# Monitoring the Birds of the Black Hills: 2009 Field Season Report

**April 2010**

ROCKY MOUNTAIN BIRD OBSERVATORY

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

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

***Core Values**: (Our goals for achieving our mission)*
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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# EXECUTIVE SUMMARY

In 2009, Rocky Mountain Bird Observatory, in cooperation with its funding partners, the United States Forest Service, Black Hills National Forest (BHNF), and South Dakota Game, Fish and Parks, implemented the ninth year of a habitat-based landbird monitoring program. This program is designed to provide rigorous population trend data for most diurnal, regularly occurring breeding bird landbird species throughout the Black Hills. The program, Monitoring the Birds of the Black Hills (MBBH), supports the BHNF's efforts to comply with requirements set forth in the National Forest Management Act and other statutes and regulations. It also contributes to RMBO's broader landscape-scale breeding bird monitoring program and the goals of state, regional and national bird conservation initiatives.

In January 2001, RMBO, in coordination with biologists from the USFS and other agencies, initially selected 10 habitats in which to implement the bird monitoring effort - Aspen, Burn Area, Mixed-grass Prairie, Ponderosa Pine - Northern Hills, Ponderosa Pine - Southern Hills, Late-successional Ponderosa Pine, Pine-juniper Shrubland, Riparian, Wet Meadows, and White Spruce (Panjabi et al. 2001). The 10 habitat types are now split into two groups of 5 due to a reduction in funding. In 2008, we sampled five of the 10 habitats originally targeted for monitoring: Aspen, Mixed-grass Prairie, Pine-juniper Shrubland, Montane Riparian and Foothills Riparian (White et al. 2009). In 2009, we surveyed the other 5 habitat types: Burn Area, Late-successional Pine, Ponderosa Pine North, Ponderosa Pine South, and White Spruce.

In 2009, we surveyed 157 transects within Black Hills National Forest that included 20 transects in each of five habitats targeted under the monitoring plan: Burn Area, Late-successional Pine, Ponderosa Pine North, Ponderosa Pine South, and White Spruce. For the first time, in 2009 we also surveyed 57 transects using a spatially-balanced design. The new transects were part of a larger program encompassing all of the Badlands and Prairies Bird Conservation Region (BCR 17; White et al. 2010).

We surveyed 100% of the assigned habitat-based transects, from 17 May to 17 July 2009. We recorded 11,677 birds of 91 species. We detected 2,272 birds of 53 species in Burn Area, 1,865 birds of 59 species in Late-successional Pine, 2,682 birds of 56 species in Ponderosa Pine North, 2,391 birds of 60 species in Ponderosa Pine South, and 2,467 birds of 58 species in White Spruce. We surveyed 95% of the assigned BCR-based transects and recorded 6,172 birds of 96 species.

For analyses of the habitat-based surveys, we pooled the 2001-2009 data and used program DISTANCE 6.0 (Thomas et al. 2010) to estimate densities of species (42) with sufficient data. The data yielded precise density estimates (Coefficient of Variation [CV] < 50%) for all 42 species in at least one habitat for 2009. We would be able to reach our target of detecting a population change of at least 3% within 30 years for these 42 species, which represent 46% of all species recorded on point-count transects in the Black Hills during 2001-2009, and 96% of all birds observed.

For the BCR-based surveys, we estimated density for 44 species. The data yielded precise density estimates for 36 species and moderately precise (CV 50-75%) for 3 additional species. We would be able to reach our target of detecting a population change of at least 3% within 30 years for these 39 species, which represent 40% of all

species recorded on point-count transects in the Black Hills during 2001-2009, and 92% of all birds observed.

NABCI (2007) recommended four steps for improving monitoring programs: 1) integrate an adaptive management approach to monitoring, 2) develop coordinated landbird monitoring among organizations and across spatial scales, 3) improve statistical designs, and 4) create a monitoring data database, available to all to make informed management decisions. Rocky Mountain Bird Observatory is committed to coordinated landbird monitoring and we have taken steps to meet all of these recommendations. For example, we are conducting multi-year monitoring programs for federal, state, and local agencies throughout 12 states and have an online database for dissemination of the data collected (http://www.rmbo.org/public/monitoring).

## ACKNOWLEDGEMENTS

We sincerely thank Kerry Burns, Steve Hirtzel and Cara Staab, of the U.S. Forest Service, for their support and involvement in the program as well as for logistical assistance provided during and after the field season. We thank Eileen Dowd-Stukel and Doug Backlund, of the South Dakota Game, Fish and Parks for their support of this program. We are especially grateful to Bob Paulson and Jeff Symstad of the Nature Conservancy, for the generous use of their comfortable facilities at the Whitney Preserve. We also thank the 2009 field crew: Jennifer Adams, Amanda Bowe, Andy Bankert, Casey O'Keefe, Josh Theurer, Katie Stassen, and Todd Reeves, who spent many weeks in the field, sometimes under difficult conditions, conducting transects. We thank Gary White, professor emeritus of Colorado State University and Paul Lukacs of the Colorado Division of Wildlife for assistance with analysis of removal modeling data. We sincerely appreciate the generosity of Dustin Welch, Tony Leukering and Dave Herr for providing the cover photos for this report. We are especially appreciative to Chandman Sambuu of RMBO for his efforts to improve the data entry system and maintain a high quality database.

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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 often reflect the abundance and diversity of other organisms with which they coexist. They are useful barometers for environmental change and measuring the sustainability of human activities on ecosystems.

Population monitoring forms the backbone of avian conservation; without current monitoring data, conservation efforts may be misguided and inefficient. Population monitoring helps to achieve the intent of legislation such as the Migratory Bird Treaty Act (1918), National Environmental Policy Act (1969), Endangered Species Act (1973), the National Forest Management Act (1976) and various state laws (Manley et al. 1993, Sauer 1993).

The North American Bird Conservation Initiative's "Opportunities for Improving Avian Monitoring" (NABCI 2007) provided goals and recommendations for avian monitoring programs. The goals are:

> Goal 1: Fully integrate monitoring into bird management and conservation practices and ensure that monitoring is aligned with management and conservation priorities.
>
> Goal 2: Coordinate monitoring programs among organizations and integrate them across spatial scales to solve conservation or management problems effectively.
>
> Goal 3: Increase the value of monitoring information by improving statistical design.
>
> Goal 4: Maintain bird population monitoring data in modern data management systems. Recognizing legal, institutional, proprietary, and other constraints, provide greater availability of raw data, associated metadata, and summary data for bird monitoring programs.

With the NABCI (2007) guidelines in mind, RMBO and its partners designed a broad-scale, "Spatially Integrated Landbird Monitoring" program for Colorado in 2008 (Blakesley and Hanni 2009). This program was adapted and applied to the Badlands and Prairies Bird Conservation Region (BCR 17) in 2009. Bird Conservation Regions (BCRs) are "ecologically distinct regions in North America with similar bird communities, habitats, and resource management issues" (http://www.nabci-us.org/bcrs.html). Black Hills National Forest (BHNF) is located within BCR 17.

The objectives of this Spatially Integrated Landbird Monitoring program are to:

1. Provide a design framework to spatially integrate existing bird monitoring efforts in the region to provide better information on distribution and abundance of breeding landbirds, especially for high priority species;
2. Provide basic habitat association data for most bird species to address habitat management issues;
3. Provide robust density, population, and occupancy estimates that are comparable at different geographic extents;

4. Provide long-term status and trend data for all regularly occurring breeding species throughout BCR 17, with a target of detecting an average annual rate of population change of ≥3.0% per year within 30 years, with power = 0.8 and alpha = 0.1;
5. Maintain a high-quality database that is accessible to all of our collaborators as well as to the public over the internet, in the form of raw and summarized data and;
6. Generate decision support tools that help guide conservation efforts and provide a better measure of conservation success.

Important properties of our study design are:

- All vegetation types are available for sampling.
- Strata are based on fixed attributes; this will allow us to relate changes in bird populations to changes on the landscape through time.
- Each state's portion of a BCR can be stratified differently, depending upon local needs and areas to which one wants to make inferences.
- Aggregation of strata-wide estimates to BCR- or state-wide estimates is built into the design.
- Local population trends can be directly compared to regional trends.
- Coordination among partners can reduce the costs of monitoring per partner.

In 2009, Rocky Mountain Bird Observatory (RMBO), in cooperation with its partners, the Black Hills National Forest (BHNF) and South Dakota Game, Fish, and Parks (SDGFP), completed the ninth year of its landbird monitoring program, entitled *Monitoring the Birds of the Black Hills (*MBBH). We designed this program to provide rigorous population trend data on most diurnal, regularly occurring breeding landbird species in BHNF. In addition to monitoring landbird populations, this program generates information useful for managing birds, such as annual density estimates, habitat associations and spatial distribution. For the first time, we conducted Bird Conservation Region (BCR) based surveys in addition to our historic habitat-based surveys in Black Hills National Forest. This report details the findings of that effort.

# METHODS

## Study Area (Habitat-based)

In January 2001, RMBO, in coordination with biologists from the USFS and other agencies, selected 10 habitats in which to implement the landbird monitoring effort - Aspen, Burn Area, Late-successional Pine, Mixed-grass Prairie, Pine-juniper Shrubland, Ponderosa Pine - Northern Hills, Ponderosa Pine - Southern Hills, Riparian, Wet Meadows, and White Spruce (Panjabi et al. 2001). In 2002, we dropped Wet Meadows from the sampling scheme because of poor on-the-ground representation of this habitat, and we split Riparian into two discrete habitats, Montane Riparian and Foothills Riparian, because of differences in bird communities across this elevational gradient (Panjabi 2003). In 2009, we sampled five of the 10 habitats originally targeted for monitoring: Burn Area, Late-successional Pine, Ponderosa Pine - Northern Hills, Ponderosa Pine - Southern Hills, and White Spruce (Figure 1). The other 5 habitats were sampled in 2008 (White 2009).

### Burn Area (BU)

Burn Area habitat is located mostly within areas affected by the Jasper Fire, which burned approximately 83,000 acres in 2000. The Jasper Burn Area is a mosaic of patches of charred, heat-killed, and live trees (mostly ponderosa pine) that ranged in seral stage from 'shrub-

seedling' to 'mature' (Buttery and Gillam 1983) prior to the burn. By 2002, herbaceous and woody ground cover had sprouted in much of the Burn Area.

### Late-successional Pine (LS)

Late-successional Pine refers to stands of ponderosa pine where seral stage is classified as either 4c (mature, closed canopy) or 5 (old growth) (Buttery and Gillam 1983). These stands typically have more large-diameter trees, coarse fallen debris, and large-diameter standing snags than do earlier-successional stands (Buttery and Gillam 1983). Because certain bird species in the Black Hills may occur primarily in such late-successional stands, we sampled LS in order to generate sufficient data to allow us to monitor these species. Additionally, independent random sampling of LS should allow for comparisons of bird densities between LS and other ponderosa forests, to assess whether some species are limited in their distribution to LS.

