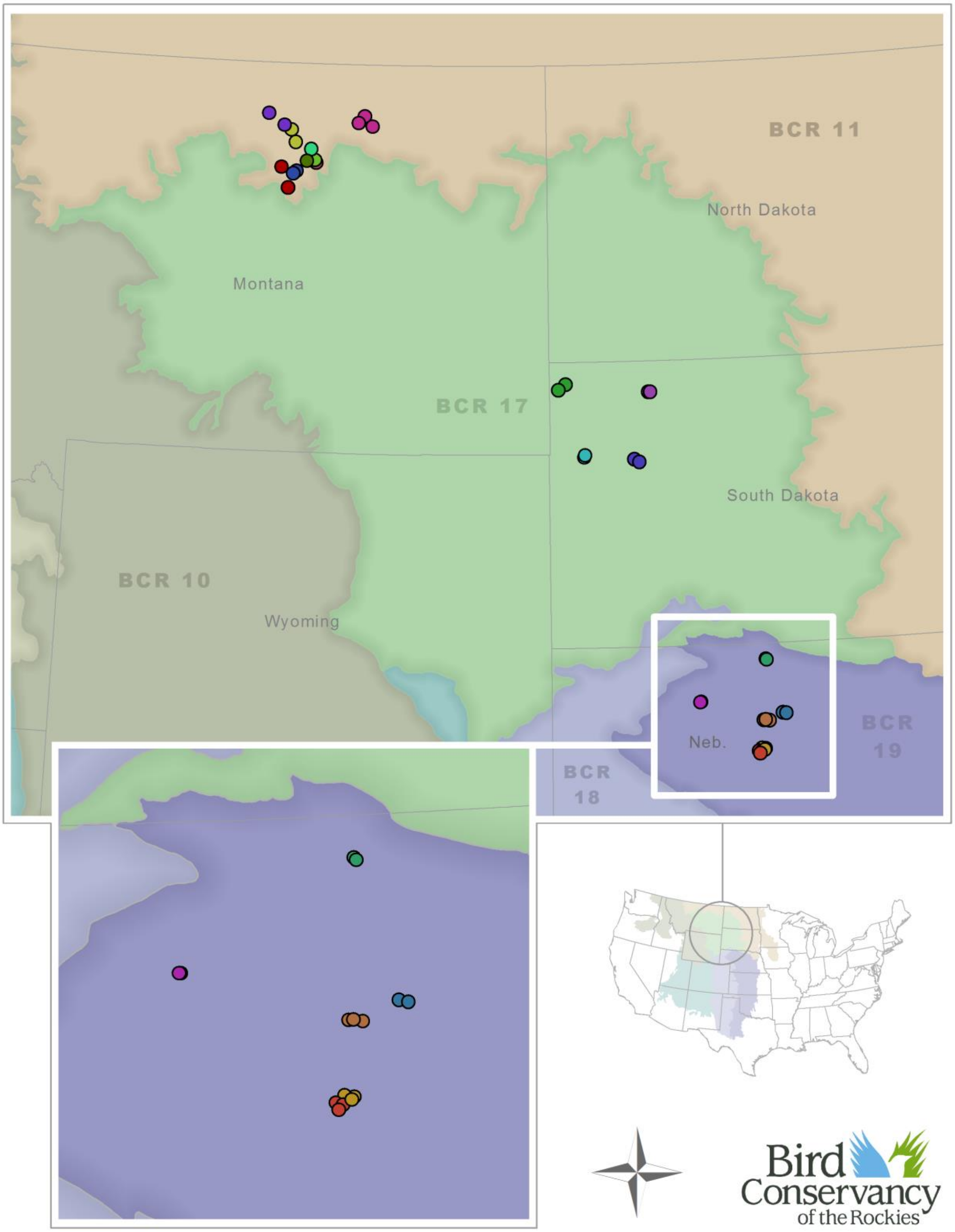