### Ponderosa Pine - Northern Hills (PN)

Ponderosa Pine - Northern Hills, or "pine north," refers to the mesic forest dominated by ponderosa pine occurring north of the Mystic Ranger District. Although predominantly pine, this habitat incorporates natural ecotonal variation in the landscape, such as small groves of aspen or oak, drainages with birch and hazelnut, and riparian corridors. Nonetheless, transects in this habitat primarily sample pine forest. We separated the northern ponderosa pine habitat from the southern pine habitat because of structural and physiognomic differences that contribute to differences in the composition of the two bird communities. The northern hills receive more rainfall than do the southern hills, and the northern pine forest often supports an extensive under- and mid-story of bur oak (*Quercus macrocarpa*), aspen, paper birch, and/or other small deciduous trees. This deciduous component contributes to a bird community that is substantially different than in the south.

### Ponderosa Pine - Southern Hills (PS)

Ponderosa Pine - Southern Hills, or "pine south," refers to the arid forest dominated by ponderosa pine occurring south of the Northern Hills Ranger District. Similar to pine-north, this habitat incorporates natural variations in the landscape, such as small groves of aspen or oak, drainages with birch and hazelnut, and riparian corridors. The southern hills receive less rainfall than in the north, and the southern pine forest typically has a grassy understory, with little or no woody undergrowth. In some areas, the southern pine forest intergrades with native mixed-grass prairies forming a unique landscape not found elsewhere in the Black Hills.

### White Spruce (WS)

White Spruce refers to coniferous forests dominated by white spruce, also known as Black Hills spruce. Often there is a significant component of ponderosa pine in this habitat and, to a lesser degree, aspen. White spruce stands typically occur at mid- to high elevations, especially in drainages and on cool north-facing slopes. Most of this habitat occurs in a semi-continuous belt extending through the north-central and western Black Hills, although isolated pockets exist further south. Stringers of white spruce also occur in moist, narrow canyons along the eastern edge of the Black Hills.

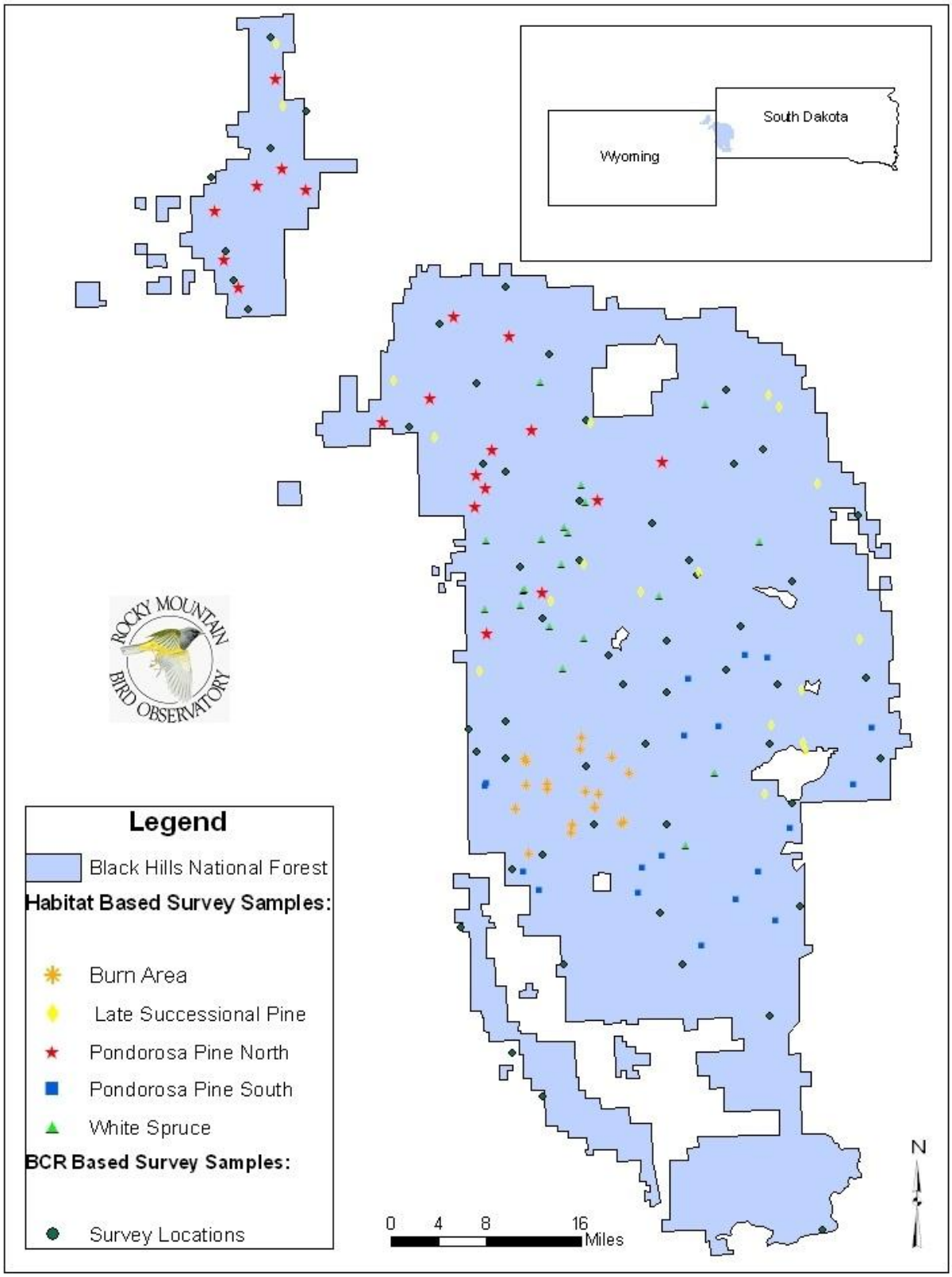


Figure 1. Sample locations (habitat- and BCR-based) within Black Hills National Forest, 2009.

## Study Area (BCR-based)

NABCI defines Bird Conservation Regions as "ecologically distinct regions in North America with similar bird communities, habitats, and resource management issues" (http://www.nabci-us.org/bcrs.html). Because bird communities do not recognize state boundaries, BCRs serve as logical boundaries for our region-wide bird monitoring programs.

Black Hills National Forest falls within the Badlands and Prairies Bird Conservation Region (BCR 17). BCR 17 is characterized by rolling plains and mixed-grass prairie which contains large, continuous tracts of intact, dry grassland managed predominately as ranchland (NABCI 2007), as well as pine and spruce forests at higher elevations. BCR 17 covers portions of five states: Montana, North Dakota, South Dakota, Wyoming and Nebraska (Figure 1).

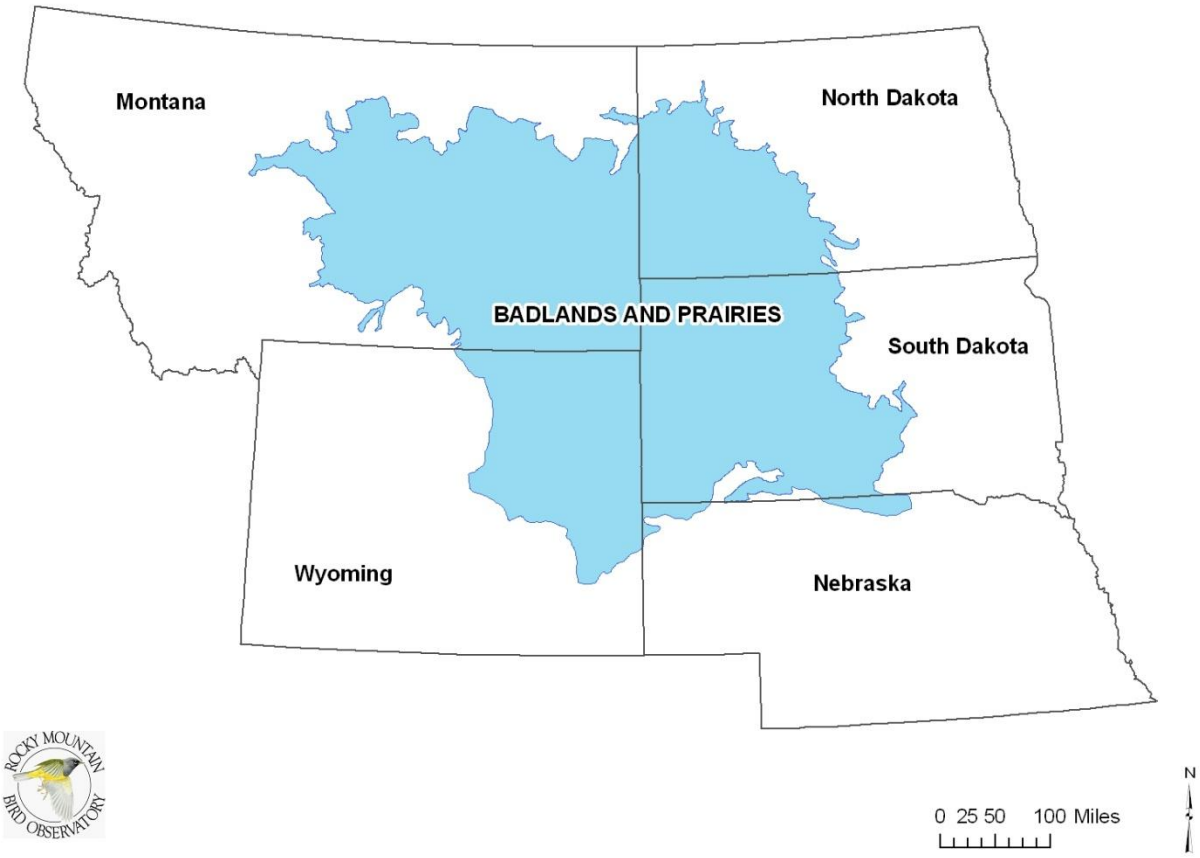


Figure 2. Badlands and Prairies Bird Conservation Region (BCR 17; Source: American Bird Conservancy), http://www.abcbirds.org/abcprograms/domestic/landscape/BCR/badlands.html).

## Sampling Design (Habitat-based)

In each of the habitats sampled in BHNF, our goal was to have 30 permanent transect locations, randomly placed within suitable habitat stands. US Forest Service (USFS) personnel identified potential stands using vegetation data layers from BHNF Geographic Information System (GIS) databases. All potential stands conformed to four selection criteria: 1) located within the Black Hills, 2) representative of the targeted habitat, 3) a minimum of 80 acres in size, and 4) accessible to the public within 3 miles of a road. We randomly selected additional stands as

back-up sites for stands we would replace if ground-truthing revealed they did not meet one or more of the selection criteria. At each of the chosen sites RMBO staff established a point transect of up to 3.5 km in length.

After the initial site selection in 2001, we added and removed several sites from the sampling scheme. In most cases, we dropped sites because they did not represent the habitat we intended to sample, or because they overlapped with another site. We added new sites to the sampling scheme in order to compensate for sites that we dropped, or to append the current sampling effort in habitats with fewer than 30 sites.

MBBH utilizes point-count transects (Buckland et al. 1993) to sample bird populations in each habitat selected for monitoring. For new transects, observers established an access point for each transect, and a random distance (between 0-400 m) and bearing from the access point at which the first point count station would be located. On the morning of the sample, the observer began the point-count transect at the first count station and then continued along the pre-selected bearing for the fourteen remaining points, if possible. In many cases, the pre-selected bearing eventually would lead out of the target habitat or in to some obstruction (e.g., cliff), forcing the observer to change the transect bearing. When this happened, the observer back-tracked to the last point and randomly turned the transect right or left, at an angle perpendicular to the original bearing, and then alternated right or left if needed. In some small or linear stands (e.g., riparian sites), the size and shape of the stand dictated the location and course of the transect.

## Sampling Design (BCR-based)

RMBO and its partners defined BCR 17 as the sampling frame; the broad-scale area selected to make inferences about bird populations. All portions of the sampling frame were available for sampling. Within the BCR, RMBO and its partners established strata and substrata based on smaller-scale areas to which we also wanted to make inferences; e.g., states, BLM land, individual National Forests. The strata within BCRs are based on fixed attributes, without regard to existing vegetation conditions. Because the Black Hills National Forest occurs in two states, the Forest is comprised of two strata.

Within each stratum, the IMBCR design uses generalized random-tessellation stratification (GRTS), a spatially balanced sampling algorithm in the SPSURVEY package (Kincaid 2008) in Program R (R Development Core Team 2008) to select sample units. The GRTS design has several appealing properties with respect to long-term monitoring of birds at large spatial scales:

- 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;

- Sample units can be weighted according to any factor expected to influence species' distributions, to adjust the probability that sample units will be selected (Stevens and Olsen 2004). The sample weight can be accounted for in data analyses;

- 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, RMBO and its partners can adjust the sampling effort among years within each stratum while still preserving a random, spatially-balanced sampling design.

The IMBCR design defines sampling units as 1-km$^2$ cells that are used to create a uniform grid over the entire BCR, with a random starting point. Within each sample cell GIS technicians established 16 survey points spaced 250 meters apart, in a four by four point grid. All spatial data were compiled using ARCGIS 9.2 (ESRI).

## Survey Methods

Field Technicians surveyed birds from points using methods that allow for estimating detection probability through the principles of Distance sampling and Occupancy modeling. 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 three critical assumptions be met: 1) all birds at and near the sampling location (distance = 0) are detected; 2) distances of birds are measured accurately; and 3) birds do not move in response to the observer's presence.

Occupancy estimation is most commonly used to quantify the proportion of sample units occupied by an organism (MacKenzie et al. 2002). Occupancy estimation uses a detection probability to adjust the proportion of sites occupied to account for species that were present but undetected (MacKenzie et al. 2002). RMBO used data collected in 2009 to estimate the site occupancy of priority species for which there were too few detections to estimate population density. Occupancy estimation requires multiple surveys to the sample unit in time or space (MacKenzie and Royle 2005). The assumptions of occupancy estimation are 1) the probabilities of detection and occupancy are constant across the sample units; 2) each point is closed to changes in occupancy over the sampling season; 3) the detection of species at each point are independent; and 4) the target species are never falsely identified (MacKenzie et al. 2006). Field technicians conducted point counts (Buckland et al. 2001) following protocol established by Leukering (2000) and modified by Hanni et al. (2009). Observers conducted surveys in the morning, from ½-hour before sunrise to 11 AM.

At each point, observers conducted a five-minute survey. The data collected during this point count was the same for habitat-based and BCR-based transects. For every bird detected during the five minute period, we recorded species, sex, horizontal distance from the observer, the minute we detected each bird, and type of detection (e.g. call, song or visual). Observers measured distances using laser rangefinders. When it was not possible to measure distance to a bird, observers estimated distance by measuring to some nearby object. We recorded all Red Squirrels (Tamiasciurus hudsonicus) detected during point counts. Observers also recorded birds flying over but not using the immediate surrounding landscape.

For habitat-based transects, observers treated the 250-m intervals between count stations as parts of a line transect and recorded individuals of a list of low-density species (all grouse, raptors, woodpeckers, and other rare or uncommon species we generally record in low numbers), measuring the distance and bearing to each from the transect line. They also recorded bearings and distances to individuals on this list when they detected these species during point counts. For BCR-based transects, observers recorded the presence of all low density species heard and seen when traveling the 250 meters between point count locations. For both study designs, we did not record birds we detected while moving between points if we already recorded them on the previous point. However, if we detected a bird between points

and then again during the subsequent point count, we removed the bird from the line-transect data and included only on the point count.

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 separate independent observations. Observers recorded clusters by recording the number of birds detected within the cluster along with a letter code to keep track of each distinct cluster.

At the start and end of each transect, we recorded the time, temperature in degrees Fahrenheit, percent cloud cover, precipitation type, and wind speed using the Beaufort scale. At each point, we recorded vegetation data (within a 50 meter radius) and distance from a road (if within 100 meters). For vegetation data, we recorded the habitat's structural stage as well as types, relative abundance, percent coverage, and mean height of trees, shrubs, and groundcover. If there was a distinct subcanopy present, we recorded the types of sub-canopy trees. We recorded these data prior to beginning each point count.

We surveyed birds from points using methods that allow for estimating detection probability through the principles of Distance sampling, Removal modeling, and Occupancy modeling. Distance sampling theory estimates detection probability as a function of the distances between the observer and the birds they detected (Buckland et al. 1993). The detection probability is used to adjust the count of birds to account for birds that were present but not detected. Removal modeling is based on mark-recapture theory, with a declining number of birds detected during consecutive sampling intervals (Farnsworth et al. 2002). In this design, sampling intervals consist of 1-2 minutes segments of a complete sampling period. Removal modeling can also incorporate distance data.

Occupancy estimation is commonly used to quantify the proportion of sample units occupied by an organism (MacKenzie et al. 2002). Occupancy estimation theory uses a detection probability to adjust the proportion of sites occupied to account for species that were present but undetected (MacKenzie et al. 2002). We used our data to estimate the site occupancy of species of special concern for which we have too few detections to estimate population density. Occupancy estimation requires multiple surveys to the sample unit in time or space (MacKenzie and Royle 2005). Under our sampling framework, we used a removal model to estimate a detection probability from the sequential 1-2 minute sampling intervals. The 16 grid points served as spatial replicates for estimating the proportion of points occupied within the sampling cells. The assumptions of occupancy estimation are 1) the probabilities of detection and occupancy are constant across the sample units, 2) each point is closed to changes in occupancy over the sampling season, 3) the detection of species at each point are independent and 4) the target species are never falsely detected (MacKenzie et al. 2006).

## Data Analysis

### Distance Analysis

Analysis of distance data is accomplished by fitting a detection function to the distribution of recorded distances. The distribution of distances can be a function of characteristics of the object (e.g., for birds, its 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 the data separately for each species.

RMBO used the analysis software Distance 6.0 (Thomas et al. 2010) to estimate detection probabilities using the point count data. We estimated densities of species for which field technicians obtained at least 60 independent detections (in a habitat stratum or across all BCR-based samples); each cluster of birds was treated as a single independent detection. We excluded birds flying over but not using the immediate surrounding landscape and birds detected between-point from analyses. We fit the following functions to the distribution of distances for each species: Half normal key function with cosine series expansion, Uniform function with cosine series expansion, Hazard rate key function with cosine series expansion, and Hazard rate key function with simple polynomial series expansion (Buckland et al. 2001). We used Akaike's Information Criterion (AIC) corrected for small sample size ($AIC_c$) and model selection theory to select the most parsimonious detection function for each species (Burnham and Anderson 2002).

We pooled the 2001-2009 habitat-based point-count data across years to estimate a common detection function and estimated density separately for each year. Modeling a common detection function allowed us to estimate densities of some low-density species that would not have had large enough sample sizes if we had used only one year of data.

Because we excluded flyovers and between-point detections and included only independent detections in our analyses, the number of independent detections *(n)* used to estimate density for each species may be lower than the number of individuals *(N)* observed. This is especially true for species that tend to associate in groups (e.g., swifts, swallows, crossbills, etc.) Note that *(n)* reflects only the number of independent detections used to estimate density (i.e., after any truncation of outliers), and may be less than the number of independent detections or the number of individuals observed.

For the BCR-based samples, after we calculated detection probabilities in Distance we used the SPSURVEY package (Kincaid 2008) in Program R (R Development Core Team 2008) to estimate density and its variance for each bird species. For the habitat-based samples, we used bootstrapping (1000 replications) to estimate the variance of density estimates.

## Occupancy Analysis

We used a multi-scale occupancy model (Nichols et al. 2008) to estimate 1) the proportion of 1-$km^2$ sampling units occupied by a species (Psi), 2) the proportion of points occupied by a species given presence within the1-$km^2$ sampling units (Theta) and 3) the probability of detecting a species given presence (p). We constrained Theta and p by holding these parameters constant. Our application of the multi-scale model is analogous to a within-season robust design (Pollock 1982) where the points are the primary samples for estimating Theta and the sampling intervals at each point are the secondary samples for estimating p (Nichols et al. 2008). We considered both Theta and p to be nuisance variables that were important for generating unbiased estimates of Psi. Theta can be considered an availability parameter or the probability that a species was present and available for sampling at the points (Nichols et al. 2008). We estimated the detection probabilities (p) using a removal model with 3 intervals. Using the five 1-minute intervals recorded during sampling, we binned minutes 1 and 2, and minutes 3 and 4 to meet the assumption of a monotonic decline in the detection rates. After the target species was detected at a point, we set all subsequent sample intervals at that point to missing data. We truncated the data, using only detections within 125 m of the sample points. We used program SAS (PROC NLMIXED, SAS Institute 2008) to estimate the model parameters and account for unequal interval length. Gary White from Colorado State University wrote the initial SAS code for running the multi-scale occupancy models. We combined stratum-level estimates of Psi using a weighted mean indexed by stratum area. We estimated

the sampling variance and standard error for the weighted mean of Psi using the delta method (Powell 2007) in program SAS (PROC IML, SAS Institute 2008).

Unless otherwise specified, all bird species names listed in this report are from the American Ornithologists'' Union (A.O.U.) Check-list of North American Birds, Seventh Edition (2007).

# RESULTS

## Habitat-based Results

In 2009, our ninth year of bird monitoring in BHNF, we conducted 1,277 point counts along 100 point transects in five habitats. We surveyed transects between 17 May and 17 July (Table 1).