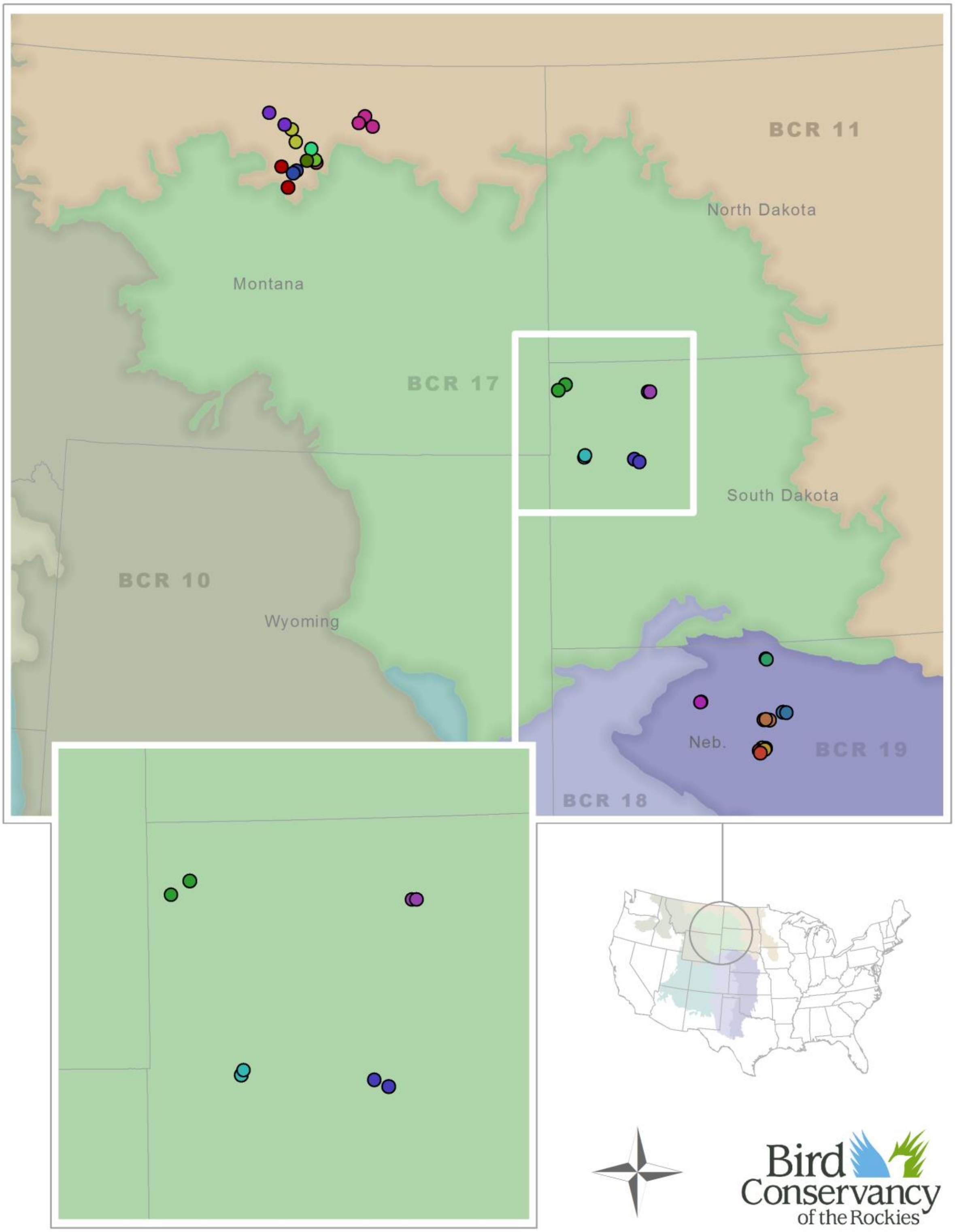