Table 1. Bird sampling periods and effort in Black Hills National Forest, 2009.

| Habitat | Dates Sampled | # Transects | #Point Counts |
|---|---|---|---|
| Burn Area | 24 May - 20 June | 20 | 257 |
| Late-successional Pine | 18 May - 9 July | 20 | 242 |
| Ponderosa Pine North | 8 June - 14 July | 20 | 269 |
| Ponderosa Pine South | 29 May - 24 June | 20 | 260 |
| White Spruce | 17 May - 17 July | 20 | 249 |
| **All Habitats** | **17 May - 17 July** | **100** | **1,277** |

We recorded 11,677 birds of 91 species (Table 2). We estimated densities of 42 of these species in at least one habitat (Tables 3-7). The data yielded precise density estimates (Coefficient of Variation [CV] < 50%) for all 42 species in at least one habitat for 2009. These 42 species represent 46% of all species recorded on point-count transects in the Black Hills during 2001-2009, and 96% of all birds observed. The number of species recorded in each habitat in 2009 ranged from 53 in Burn Area to 60 in Ponderosa Pine South (Table 2). Of the five habitats sampled in 2009, the average number of species per transect was greatest in Burn Area and Ponderosa Pine North and fewest in White Spruce (Table 2).

Table 2. Birds recorded by habitat in Black Hills National Forest, 2009.

| Habitat | # birds recorded | Avg. # birds per transect | # species recorded | Avg. # species per transect |
|---|---|---|---|---|
| Burn Area | 2,272 | 114 | 53 | 24 |
| Late-successional Pine | 1,865 | 93 | 59 | 22 |
| Ponderosa Pine North | 2,682 | 134 | 56 | 24 |
| Ponderosa Pine South | 2,391 | 120 | 60 | 23 |
| White Spruce | 2,467 | 123 | 58 | 20 |
| **All Habitats** | **11,677** | **117** | **91** | **23** |

### Burn Area (BU)

We estimated densities of 27 species in BU for 2009. The pooled 2001-2009 data from BU yielded precise density estimates for all 27 species (Table 3). These species represent 51% of species recorded in BU in 2009, and 91% of all birds recorded. The following species had the highest estimated densities of all species recorded in BU (listed in order of highest to lowest density):

1. Chipping Sparrow
2. Dark-eyed Junco
3. Mountain Bluebird
4. Brown-headed Cowbird

5. Vesper Sparrow
6. Western Tanager
7. Northern Flicker
8. American Robin
9. House Wren
10. Black-capped Chickadee

The following 10 species had higher estimated densities in BU relative to the other four habitats sampled (listed in order of highest to lowest density):

1. Mountain Bluebird
2. Brown-headed Cowbird
3. Vesper Sparrow
4. Northern Flicker
5. House Wren
6. Hairy Woodpecker
7. Red-headed Woodpecker
8. Black-backed Woodpecker
9. Eastern Bluebird
10. Western Meadowlark

Table 3. Estimated densities of breeding birds in Burn Area in Black Hills National Forest, 2001-2009[1].

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| Mourning Dove | 2001 | 0.2 | 0.1 | 0.6 | 59 | 8 |
| | 2002 | 1.1 | 0.7 | 1.9 | 30 | 36 |
| | 2003 | 0.8 | 0.5 | 1.5 | 37 | 27 |
| | 2004 | 2.2 | 1.4 | 3.4 | 28 | 68 |
| | 2005 | 0.4 | 0.2 | 0.7 | 40 | 12 |
| | 2007 | 2.1 | 1.4 | 3.2 | 25 | 27 |
| | 2009 | 1.4 | 0.9 | 2.2 | 27 | 40 |
| Red-headed Woodpecker[2] | 2001 | 0.6 | 0.3 | 1.2 | 50 | 13 |
| | 2002 | 0.8 | 0.4 | 1.4 | 37 | 16 |
| | 2003 | 0.7 | 0.4 | 1.3 | 36 | 16 |
| | 2004 | 1.0 | 0.6 | 1.8 | 34 | 20 |
| | 2005 | 1.6 | 1.0 | 2.7 | 31 | 33 |
| | 2007 | 2.0 | 1.3 | 3.1 | 27 | 23 |
| | 2009 | 7.2 | 3.9 | 13.1 | 38 | 89 |
| Hairy Woodpecker | 2001 | 2.0 | 1.3 | 3.1 | 26 | 18 |
| | 2002 | 15.4 | 11.8 | 20.2 | 16 | 129 |
| | 2003 | 13.9 | 10.5 | 18.3 | 17 | 121 |
| | 2004 | 16.0 | 12.9 | 19.9 | 13 | 131 |
| | 2005 | 9.4 | 7.5 | 11.8 | 14 | 80 |
| | 2007 | 15.7 | 11.4 | 21.5 | 19 | 48 |
| | 2009 | 9.7 | 6.8 | 14.0 | 22 | 77 |
| Black-backed Woodpecker[2] | 2001 | 0.6 | 0.3 | 1.2 | 50 | 4 |
| | 2002 | 6.2 | 3.1 | 12.4 | 44 | 41 |
| | 2003 | 4.7 | 2.6 | 8.7 | 38 | 33 |
| | 2004 | 4.4 | 2.3 | 8.1 | 39 | 29 |
| | 2005 | 2.5 | 1.3 | 4.6 | 40 | 17 |
| | 2007 | 2.3 | 1.1 | 4.8 | 46 | 10 |
| | 2009 | 6.8 | 3.4 | 13.3 | 43 | 27 |
| Northern Flicker | 2001 | 1.6 | 1.1 | 2.4 | 24 | 25 |
| | 2002 | 2.1 | 1.4 | 3.2 | 25 | 31 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2003 | 2.5 | 1.7 | 3.7 | 24 | 38 |
| | 2004 | 4.7 | 3.4 | 6.4 | 20 | 68 |
| | 2005 | 7.8 | 6.2 | 9.9 | 14 | 115 |
| | 2007 | 6.7 | 4.7 | 9.6 | 22 | 60 |
| | 2009 | 15.9 | 12.1 | 20.7 | 16 | 139 |
| Western Wood-Pewee | 2001 | 1.5 | 0.7 | 3.1 | 48 | 30 |
| | 2002 | 2.3 | 1.3 | 4.2 | 37 | 44 |
| | 2003 | 6.1 | 4.3 | 8.6 | 21 | 117 |
| | 2004 | 11.3 | 8.6 | 14.7 | 16 | 214 |
| | 2005 | 4.9 | 3.4 | 7.2 | 23 | 94 |
| | 2007 | 15.1 | 11.4 | 20.1 | 17 | 75 |
| | 2009 | 6.9 | 3.5 | 13.4 | 41 | 170 |
| Dusky Flycatcher | 2001 | 7.0 | 4.8 | 10.2 | 23 | 70 |
| | 2002 | 11.8 | 7.7 | 18.1 | 26 | 95 |
| | 2003 | 11.9 | 8.5 | 16.6 | 20 | 136 |
| | 2004 | 12.7 | 8.6 | 18.7 | 24 | 96 |
| | 2005 | 10.5 | 7.5 | 14.7 | 21 | 141 |
| | 2007 | 28.0 | 13.0 | 60.4 | 49 | 53 |
| | 2009 | 10.0 | 6.7 | 14.9 | 24 | 102 |
| Plumbeous Vireo | 2001 | 5.2 | 3.3 | 8.0 | 27 | 49 |
| | 2002 | 5.5 | 3.7 | 8.4 | 26 | 50 |
| | 2003 | 6.7 | 4.3 | 10.4 | 27 | 61 |
| | 2004 | 3.5 | 2.3 | 5.2 | 25 | 32 |
| | 2005 | 5.0 | 3.0 | 8.2 | 31 | 46 |
| | 2007 | 4.8 | 3.0 | 7.7 | 30 | 27 |
| | 2009 | 5.0 | 2.6 | 9.6 | 42 | 27 |
| Warbling Vireo | 2001 | 4.1 | 2.6 | 6.5 | 28 | 53 |
| | 2002 | 4.0 | 2.3 | 7.0 | 35 | 48 |
| | 2003 | 3.8 | 2.4 | 6.0 | 28 | 48 |
| | 2004 | 6.4 | 4.2 | 9.5 | 25 | 79 |
| | 2005 | 3.4 | 2.2 | 5.4 | 28 | 43 |
| | 2007 | 9.3 | 6.2 | 14.0 | 25 | 38 |
| | 2009 | 5.3 | 3.0 | 9.4 | 36 | 69 |
| Gray Jay | 2001 | 3.7 | 2.0 | 6.9 | 39 | 23 |
| | 2002 | 4.7 | 2.3 | 9.9 | 47 | 27 |
| | 2003 | 4.0 | 2.0 | 8.0 | 43 | 24 |
| | 2004 | 2.9 | 1.3 | 6.7 | 53 | 13 |
| | 2005 | 2.5 | 1.0 | 4.1 | 235 | 12 |
| | 2007 | 0.6 | 0.1 | 2.5 | 109 | 1 |
| | 2009 | 2.6 | 1.1 | 6.2 | 57 | 9 |
| American Crow | 2001 | 0.2 | 0.1 | 0.4 | 34 | 39 |
| | 2002 | 0.2 | 0.1 | 0.3 | 26 | 26 |
| | 2003 | 0.3 | 0.2 | 0.4 | 23 | 40 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2004 | 0.2 | 0.1 | 0.4 | 42 | 22 |
| | 2005 | 0.1 | 0.1 | 0.2 | 35 | 22 |
| | 2007 | 0.3 | 0.2 | 0.4 | 26 | 24 |
| | 2009 | 0.3 | 0.2 | 0.5 | 28 | 26 |
| Black-capped Chickadee | 2001 | 9.8 | 7.1 | 13.4 | 19 | 93 |
| | 2002 | 15.3 | 11.4 | 20.6 | 18 | 135 |
| | 2003 | 7.8 | 5.2 | 11.6 | 25 | 72 |
| | 2004 | 9.4 | 6.5 | 13.7 | 23 | 82 |
| | 2005 | 7.5 | 5.4 | 10.4 | 20 | 66 |
| | 2007 | 9.8 | 6.9 | 13.8 | 21 | 48 |
| | 2009 | 11.7 | 8.0 | 17.0 | 23 | 55 |
| Red-breasted Nuthatch | 2001 | 3.4 | 1.6 | 7.3 | 49 | 56 |
| | 2002 | 6.1 | 3.4 | 10.9 | 37 | 95 |
| | 2003 | 2.7 | 1.4 | 5.0 | 40 | 44 |
| | 2004 | 2.7 | 1.4 | 5.2 | 40 | 43 |
| | 2005 | 3.8 | 1.7 | 8.4 | 52 | 61 |
| | 2007 | 3.8 | 2.1 | 6.9 | 38 | 35 |
| | 2009 | 3.7 | 1.7 | 7.9 | 48 | 38 |
| White-breasted Nuthatch | 2001 | 3.9 | 0.7 | 20.8 | 136 | 31 |
| | 2002 | 6.7 | 1.3 | 35.6 | 133 | 51 |
| | 2003 | 9.6 | 2.1 | 44.6 | 117 | 76 |
| | 2004 | 8.1 | 1.6 | 41.6 | 130 | 62 |
| | 2005 | 9.1 | 1.7 | 47.4 | 132 | 70 |
| | 2007 | 13.4 | 3.0 | 59.7 | 113 | 21 |
| | 2009 | 4.7 | 0.9 | 23.5 | 127 | 65 |
| Rock Wren | 2001 | 0.1 | 0.0 | 0.2 | 71 | 3 |
| | 2002 | 0.2 | 0.1 | 0.5 | 71 | 6 |
| | 2003 | 0.3 | 0.2 | 0.6 | 38 | 12 |
| | 2004 | 2.0 | 1.3 | 2.9 | 25 | 67 |
| | 2005 | 2.4 | 1.5 | 3.8 | 29 | 80 |
| | 2007 | 0.4 | 0.3 | 0.8 | 34 | 9 |
| | 2009 | 0.7 | 0.3 | 1.5 | 47 | 15 |
| House Wren | 2001 | 0.1 | 0.0 | 0.5 | 109 | 1 |
| | 2002 | 0.6 | 0.3 | 1.1 | 40 | 7 |
| | 2003 | 1.5 | 0.9 | 2.4 | 32 | 19 |
| | 2004 | 6.9 | 4.7 | 10.1 | 23 | 85 |
| | 2005 | 7.8 | 5.4 | 11.4 | 23 | 100 |
| | 2007 | 12.7 | 9.0 | 18.0 | 21 | 95 |
| | 2009 | 13.0 | 8.4 | 20.2 | 27 | 98 |
| Eastern Bluebird | 2001 | 2.0 | 1.0 | 3.8 | 41 | 24 |
| | 2002 | 2.8 | 1.6 | 5.1 | 37 | 31 |
| | 2003 | 3.2 | 2.1 | 5.0 | 27 | 35 |
| | 2004 | 4.3 | 2.6 | 7.1 | 31 | 51 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2005 | 4.1 | 2.8 | 5.9 | 23 | 46 |
| | 2007 | 2.8 | 1.6 | 4.7 | 34 | 14 |
| | 2009 | 2.1 | 1.0 | 4.4 | 47 | 20 |
| Mountain Bluebird[2] | 2001 | 5.6 | 3.7 | 8.5 | 25 | 35 |
| | 2002 | 9.3 | 5.9 | 14.6 | 28 | 54 |
| | 2003 | 9.6 | 6.6 | 13.9 | 23 | 58 |
| | 2004 | 19.6 | 15.2 | 25.4 | 16 | 110 |
| | 2005 | 30.6 | 23.0 | 40.7 | 17 | 170 |
| | 2007 | 35.3 | 26.7 | 46.7 | 17 | 112 |
| | 2009 | 38.7 | 29.1 | 51.6 | 18 | 126 |
| Townsend's Solitaire | 2001 | 7.3 | 5.9 | 9.2 | 14 | 152 |
| | 2002 | 8.7 | 6.8 | 11.1 | 15 | 171 |
| | 2003 | 8.6 | 6.7 | 11.1 | 15 | 175 |
| | 2004 | 7.5 | 5.9 | 9.4 | 14 | 151 |
| | 2005 | 3.5 | 2.6 | 4.7 | 18 | 71 |
| | 2007 | 5.4 | 3.8 | 7.6 | 22 | 30 |
| | 2009 | 2.6 | 1.4 | 5.0 | 41 | 66 |
| American Robin | 2001 | 17.2 | 13.6 | 21.8 | 14 | 271 |
| | 2002 | 22.0 | 17.2 | 28.1 | 15 | 323 |
| | 2003 | 24.6 | 20.4 | 29.6 | 11 | 378 |
| | 2004 | 20.6 | 16.9 | 25.0 | 12 | 311 |
| | 2005 | 20.9 | 17.3 | 25.1 | 11 | 316 |
| | 2007 | 13.6 | 10.5 | 17.8 | 16 | 119 |
| | 2009 | 13.8 | 11.0 | 17.2 | 14 | 124 |
| Yellow-rumped Warbler | 2001 | 22.9 | 18.9 | 27.7 | 12 | 372 |
| | 2002 | 23.1 | 17.4 | 30.6 | 17 | 353 |
| | 2003 | 15.7 | 12.8 | 19.2 | 12 | 248 |
| | 2004 | 7.4 | 5.7 | 9.6 | 16 | 116 |
| | 2005 | 8.9 | 6.7 | 12.0 | 18 | 141 |
| | 2007 | 10.7 | 7.9 | 14.4 | 18 | 37 |
| | 2009 | 4.0 | 2.5 | 6.5 | 30 | 102 |
| Western Tanager | 2001 | 11.4 | 6.2 | 21.2 | 39 | 138 |
| | 2002 | 10.5 | 6.7 | 16.4 | 27 | 151 |
| | 2003 | 23.2 | 13.3 | 40.4 | 35 | 275 |
| | 2004 | 20.9 | 12.2 | 35.6 | 33 | 127 |
| | 2005 | 12.7 | 8.2 | 19.9 | 27 | 136 |
| | 2007 | 7.9 | 5.3 | 11.8 | 24 | 68 |
| | 2009 | 17.9 | 11.2 | 28.7 | 29 | 77 |
| Chipping Sparrow | 2001 | 42.8 | 20.9 | 87.6 | 45 | 144 |
| | 2002 | 34.5 | 23.0 | 51.7 | 25 | 194 |
| | 2003 | 108.8 | 33.7 | 351.0 | 81 | 323 |
| | 2004 | 194.5 | 82.2 | 460.1 | 56 | 299 |
| | 2005 | 157.8 | 107.8 | 230.9 | 23 | 438 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2007 | 188.5 | 116.2 | 305.8 | 30 | 195 |
| | 2009 | 115.0 | 62.3 | 212.2 | 38 | 197 |
| Vesper Sparrow[2] | 2001 | 2.0 | 1.2 | 3.3 | 32 | 30 |
| | 2002 | 3.2 | 1.8 | 5.8 | 38 | 45 |
| | 2003 | 3.1 | 2.2 | 4.5 | 23 | 47 |
| | 2004 | 5.8 | 4.4 | 7.6 | 17 | 84 |
| | 2005 | 7.7 | 5.8 | 10.3 | 18 | 113 |
| | 2007 | 16.9 | 12.6 | 22.7 | 18 | 149 |
| | 2009 | 20.2 | 14.7 | 27.9 | 20 | 170 |
| Dark-eyed Junco[2] | 2001 | 47.6 | 34.5 | 65.7 | 20 | 195 |
| | 2002 | 56.9 | 41.6 | 78.0 | 19 | 221 |
| | 2003 | 67.3 | 49.9 | 90.7 | 18 | 271 |
| | 2004 | 86.7 | 63.4 | 118.6 | 19 | 320 |
| | 2005 | 81.4 | 58.8 | 112.6 | 20 | 312 |
| | 2007 | 115.5 | 83.1 | 160.5 | 20 | 93 |
| | 2009 | 47.0 | 29.8 | 74.1 | 28 | 271 |
| Western Meadowlark[2] | 2001 | -- | -- | -- | -- | 0 |
| | 2002 | 0.2 | 0.1 | 0.4 | 66 | 8 |
| | 2003 | 0.3 | 0.2 | 0.7 | 48 | 17 |
| | 2004 | 1.7 | 1.0 | 3.0 | 33 | 87 |
| | 2005 | 1.9 | 1.1 | 3.3 | 33 | 95 |
| | 2007 | 1.7 | 1.0 | 2.8 | 31 | 50 |
| | 2009 | 1.8 | 1.0 | 3.4 | 39 | 53 |
| Brown-headed Cowbird | 2001 | 25.2 | 17.9 | 35.4 | 21 | 150 |
| | 2002 | 19.5 | 13.8 | 27.7 | 21 | 146 |
| | 2003 | 22.5 | 12.8 | 39.6 | 35 | 188 |
| | 2004 | 38.9 | 22.8 | 66.2 | 33 | 148 |
| | 2005 | 28.0 | 17.0 | 46.0 | 31 | 177 |
| | 2007 | 33.8 | 22.4 | 51.1 | 25 | 94 |
| | 2009 | 27.2 | 19.7 | 37.6 | 20 | 137 |
| Red Crossbill | 2001 | 23.5 | 12.7 | 43.4 | 38 | 175 |
| | 2002 | 78.3 | 44.8 | 136.9 | 35 | 469 |
| | 2003 | 4.4 | 1.8 | 10.7 | 53 | 14 |
| | 2004 | 93.7 | 61.9 | 141.9 | 26 | 227 |
| | 2005 | 5.9 | 2.8 | 12.1 | 45 | 31 |
| | 2007 | 51.2 | 33.6 | 78.0 | 26 | 24 |
| | 2009 | 9.4 | 4.5 | 19.7 | 45 | 98 |
| Pine Siskin | 2001 | 10.7 | 5.0 | 22.6 | 48 | 46 |
| | 2002 | 17.4 | 8.7 | 34.8 | 44 | 69 |
| | 2003 | 5.6 | 2.8 | 11.5 | 45 | 24 |
| | 2004 | 0.7 | 0.3 | 2.1 | 70 | 3 |
| | 2005 | 9.5 | 4.5 | 19.7 | 47 | 32 |
| | 2007 | 3.5 | 1.3 | 9.3 | 64 | 7 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2009 | 4.4 | 1.8 | 11.0 | 58 | 8 |
| American Goldfinch | 2001 | 1.3 | 0.8 | 2.1 | 32 | 14 |
| | 2002 | 2.4 | 1.2 | 4.5 | 40 | 25 |
| | 2003 | 3.7 | 2.6 | 5.4 | 23 | 39 |
| | 2004 | 0.4 | 0.2 | 0.7 | 47 | 4 |
| | 2005 | 2.5 | 1.5 | 4.1 | 31 | 26 |
| | 2007 | 2.9 | 1.4 | 6.0 | 46 | 7 |
| | 2009 | 1.1 | 0.5 | 2.7 | 56 | 16 |
| Red Squirrel | 2001 | -- | -- | -- | -- | 0 |
| | 2002 | 1.5 | 0.5 | 4.7 | 77 | 3 |
| | 2003 | 2.9 | 1.2 | 7.0 | 56 | 6 |
| | 2004 | 4.4 | 1.9 | 10.2 | 52 | 9 |
| | 2005 | 1.0 | 0.3 | 3.0 | 76 | 2 |
| | 2007 | 15.9 | 8.1 | 31.1 | 42 | 13 |
| | 2009 | 10.7 | 5.7 | 19.9 | 38 | 20 |

[1]D = estimated density (birds/km$^2$); LCL and UCL = lower and upper 90% confidence limits on D; %CV = percent coefficient of variation of D; n = number of observations used to estimate D. Note: if n<10, then we omitted the density estimates.
[2]Priority species in Black Hills National Forest.