Figure 4. Survey locations within the SD-WWFRA-SW stratum in 2015. Survey locations within the same private ranch are shown in the same color.



All Other Lands in Montana BCR 11
Observers conducted avian point counts within 9 distinct grid cells resulting in a total of 116 individual point count stations surveyed (Table 3). Surveys were completed between 23 May and 12 June, 2015. Collectively, the point counts resulted in a total of 1,992 observed individuals of 65 species.

The Bird Conservancy estimated densities and population sizes for 56 species within the Montana BCR 11 All Other Lands stratum (MT-BCR11-AO). The data yielded robust density estimates (CV < 50%) for 17 of these species. The Bird Conservancy estimated the proportion of 1 km^2 sampling units occupied (Psi) within the MT-BCR11-AO stratum for 53 species. The data yielded robust occupancy estimates (CV < 50%) for 26 of these species. Counts of individual birds by species, occupancy and density estimates for the MT-BCR11-AO stratum can be viewed on the Rocky Mountain Avian Data Center by clicking here and then clicking on the "Run Query" button highlighted in red near the top of the page.

Montana BCR 11
Observers conducted avian point counts within 19 distinct grid cells resulting in a total of 264 individual point count stations surveyed (Table 3). Surveys were completed between 21 May and 12 June, 2015. Collectively, the point counts resulted in a total of 4,335 observed individuals of 88 species.

The Bird Conservancy estimated densities and population sizes for 70 species within the Montana portion of BCR 11. The data yielded robust density estimates (CV < 50%) for 22 of these species. The Bird Conservancy estimated the proportion of 1 km^2 sampling units occupied (Psi) within the Montana portion of BCR 11 for 68 species. The data yielded robust occupancy estimates (CV < 50%) for 31 of these species. Counts of individual birds by species, occupancy and density estimates for the Montana portion of BCR 11 can be viewed on the Rocky Mountain Avian Data Center by clicking here and then clicking on the "Run Query" button highlighted in red near the top of the page.

Nebraska BCR 19
Observers conducted avian point counts within 6 distinct grid cells resulting in a total of 91 individual point count stations surveyed (Table 3). Surveys were completed between 26 May and 28 May, 2015. Collectively, the point counts resulted in a total of 1,309 observed individuals of 52 species.

The Bird Conservancy estimated densities and population sizes for 39 species within a subset of the Nebraska portion of BCR 19. The data yielded robust density estimates (CV < 50%) for 9 of these species. The Bird Conservancy estimated the proportion of 1 km^2 sampling units occupied (Psi) within a subset of the Nebraska portion of BCR 19 for 30 species. The data yielded robust occupancy estimates (CV < 50%) for 8 of these species. Counts of individual birds by species, occupancy and density estimates for a subset of the Nebraska portion of BCR 19 can be viewed on the Rocky Mountain Avian Data Center by clicking here and then clicking on the "Run Query" button highlighted in red near the top of the page.

All Other Lands in South Dakota BCR 17
Observers conducted avian point counts within 8 distinct grid cells resulting in a total of 77 individual point count stations surveyed (Table 3). Surveys were completed between 19 May and 4 July, 2015. Collectively, the point counts resulted in a total of 1,301 observed individuals of 87 species.

The Bird Conservancy estimated densities and population sizes for 69 species within the South Dakota BCR 17 All Other Lands stratum (SD-BCR17-OW). The data yielded robust density estimates (CV < 50%) for 9 of these species. The Bird Conservancy estimated the proportion of 1 km^2 sampling units occupied (Psi) within the SD-BCR17-OW stratum for 63 species. The data yielded robust occupancy estimates (CV < 50%) for 12 of these species. Counts of individual birds by species, occupancy and density estimates for the SD-BCR17-OW stratum can be viewed on the Rocky Mountain Avian Data Center by clicking here and then clicking on the "Run Query" button highlighted in red near the top of the page.

South Dakota BCR 17

Observers conducted avian point counts within 109 distinct grid cells resulting in a total of 1,197 individual point count stations surveyed (Table 3). Surveys were completed between 19 May and 14 July, 2015. Collectively, the point counts resulted in a total of 17,445 observed individuals of 141 species.