## Late-successional Pine (LS)

We estimated densities of 25 species in LS for 2009. The pooled 2001-2009 data from LS yielded precise density estimates of all 25 species (Table 3). These species represent 44% of species recorded in LS in 2009, and more than 90% of all individual birds recorded. The following species had the highest estimated densities of all species recorded in LS (listed in order of highest to lowest density):

1. Chipping Sparrow
2. Dark-eyed Junco
3. American Robin
4. Yellow-rumped Warbler
5. Red-breasted Nuthatch
6. Red Squirrel
7. Ovenbird
8. Black-capped Chickadee
9. Ruby-crowned Kinglet
10. White-breasted Nuthatch

The following three species had higher estimated densities in LS relative to the other four habitats sampled (listed in order of highest to lowest density):

1. White-breasted Nuthatch
2. Western Wood-Pewee
3. Brown Creeper

Table 4. Estimated densities of breeding birds in Late-successional Pine in Black Hills National Forest, 2001-2009[1].

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| Red-naped Sapsucker | 2001 | 8.3 | 3.7 | 18.5 | 51 | 18 |
| | 2002 | 7.3 | 3.0 | 17.6 | 57 | 16 |
| | 2004 | 15.5 | 7.4 | 32.5 | 47 | 38 |
| | 2007 | 16.6 | 5.3 | 52.3 | 78 | 16 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2009 | 16.0 | 7.5 | 34.3 | 48 | 23 |
| Hairy Woodpecker | 2001 | 2.5 | 1.3 | 4.7 | 40 | 12 |
| | 2002 | 6.6 | 4.1 | 10.7 | 30 | 33 |
| | 2004 | 6.8 | 3.8 | 12.2 | 36 | 38 |
| | 2007 | 8.7 | 5.1 | 14.9 | 34 | 21 |
| | 2009 | 6.7 | 4.0 | 11.4 | 33 | 21 |
| Northern Flicker | 2001 | 0.6 | 0.3 | 1.3 | 48 | 8 |
| | 2002 | 0.3 | 0.1 | 0.7 | 54 | 4 |
| | 2004 | 0.8 | 0.4 | 1.4 | 38 | 12 |
| | 2007 | 1.1 | 0.5 | 2.5 | 52 | 7 |
| | 2009 | 3.4 | 2.0 | 5.9 | 33 | 29 |
| Western Wood-Pewee | 2001 | 2.0 | 0.4 | 10.5 | 128 | 12 |
| | 2002 | 3.3 | 1.3 | 8.7 | 63 | 23 |
| | 2004 | 3.2 | 1.4 | 7.2 | 53 | 25 |
| | 2007 | 8.3 | 3.6 | 18.9 | 53 | 29 |
| | 2009 | 14.0 | 6.9 | 28.2 | 45 | 63 |
| Dusky Flycatcher | 2001 | 8.1 | 5.2 | 12.8 | 28 | 41 |
| | 2002 | 10.4 | 6.8 | 15.8 | 26 | 54 |
| | 2004 | 11.4 | 7.0 | 18.7 | 30 | 69 |
| | 2007 | 17.2 | 10.0 | 29.7 | 34 | 43 |
| | 2009 | 11.7 | 6.9 | 19.9 | 33 | 39 |
| Cordilleran Flycatcher | 2001 | 6.8 | 4.0 | 11.6 | 33 | 24 |
| | 2002 | 12.4 | 6.6 | 23.6 | 40 | 45 |
| | 2004 | 9.8 | 5.3 | 17.9 | 38 | 42 |
| | 2007 | 5.6 | 2.7 | 11.5 | 46 | 10 |
| | 2009 | 1.3 | 0.5 | 3.2 | 61 | 3 |
| Plumbeous Vireo | 2001 | 1.6 | 0.5 | 4.9 | 74 | 13 |
| | 2002 | 2.3 | 0.9 | 5.7 | 60 | 18 |
| | 2004 | 1.5 | 0.4 | 5.4 | 88 | 14 |
| | 2007 | 2.2 | 0.5 | 9.2 | 106 | 8 |
| | 2009 | 2.7 | 0.7 | 10.1 | 95 | 14 |
| Warbling Vireo | 2001 | 17.0 | 10.7 | 27.0 | 29 | 175 |
| | 2002 | 13.7 | 9.5 | 19.7 | 23 | 148 |
| | 2004 | 24.7 | 18.5 | 33.0 | 18 | 240 |
| | 2007 | 29.5 | 18.4 | 47.2 | 29 | 122 |
| | 2009 | 18.9 | 11.6 | 30.8 | 30 | 95 |
| Gray Jay | 2001 | 4.7 | 2.2 | 9.8 | 46 | 15 |
| | 2002 | 6.5 | 3.8 | 11.4 | 34 | 22 |
| | 2004 | 9.5 | 5.0 | 18.2 | 40 | 19 |
| | 2007 | 3.6 | 1.2 | 11.1 | 58 | 4 |
| | 2009 | 4.7 | 1.2 | 17.9 | 76 | 5 |
| American Crow | 2001 | 0.3 | 0.1 | 0.5 | 41 | 20 |
| | 2002 | 0.2 | 0.1 | 0.5 | 41 | 18 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2004 | 0.1 | 0.0 | 0.2 | 44 | 8 |
| | 2007 | 0.2 | 0.1 | 0.5 | 46 | 8 |
| | 2009 | 0.2 | 0.1 | 0.5 | 43 | 11 |
| Black-capped Chickadee | 2001 | 12.5 | 9.3 | 16.7 | 18 | 80 |
| | 2002 | 14.6 | 10.9 | 19.5 | 18 | 98 |
| | 2004 | 14.0 | 10.5 | 18.7 | 18 | 107 |
| | 2007 | 13.5 | 9.9 | 18.4 | 19 | 43 |
| | 2009 | 19.1 | 14.2 | 25.6 | 18 | 73 |
| Red-breasted Nuthatch | 2001 | 16.6 | 11.9 | 23.0 | 20 | 169 |
| | 2002 | 19.1 | 10.7 | 34.2 | 36 | 181 |
| | 2004 | 32.9 | 23.3 | 46.6 | 21 | 195 |
| | 2007 | 42.2 | 26.9 | 66.1 | 28 | 134 |
| | 2009 | 27.4 | 17.9 | 42.1 | 26 | 115 |
| White-breasted Nuthatch | 2001 | 3.0 | 1.4 | 6.4 | 48 | 11 |
| | 2002 | 3.5 | 1.9 | 6.5 | 38 | 13 |
| | 2004 | 5.4 | 2.0 | 14.6 | 65 | 20 |
| | 2007 | 6.0 | 2.7 | 13.6 | 51 | 9 |
| | 2009 | 20.4 | 10.7 | 39.0 | 41 | 47 |
| Brown Creeper[2] | 2001 | 11.1 | 7.0 | 17.6 | 29 | 32 |
| | 2002 | 11.8 | 7.4 | 19.0 | 29 | 36 |
| | 2004 | 14.1 | 9.2 | 21.7 | 26 | 50 |
| | 2007 | 0.7 | 0.2 | 2.7 | 98 | 1 |
| | 2009 | 9.2 | 5.8 | 14.5 | 28 | 18 |
| Golden-crowned Kinglet[2] | 2001 | 0.6 | 0.1 | 3.0 | 121 | 1 |
| | 2002 | 3.5 | 1.2 | 10.7 | 74 | 6 |
| | 2004 | 19.5 | 6.9 | 55.1 | 69 | 35 |
| | 2007 | 3.7 | 0.1 | 145.3 | 87 | 2 |
| | 2009 | 15.6 | 6.9 | 35.6 | 52 | 15 |
| Ruby-crowned Kinglet | 2001 | 2.3 | 1.1 | 4.7 | 45 | 18 |
| | 2002 | 7.6 | 4.3 | 13.2 | 35 | 62 |
| | 2004 | 9.0 | 5.5 | 14.9 | 31 | 84 |
| | 2007 | 7.6 | 4.0 | 14.2 | 39 | 29 |
| | 2009 | 17.9 | 10.4 | 30.7 | 33 | 95 |
| Townsend's Solitaire | 2001 | 6.9 | 4.8 | 9.7 | 21 | 87 |
| | 2002 | 9.0 | 6.3 | 12.9 | 22 | 115 |
| | 2004 | 10.6 | 7.3 | 15.4 | 23 | 156 |
| | 2007 | 4.1 | 2.4 | 7.0 | 33 | 26 |
| | 2009 | 4.3 | 2.7 | 6.7 | 28 | 34 |
| Swainson's Thrush | 2001 | 5.4 | 3.3 | 9.0 | 31 | 39 |
| | 2002 | 4.3 | 2.3 | 8.1 | 39 | 32 |
| | 2004 | 6.6 | 4.1 | 10.8 | 30 | 55 |
| | 2007 | 6.5 | 2.4 | 17.4 | 65 | 23 |
| | 2009 | 4.4 | 1.7 | 11.0 | 60 | 21 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| American Robin | 2001 | 14.0 | 7.4 | 26.2 | 39 | 118 |
| | 2002 | 19.0 | 10.0 | 36.2 | 40 | 165 |
| | 2004 | 33.3 | 22.7 | 48.9 | 24 | 213 |
| | 2007 | 24.5 | 12.4 | 48.2 | 43 | 78 |
| | 2009 | 30.8 | 20.4 | 46.5 | 25 | 116 |
| Yellow-rumped Warbler | 2001 | 33.3 | 26.1 | 42.6 | 15 | 231 |
| | 2002 | 36.1 | 29.1 | 44.8 | 13 | 258 |
| | 2004 | 30.7 | 23.3 | 40.3 | 17 | 255 |
| | 2007 | 45.3 | 34.7 | 59.1 | 16 | 158 |
| | 2009 | 30.6 | 23.5 | 40.0 | 16 | 143 |
| American Redstart | 2001 | 4.1 | 1.5 | 11.1 | 66 | 23 |
| | 2002 | 2.1 | 1.0 | 4.4 | 47 | 12 |
| | 2004 | 4.4 | 1.7 | 11.0 | 60 | 28 |
| | 2007 | 3.2 | 1.1 | 9.2 | 71 | 9 |
| | 2009 | 2.6 | 0.8 | 8.0 | 76 | 9 |
| Ovenbird | 2001 | 23.6 | 15.8 | 35.3 | 25 | 203 |
| | 2002 | 21.8 | 15.0 | 31.7 | 23 | 191 |
| | 2004 | 21.4 | 14.5 | 31.7 | 24 | 218 |
| | 2007 | 30.4 | 16.5 | 56.0 | 37 | 130 |
| | 2009 | 19.8 | 11.0 | 35.6 | 36 | 112 |
| MacGillivray's Warbler | 2001 | 4.0 | 1.7 | 9.7 | 56 | 14 |
| | 2002 | 4.0 | 2.2 | 7.1 | 36 | 15 |
| | 2004 | 4.8 | 1.9 | 11.9 | 59 | 22 |
| | 2007 | 7.4 | 2.8 | 19.2 | 63 | 14 |
| | 2009 | 3.8 | 1.3 | 11.4 | 73 | 9 |
| Western Tanager | 2001 | 8.2 | 5.3 | 12.8 | 27 | 98 |
| | 2002 | 6.4 | 4.7 | 8.8 | 19 | 111 |
| | 2004 | 9.9 | 6.5 | 15.1 | 26 | 99 |
| | 2007 | 12.9 | 7.3 | 22.9 | 35 | 66 |
| | 2009 | 15.2 | 8.3 | 27.7 | 37 | 74 |
| Chipping Sparrow | 2001 | 17.4 | 11.0 | 27.7 | 29 | 43 |
| | 2002 | 22.6 | 14.0 | 36.5 | 30 | 57 |
| | 2004 | 39.7 | 25.2 | 62.6 | 28 | 106 |
| | 2007 | 41.8 | 24.8 | 70.6 | 33 | 50 |
| | 2009 | 64.7 | 42.5 | 98.5 | 26 | 100 |
| Dark-eyed Junco[2] | 2001 | 17.7 | 7.7 | 40.8 | 54 | 168 |
| | 2002 | 49.1 | 16.3 | 148.1 | 75 | 184 |
| | 2004 | 61.5 | 38.5 | 98.1 | 29 | 207 |
| | 2007 | 46.6 | 20.5 | 105.9 | 53 | 123 |
| | 2009 | 58.7 | 35.2 | 97.7 | 32 | 134 |
| Brown-headed Cowbird | 2001 | 5.2 | 3.3 | 8.4 | 29 | 29 |
| | 2002 | 6.1 | 3.6 | 10.5 | 34 | 33 |
| | 2004 | 4.9 | 2.9 | 8.3 | 32 | 28 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2007 | 10.3 | 6.6 | 16.2 | 28 | 28 |
| | 2009 | 13.1 | 7.8 | 22.1 | 32 | 39 |
| Red Crossbill | 2001 | 28.8 | 16.6 | 50.1 | 34 | 194 |
| | 2002 | 27.0 | 14.5 | 50.3 | 39 | 138 |
| | 2004 | 45.0 | 29.7 | 68.3 | 26 | 109 |
| | 2007 | 30.7 | 18.0 | 52.3 | 33 | 74 |
| | 2009 | 17.6 | 10.9 | 28.3 | 30 | 58 |
| Pine Siskin | 2001 | 11.9 | 6.4 | 22.0 | 39 | 47 |
| | 2002 | 9.5 | 5.1 | 17.7 | 39 | 39 |
| | 2004 | 2.3 | 0.9 | 5.9 | 60 | 11 |
| | 2007 | 7.1 | 3.2 | 15.4 | 50 | 14 |
| | 2009 | 10.2 | 5.4 | 19.3 | 39 | 20 |
| Red Squirrel | 2001 | 16.6 | 10.8 | 25.6 | 27 | 41 |
| | 2002 | 21.2 | 12.0 | 37.4 | 35 | 53 |
| | 2004 | 12.7 | 8.1 | 19.9 | 28 | 38 |
| | 2007 | 79.7 | 48.5 | 131.0 | 30 | 99 |
| | 2009 | 25.1 | 16.8 | 37.4 | 25 | 42 |

[1]D = estimated density (birds/km$^2$); LCL and UCL = lower and upper 90% confidence limits on D; %CV = percent coefficient of variation of D; n = number of observations used to estimate D. Note: if n<10, then we omitted the density estimates.
[2]Prority species in Black Hills National Forest.

## Ponderosa Pine North (PN)

We estimated densities of 27 species in PN for 2009. The pooled 2001-2009 data from PN yielded precise density estimates of all 27 species (Table 3). These species represent 48% of species recorded in PN in 2009, and 94% of all individual birds recorded. The following species had the highest estimated densities of all species recorded in PN (listed in order of highest to lowest density):

1. American Robin
2. Ovenbird
3. Chipping Sparrow
4. Warbling Vireo
5. Red Squirrel
6. Dark-eyed Junco
7. Yellow-rumped Warbler
8. Gray Jay
9. Red-naped Sapsucker
10. Red-breasted Nuthatch

The following 11 species had higher estimated densities in PN relative to the other four habitats sampled (listed in order of highest to lowest density):

1. Ovenbird
2. Warbling Vireo
3. Gray Jay
4. Red-naped Sapsucker
5. Red-breasted Nuthatch
6. American Redstart
7. Dusky Flycatcher
8. Red Crossbill
9. MacGillivray's Warbler
10. Pine Siskin
11. Black-headed Grosbeak

Table 5. Estimated densities of breeding birds in Ponderosa Pine North in Black Hills National Forest, 2001-2009[1].