The Bird Conservancy estimated densities and population sizes for 126 species for the South Dakota portion of BCR 17. The data yielded robust density estimates (CV < 50%) for 30 of these species. The Bird Conservancy estimated the proportion of 1 km^2 sampling units occupied (Psi) within the South Dakota portion of BCR 17 for 121 species. The data yielded robust occupancy estimates (CV < 50%) for 36 of these species. Counts of individual birds by species, occupancy and density estimates for the South Dakota portion of BCR 17 can be viewed on the Rocky Mountain Avian Data Center by clicking here and then clicking on the "Run Query" button highlighted in red near the top of the page.

Table 3. The number of grid cells visited, number of point counts conducted, average number of point counts conducted per grid, and the survey date range for each IMBCR stratum surveyed in 2015 which were cited in this report.

Stratum	Grid Cells	Point Counts	Avg Counts / Grid	Survey Dates
MT-BCR11-AO: All Other Lands*	9	116	12.9	5/23 - 6/12/2015
MT-BCR11-BN: Bureau of Land Management - North Valley*	2	29	14.5	5/24 - 5/25/2015
MT-BCR11-BO: Bureau of Land Management – Other*	2	31	15.5	6/1 - 6/6/2015
MT-BCR11-CM: Charles M. Russell National Wildlife Refuge*	2	26	13	5/22 - 5/25/2015
MT-BCR11-FO: All other USFWS lands*	2	30	15	5/31 - 6/7/2015
MT-BCR11-TR: Rocky Boys; Fort Peck; Fort Belknap and Blackfeet Reservations*	2	32	16	5/21 - 5/22/2015
NE-BCR19-BE: Nebraska National Forest - Bessey District**	3	44	14.7	5/26 - 5/28/2015
NE-BCR19-SG: Samuel R. McKelvie National Forest**	3	47	15.7	5/27 - 5/28/2015
SD-BCR17-BF: Black Hills National Forest - All other Watersheds***	13	131	10.1	6/19 - 7/12/2015
SD-BCR17-BM: Bureau of Land Management***	13	150	11.5	5/22 - 7/3/2015
SD-BCR17-BN: Badlands National Park - North Unit***	15	161	10.7	5/20 - 7/11/2015
SD-BCR17-BS: Badlands National Park - South Unit***	2	24	12	7/7 - 7/9/2015
SD-BCR17-GG: Buffalo Gap National Grassland***	5	53	10.6	5/19 - 6/15/2015
SD-BCR17-HU: Black Hills National Forest - Hydrologic Code 7 Watersheds***	3	32	10.7	7/7 - 7/10/2015
SD-BCR17-JC: Jewel Cave National Monument***	5	57	11.4	7/1 - 7/6/2015
SD-BCR17-MR: Mount Rushmore National Monument***	6	55	9.2	6/30 - 7/14/2015
SD-BCR17-OW: All Other Lands***	8	77	9.6	5/19 - 7/4/2015
SD-BCR17-PG: Fort Pierre National Grassland***	5	62	12.4	5/21 - 5/25/2015
SD-BCR17-RG: Grand River National Grassland***	5	55	11	5/26 - 5/31/2015
SD-BCR17-TB: Select Tribal Lands***	2	28	14	5/25 - 7/8/2015
SD-BCR17-UF: Custer National Forest***	13	153	11.8	6/1 - 7/8/2015
SD-BCR17-WC: Wind Cave National Park***	14	159	11.4	6/12 - 7/12/2015

* Stratum incorporated in MT BCR 11 regional estimate
** Stratum incorporated in NE BCR19 regional estimate
*** Stratum incorporated in SD BCR 17 regional estimate

DISCUSSION

Temporal and Spatial Comparisons

The IMBCR program's ability to make comparisons between small-scale locations, large regions, and across years can provide managers with important information about the lands they manage. Data collected and results produced in this study can be used in the following ways to inform avian conservation:

1) Population estimates can be compared in space and time. For example, estimates for the WWF-affiliated ranch strata can be compared to state and regional estimates to determine if local populations are above or below estimates for the region;
2) Population estimates can be used to make informed management decisions about where to focus conservation efforts. For example, strata with large population densities can be targeted for protection and strata with low densities can be prioritized for conservation action; a threshold could be set to trigger a management action when populations reach a predetermined level;
3) Annual estimates of density and occupancy can be compared over time to determine if population changes are a result of population growth or decline and/or range expansion or contraction. For example, if population densities of a species declined over time, but the occupancy rates remained constant, then the population change was due to declines in local abundance. In contrast, if both density and occupancy rates of a species declined, then population change was due to range contraction;
4) Occupancy rates can be multiplied by the land area in a region of interest to estimate the area occupied by a species. For example, if a stratum comprises 120,000 km^2 and the occupancy estimate for Western Meadowlark is 0.57, managers can estimate that 68,400 km^2 (120,000 km^2 * 0.57) of habitat within that stratum is occupied by Western Meadowlarks.

Advantages of collaboration and the IMBCR program

Auxiliary, or "overlay", projects are a growing component of the IMBCR program that improve efficiency and can be tailored to address specific management questions. Auxiliary projects, such as the monitoring effort on WWF-affiliated ranches discussed in this report, utilize the IMBCR sampling design and field methods but are not integrated into the nested stratification of the IMBCR program. These projects benefit from the IMBCR program by incorporating detection data from relevant IMBCR surveys in their analyses. Leveraging IMBCR data in analyses improves the number of species for which results can be obtained and the precision of the resulting estimates. Utilizing the IMBCR design also allows the resulting population estimates to be placed in a regional context. In this way, the collaborative efficiency of the IMBCR program is extended to auxiliary projects by improving the accuracy and precision of population estimates for infrequently detected species as well as allowing those estimates to be compared to larger, geographic regions. In a similar fashion, data collected as part of auxiliary projects contribute to the efficiency of the IMBCR program by increasing the overall size of the bird detection data set.

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APPENDIX: AVIAN DATA CENTER USAGE TIPS

The Avian Data Center has been designed to provide information for specific questions and therefore works best when users select multiple filters for a query. To run a query, click the arrow for the drop down "Filter" menu (located in the extreme upper left corner of the screen) and select one of the following filter types: Study Design, Species, Stratum, Super Stratum, BCR, State, County, Habitat, Year, Priority Species List, or Management Entity. After selecting the filter type, click the "Add" button immediately to the right of the drop down menu. A box will appear with options for the filter that you may select. Use the drop down menu in the box to select the specific filter and then click "Add filter". The selected filter will appear near the top of the screen. Users may add multiple filter types to view results for a very specific inquiry (e.g., to view IMBCR results for BRSP in CO you would apply the following filters: Study Design = IMBCR, Species = Brewer's Sparrow, and State = CO) or to view multiple outputs at once (e.g., to view data and results for Brewer's Sparrow and Vesper Sparrow at the same time select Species = Brewer's Sparrow and Species =Vesper Sparrow). Below is an explanation of the different filter types you may choose from.

Study Design: This filter will allow users to select data and results for IMBCR, GRTS, NEON, Migration Phenology or NPS study designs.

Species: This filter allows users to select data and results for a particular species.

Stratum: This filter allows users to select data and results for a particular stratum.

Super Stratum: This filter allows users to select data and results for multiple stratum that were analyzed jointly (e.g., the entire Bridger-Teton National Forest which is broken up into 2 strata or the entire state of Colorado which is broken up into 29 strata).

BCR: This filter will allow users to select data and results for a particular BCR.

State: This filter will allow users to select data and results for a particular state.

County: This filter will allow users to select data and results for a particular county. Please note that only raw count data and survey locations are available at the county level.

Year: This filter will allow users to select data and results for a particular year.

Priority Species List: This filter will allow users to select data and results for multiple species at once. The query will display data and results for all species included on the selected management indicator list, species of conservation concern list, etc.

Management Entity: This filter will allow users to select data and results for All Other Lands, US Forest Service (USFS), Bureau of Land Management (BLM), National Park Service (NPS), Bureau of Indian Affairs (BIA), Department of Defense (DOD), or US Fish and Wildlife Service (USFWS). Once a management entity is chosen, users may notice that additional filter types are available in the filters drop down list. These additional filter types, listed from most general to most specific, are management regions (e.g., USFS Region 1), management units (e.g., Dakota Prairie Grasslands), management forests (e.g., Shoshone National Forest), or management districts (e.g., North Kaibab district within Kaibab National Forest). Below is the filter hierarchy for the different management entities.

USFS:
Tier One – Management Entity – US Forest Service
Tier Two – Management Region – USFS Regions (correct!)
Tier Three – Management Unit – NF or NG management units
Tier Four – National Forest or Grassland – NF or NG
Tier Five – Management District – NF or NG Ranger Districts

NPS:
Tier One – Management Entity – National Park Service
Tier Two – Management Region – Inventory and Monitoring Network
Tier Three – Management Unit – Individual Park Units
Tier Four – Mgmt Forest – Not applicable
Tier Five – Management District – Not applicable

BLM:
Tier One – Management Entity – Bureau of Land Management
Tier Two – Management Region – BLM Field Office
Tier Three – Management Unit – Not applicable
Tier Four – National Forest or Grassland – Not applicable
Tier Five – Management District – Not applicable

DOD:
Tier One – Management Entity – US Department of Defense
Tier Two – Management Region – Installation Unit
Tier Three – Management Unit – Not applicable
Tier Four – National Forest or Grassland – Not applicable
Tier Five – Management District – Not applicable

Tribal Lands:
Tier One – Management Entity – US Bureau of Indian Affairs
Tier Two – Management Region – Reservation Region
Tier Three – Management Unit – Reservation
Tier Four – National Forest or Grassland – Not applicable
Tier Five – Management District – Not applicable

All Other Lands:
Tier One – Management Entity – All Other Lands
Tier Two – Management Region – Not applicable
Tier Three – Management Unit – Not applicable
Tier Four – National Forest or Grassland – Not applicable
Tier Five – Management District – Not applicable

USFWS:
Tier One – Management Entity – US Fish and Wildlife Service
Tier Two – Management Region – USFWS Region
Tier Three – Management Unit – USFWS Unit
Tier Four – National Forest or Grassland – Not applicable
Tier Five – Management District – Not applicable

The Nature Conservancy:
Tier One – Management Entity – The Nature Conservancy
Tier Two – Management Region – Cherry Creek

Tier Three – Management Unit – Not applicable
Tier Four – National Forest or Grassland – Not applicable
Tier Five – Management District – Not applicable

Clearing Filters
Filters can be cleared in one of two ways. You may click on the circled “X” to the left of an individual filter at the top of the screen to remove it or you may click the “clear all filters” button at the top of the screen to start building a new query.

Running Queries
Once you have selected your desired filters, please click on the “Run Query” button located at the top of the screen. The amount of time it takes for the desired data and results to be displayed will depend on how specific your query is.

Comparing Multiple Queries
Users may view results of more than one query at once. To do this, run the first query as described above and then click the button “New Query Window” (located at the top of the screen). A new window will appear where a new query can be run and the two windows can then be viewed side by side.

Viewing Maps (Map Tab)
What is displayed?
By default, the map tab is the initial start-up page. After clicking the “Run Query” button, the ADC will display a map of all survey locations corresponding to your set of filters (surveyed grid cells are represented by blue semi-transparent circles) in Google Earth. If you have filtered by species, survey locations where that species was not detected will be represented by the blue circle. Locations where that species was detected will have a pink dot in the center of the blue circle. To see the specific name of a survey location, move the mouse arrow over the blue circle. After a moment the name of the surveyed grid cell should appear. You may view the bird detection info for a grid cell and the survey dates by left clicking your mouse on the blue circle.

By default, the zoom capability of the maps page is restricted to protect the privacy of private landowners. Partners wishing for more precise location information to be displayed should request a password from the Bird Conservancy of the Rockies via email (it@birdconservancy.org). Once a user has a password, click on the “View Options” button at the top of the screen, enter the password in the field provided, and click “Save”. If you have run a query prior to entering the password, you will need to click the “Run Query” button again in order to utilize the enhanced zooming features now available to you.

Adding boundary layers
You may add the following layers to the map: Bird Conservation Region boundaries, BIA boundaries, DOD boundaries, NPS boundaries, and USFS boundaries. To do this, left click on the drop down menu at the top left corner of the map, select the desired layer, and click the “add layer” button. It is possible to add multiple layers to the map by repeating this process. If you left click your mouse inside of any of these boundaries a text box will appear that contains the name of the region encompassed by the boundary.

Viewing Occupancy/Density Results (Occupancy and Density Tabs)
Viewing Tables
You may view a table of occupancy or density results and a chart for all appropriate strata

(based on the set of filters) for which we have results by clicking on the tabs labeled "Occupancy" or "Density". These tabs are located just below the drop down filter menu in the upper left corner of the screen. The occupancy tables will display the species for which the estimate was produced, the stratum the estimate pertains to, the year, Psi (proportion of grid cells expected to be occupied), the number of grid cells the species was detected on, the standard error (SE) of the estimate, and the percent coefficient of variation (% CV). The density tables will display the species for which the estimate was produced, the stratum or habitat type that the estimate pertains to, the year, the number of birds expected per km^2 (D), the total number of individuals expected to reside within the stratum (N), the percent coefficient of variation (% CV), and the number of individuals detected (n). You may view a description of the column headings by moving the mouse arrow over the column heading. You may also sort the table by clicking on any of the column headings.

Viewing the Charts

When viewing the occupancy and density charts, the point estimate of Psi or D is indicated with a dot. Additionally, short horizontal dashes above and below the point estimate represent values one standard error away from the point estimate. To view the species, stratum, and year that correspond to an estimate on the chart, simply move your mouse arrow over the point estimate or standard error bar. A message will pop up with the appropriate information. If you have queried out multiple years of data the point estimates for each year will be connected with a solid line. You may remove an individual estimate from the chart by clicking on the corresponding row of the table on the left side of the screen. Estimates that are not displayed on the chart will turn a peach color in the table. You may add the estimate back onto the chart simply by clicking on the peach colored row in the table.

Knowing which species have estimates

To restrict the species filter to display only those species for which occupancy or density estimates have been produced, click on the "View Options" button on the very top of the screen and then check the box next to "Only show species for which occupancy/density results are available". This will prevent you from querying out numerous species for which occupancy or density estimates are not available.

Saving results of your query

You may easily save the results of your query by clicking the "Copy to clipboard" button and pasting the results into another program such as excel or by clicking the "Save to CSV" button. To save images, the best option is to take a screenshot. Use the Print Screen key on Windows or Command-Shift-3 on a Mac.

Functionality

Please keep in mind that queries with very generic filters will result in long wait times and may not function optimally (your browser may end up crashing). For instance, if a user selects only the IMBCR filter, occupancy results will be displayed for every species and strata/super strata combination for which there are occupancy and/or density results. If your query is not specific enough, the chart on the right side of the screen will not be displayed or a pop-up box will appear asking if you'd like to continue. This pop-up box is designed to prevent your web browser from crashing while the ADC attempts to create a chart that would be extremely difficult to interpret. We recommend that you cancel the proposed query and add additional filters to make your query less generic.

What is available?

Currently, occupancy results are available for 2010 to 2013 via the ADC as well as density results for 2009 thru 2013.

Viewing Raw Count Statistics (Species Counts Tab)

You may view the raw count of detections for each species (left table) and the effort (expressed as the number of points surveyed) (right table) for your query by clicking on the “Species Counts” tab located next to the “Density Tab” in the upper left corner of your screen. Both the counts and effort tables may be sorted by clicking on the row header. Additionally, you may view the counts and effort by BCR, State, County, Stratum, or Management Entity by clicking on the “Count by” drop down menu located above the counts table. If you have filtered using “Super Strata”, viewing counts by Stratum is an excellent way of getting a list of all the strata that comprise a Super Strata. If you would prefer to view effort expressed as the number of grid cells surveyed, click on the “View Options” button located at the top of the screen and check the box labeled “Show effort by number of grid cells instead of by point”.