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| Red-naped Sapsucker | 2001 | 15.7 | 9.5 | 25.9 | 31 | 38 |
| | 2002 | 14.7 | 9.3 | 23.1 | 28 | 33 |
| | 2003 | 18.9 | 11.9 | 30.2 | 29 | 48 |
| | 2005 | 12.1 | 7.4 | 19.8 | 31 | 30 |
| | 2007 | 7.4 | 3.7 | 15.2 | 45 | 12 |
| | 2009 | 29.4 | 18.4 | 47.0 | 29 | 45 |
| Hairy Woodpecker | 2001 | 5.3 | 2.8 | 10.1 | 41 | 22 |
| | 2002 | 6.6 | 3.8 | 11.4 | 34 | 26 |
| | 2003 | 6.2 | 3.6 | 10.9 | 35 | 28 |
| | 2005 | 6.6 | 3.9 | 11.2 | 33 | 27 |
| | 2007 | 5.8 | 3.4 | 9.9 | 33 | 16 |
| | 2009 | 7.3 | 4.1 | 12.7 | 35 | 19 |
| Northern Flicker | 2001 | 1.3 | 0.6 | 2.6 | 44 | 24 |
| | 2002 | 0.6 | 0.2 | 1.4 | 58 | 10 |
| | 2003 | 0.8 | 0.4 | 1.6 | 43 | 15 |
| | 2005 | 1.9 | 1.0 | 3.7 | 42 | 35 |
| | 2007 | 1.0 | 0.5 | 1.9 | 41 | 12 |
| | 2009 | 2.2 | 1.4 | 3.7 | 30 | 27 |
| Western Wood-Pewee | 2001 | 2.8 | 1.5 | 5.3 | 40 | 33 |
| | 2002 | 7.0 | 4.1 | 11.7 | 32 | 76 |
| | 2003 | 7.2 | 4.4 | 11.8 | 31 | 88 |
| | 2005 | 6.2 | 3.8 | 10.2 | 31 | 75 |
| | 2007 | 13.2 | 7.9 | 22.1 | 31 | 98 |
| | 2009 | 11.7 | 7.2 | 18.9 | 29 | 88 |
| Dusky Flycatcher | 2001 | 26.5 | 17.8 | 39.4 | 24 | 150 |
| | 2002 | 27.7 | 19.7 | 39.0 | 21 | 147 |
| | 2003 | 22.0 | 15.7 | 30.8 | 21 | 132 |
| | 2005 | 21.5 | 15.3 | 30.4 | 21 | 126 |
| | 2007 | 25.3 | 18.7 | 34.4 | 19 | 93 |
| | 2009 | 25.4 | 17.4 | 37.1 | 23 | 94 |
| Cordilleran Flycatcher | 2001 | 3.5 | 2.3 | 5.5 | 27 | 22 |
| | 2002 | 3.8 | 2.1 | 7.0 | 37 | 22 |
| | 2003 | 5.7 | 3.3 | 9.9 | 34 | 37 |
| | 2005 | 6.6 | 3.9 | 11.3 | 33 | 42 |
| | 2007 | 3.5 | 2.0 | 6.2 | 34 | 14 |
| | 2009 | 2.7 | 1.4 | 5.3 | 42 | 11 |
| Plumbeous Vireo | 2001 | 3.0 | 1.4 | 6.4 | 48 | 32 |
| | 2002 | 0.9 | 0.4 | 2.1 | 55 | 9 |
| | 2003 | 1.2 | 0.6 | 2.3 | 40 | 14 |
| | 2005 | 2.1 | 1.2 | 3.6 | 33 | 25 |
| | 2007 | 0.9 | 0.4 | 2.0 | 54 | 6 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2009 | 1.3 | 0.5 | 3.3 | 60 | 9 |
| Warbling Vireo | 2001 | 47.2 | 36.5 | 61.1 | 16 | 388 |
| | 2002 | 46.5 | 37.2 | 58.2 | 14 | 355 |
| | 2003 | 39.0 | 31.7 | 48.0 | 13 | 337 |
| | 2005 | 44.7 | 36.1 | 55.2 | 13 | 379 |
| | 2007 | 49.2 | 39.2 | 61.8 | 14 | 259 |
| | 2009 | 56.4 | 44.8 | 70.8 | 14 | 299 |
| Red-eyed Vireo | 2001 | 7.1 | 2.9 | 17.4 | 58 | 33 |
| | 2002 | 3.6 | 1.6 | 8.2 | 53 | 17 |
| | 2003 | 3.6 | 1.5 | 8.2 | 53 | 19 |
| | 2005 | 3.5 | 1.6 | 7.7 | 50 | 18 |
| | 2007 | 1.6 | 0.5 | 5.0 | 77 | 5 |
| | 2009 | 2.6 | 0.8 | 8.8 | 84 | 8 |
| Gray Jay | 2001 | 29.2 | 10.0 | 85.0 | 71 | 21 |
| | 2002 | 4.1 | 1.2 | 13.9 | 86 | 3 |
| | 2003 | 20.7 | 9.8 | 43.7 | 47 | 17 |
| | 2005 | 11.5 | 4.4 | 30.2 | 63 | 9 |
| | 2007 | 20.9 | 8.9 | 48.8 | 55 | 10 |
| | 2009 | 26.7 | 12.5 | 57.0 | 48 | 13 |
| American Crow | 2001 | 0.6 | 0.3 | 1.1 | 41 | 25 |
| | 2002 | 0.2 | 0.1 | 0.4 | 40 | 8 |
| | 2003 | 0.4 | 0.3 | 0.7 | 33 | 20 |
| | 2005 | 0.2 | 0.1 | 0.5 | 44 | 10 |
| | 2007 | 0.7 | 0.4 | 1.3 | 38 | 17 |
| | 2009 | 1.1 | 0.6 | 2.1 | 38 | 28 |
| Black-capped Chickadee | 2001 | 12.0 | 9.0 | 16.0 | 18 | 102 |
| | 2002 | 13.9 | 10.8 | 17.9 | 15 | 109 |
| | 2003 | 13.5 | 10.2 | 17.7 | 17 | 118 |
| | 2005 | 19.7 | 15.3 | 25.3 | 15 | 163 |
| | 2007 | 14.3 | 9.9 | 20.6 | 22 | 76 |
| | 2009 | 9.8 | 6.7 | 14.1 | 22 | 52 |
| Red-breasted Nuthatch | 2001 | 21.0 | 3.7 | 118.5 | 141 | 193 |
| | 2002 | 19.5 | 13.3 | 28.5 | 23 | 197 |
| | 2003 | 28.2 | 3.7 | 215.6 | 188 | 152 |
| | 2005 | 22.5 | 10.7 | 47.5 | 48 | 178 |
| | 2007 | 25.4 | 19.0 | 33.9 | 18 | 144 |
| | 2009 | 26.8 | 18.2 | 39.6 | 24 | 126 |
| White-breasted Nuthatch | 2001 | 2.7 | 1.4 | 4.9 | 38 | 17 |
| | 2002 | 4.2 | 2.1 | 8.4 | 44 | 26 |
| | 2003 | 9.1 | 5.2 | 15.8 | 35 | 60 |
| | 2005 | 2.7 | 1.4 | 5.2 | 40 | 18 |
| | 2007 | 5.6 | 3.2 | 9.8 | 34 | 23 |
| | 2009 | 8.7 | 4.3 | 17.7 | 45 | 36 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| Brown Creeper[2] | 2001 | 3.4 | 1.7 | 6.5 | 42 | 13 |
| | 2002 | 6.1 | 3.5 | 10.7 | 35 | 22 |
| | 2003 | 7.3 | 4.4 | 12.2 | 32 | 30 |
| | 2005 | 7.3 | 4.2 | 12.5 | 34 | 29 |
| | 2007 | 2.4 | 1.1 | 5.3 | 50 | 6 |
| | 2009 | 1.2 | 0.5 | 3.0 | 60 | 3 |
| Ruby-crowned Kinglet | 2001 | 4.7 | 2.6 | 8.5 | 37 | 44 |
| | 2002 | 9.4 | 6.0 | 14.9 | 28 | 81 |
| | 2003 | 5.7 | 3.4 | 9.6 | 32 | 56 |
| | 2005 | 8.2 | 4.9 | 13.8 | 32 | 78 |
| | 2007 | 8.3 | 5.4 | 12.8 | 27 | 49 |
| | 2009 | 11.3 | 7.1 | 18.2 | 29 | 67 |
| Townsend's Solitaire | 2001 | 7.4 | 5.7 | 9.6 | 16 | 110 |
| | 2002 | 8.0 | 6.0 | 10.8 | 18 | 111 |
| | 2003 | 11.5 | 8.5 | 15.4 | 18 | 180 |
| | 2005 | 7.2 | 5.2 | 9.9 | 20 | 109 |
| | 2007 | 8.5 | 6.3 | 11.5 | 18 | 82 |
| | 2009 | 2.6 | 1.7 | 3.8 | 25 | 25 |
| Swainson's Thrush | 2001 | 2.2 | 1.3 | 3.8 | 33 | 40 |
| | 2002 | 2.5 | 1.7 | 3.6 | 22 | 42 |
| | 2003 | 3.0 | 1.9 | 4.6 | 27 | 57 |
| | 2005 | 1.7 | 1.1 | 2.6 | 26 | 31 |
| | 2007 | 2.1 | 1.3 | 3.2 | 27 | 25 |
| | 2009 | 2.8 | 1.7 | 4.9 | 33 | 33 |
| American Robin | 2001 | 21.8 | 15.9 | 30.0 | 19 | 228 |
| | 2002 | 22.1 | 16.9 | 28.9 | 16 | 199 |
| | 2003 | 23.8 | 14.5 | 39.3 | 31 | 234 |
| | 2005 | 30.5 | 21.9 | 42.5 | 20 | 231 |
| | 2007 | 44.8 | 32.0 | 62.9 | 21 | 177 |
| | 2009 | 71.1 | 51.2 | 98.8 | 20 | 216 |
| Yellow-rumped Warbler | 2001 | 33.3 | 23.8 | 46.4 | 20 | 336 |
| | 2002 | 46.3 | 30.9 | 69.6 | 25 | 363 |
| | 2003 | 37.7 | 25.5 | 55.6 | 24 | 363 |
| | 2005 | 52.9 | 33.1 | 84.6 | 29 | 432 |
| | 2007 | 35.2 | 28.5 | 43.5 | 13 | 257 |
| | 2009 | 48.5 | 12.7 | 185.2 | 96 | 184 |
| American Redstart | 2001 | 10.9 | 5.5 | 21.8 | 44 | 40 |
| | 2002 | 5.7 | 2.7 | 11.9 | 47 | 20 |
| | 2003 | 8.1 | 3.9 | 17.2 | 48 | 32 |
| | 2005 | 7.7 | 3.9 | 15.2 | 43 | 30 |
| | 2007 | 10.5 | 4.2 | 26.2 | 60 | 25 |
| | 2009 | 24.3 | 13.4 | 44.1 | 37 | 60 |
| Ovenbird | 2001 | 20.6 | 12.2 | 34.9 | 33 | 282 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2002 | 18.9 | 12.6 | 28.5 | 25 | 223 |
| | 2003 | 25.3 | 16.0 | 40.1 | 28 | 296 |
| | 2005 | 24.7 | 15.5 | 39.3 | 29 | 286 |
| | 2007 | 11.4 | 5.4 | 23.8 | 47 | 132 |
| | 2009 | 65.9 | 39.1 | 111.1 | 32 | 261 |
| MacGillivray's Warbler | 2001 | 12.2 | 6.5 | 22.6 | 39 | 39 |
| | 2002 | 8.9 | 4.6 | 17.2 | 42 | 27 |
| | 2003 | 11.0 | 4.6 | 26.4 | 57 | 35 |
| | 2005 | 10.5 | 4.9 | 22.9 | 50 | 32 |
| | 2007 | 8.3 | 3.6 | 19.4 | 55 | 17 |
| | 2009 | 13.0 | 6.5 | 26.2 | 44 | 27 |
| Western Tanager | 2001 | 7.8 | 5.4 | 11.3 | 23 | 96 |
| | 2002 | 8.2 | 5.6 | 12.0 | 23 | 95 |
| | 2003 | 11.7 | 8.0 | 17.1 | 23 | 154 |
| | 2005 | 10.6 | 7.5 | 14.9 | 21 | 133 |
| | 2007 | 10.3 | 7.1 | 14.9 | 23 | 81 |
| | 2009 | 9.0 | 6.1 | 13.2 | 24 | 71 |
| Chipping Sparrow | 2001 | 36.9 | 20.9 | 65.3 | 35 | 134 |
| | 2002 | 35.3 | 20.5 | 60.7 | 34 | 130 |
| | 2003 | 79.0 | 55.9 | 111.8 | 21 | 195 |
| | 2005 | 64.2 | 39.9 | 103.4 | 29 | 240 |
| | 2007 | 58.7 | 37.5 | 92.0 | 28 | 159 |
| | 2009 | 57.9 | 43.5 | 77.3 | 18 | 157 |
| Dark-eyed Junco[2] | 2001 | 46.2 | 37.2 | 57.4 | 13 | 196 |
| | 2002 | 36.7 | 28.9 | 46.5 | 15 | 146 |
| | 2003 | 51.4 | 41.7 | 63.2 | 13 | 230 |
| | 2005 | 46.0 | 36.6 | 57.7 | 14 | 197 |
| | 2007 | 78.3 | 60.0 | 102.1 | 16 | 210 |
| | 2009 | 52.3 | 38.0 | 71.9 | 19 | 139 |
| Black-headed Grosbeak | 2001 | 3.5 | 1.6 | 7.6 | 49 | 34 |
| | 2002 | 1.5 | 0.6 | 3.3 | 53 | 13 |
| | 2003 | 1.5 | 0.6 | 4.2 | 67 | 15 |
| | 2005 | 1.7 | 0.7 | 4.3 | 60 | 17 |
| | 2007 | 1.8 | 0.7 | 4.8 | 64 | 11 |
| | 2009 | 5.8 | 2.8 | 12.3 | 47 | 36 |
| Brown-headed Cowbird | 2001 | 17.0 | 8.1 | 35.8 | 47 | 90 |
| | 2002 | 11.0 | 6.0 | 20.0 | 37 | 66 |
| | 2003 | 10.5 | 6.6 | 16.8 | 29 | 99 |
| | 2005 | 8.3 | 5.0 | 14.0 | 32 | 64 |
| | 2007 | 27.2 | 15.9 | 46.3 | 33 | 72 |
| | 2009 | 30.4 | 20.0 | 46.2 | 26 | 82 |
| Red Crossbill | 2001 | 20.1 | 9.7 | 41.6 | 46 | 201 |
| | 2002 | 27.6 | 14.6 | 51.9 | 40 | 195 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2003 | 17.1 | 11.5 | 25.3 | 24 | 184 |
| | 2005 | 18.6 | 12.5 | 27.7 | 25 | 137 |
| | 2007 | 29.9 | 19.4 | 46.1 | 27 | 91 |
| | 2009 | 24.5 | 12.6 | 47.6 | 42 | 49 |
| Pine Siskin | 2001 | 31.1 | 20.3 | 47.5 | 26 | 115 |
| | 2002 | 25.1 | 15.9 | 39.8 | 28 | 88 |
| | 2003 | 5.0 | 2.4 | 10.4 | 47 | 20 |
| | 2005 | 19.2 | 11.6 | 31.9 | 31 | 66 |
| | 2007 | 23.3 | 13.3 | 40.9 | 35 | 31 |
| | 2009 | 11.4 | 6.5 | 20.2 | 36 | 25 |
| Red Squirrel | 2001 | 28.1 | 18.8 | 42.2 | 25 | 58 |
| | 2002 | 20.4 | 12.1 | 34.4 | 33 | 39 |
| | 2003 | 15.6 | 6.7 | 36.3 | 55 | 34 |
| | 2005 | 7.5 | 4.3 | 13.2 | 35 | 15 |
| | 2007 | 72.1 | 44.6 | 116.8 | 30 | 95 |
| | 2009 | 54.5 | 32.3 | 91.9 | 32 | 71 |

[1]D = estimated density (birds/km$^2$); LCL and UCL = lower and upper 90% confidence limits on D; %CV = percent coefficient of variation of D; n = number of observations used to estimate D. Note: if n<10, then we omitted the density estimates.
[2]Priority species in Black Hills National Forest.

## Ponderosa Pine South (PS)

We estimated densities of 27 species in PS for 2009. The pooled 2001-2009 data from PS yielded precise density estimates of all 27 species (Table 3). These species represent 45% of species recorded in PS in 2009 and 94% of all individual birds recorded. The following species had the highest estimated densities of all species recorded in PS (listed in order of highest to lowest density):

1. Chipping Sparrow
2. Dark-eyed Junco
3. Yellow-rumped Warbler
4. Brown-headed Cowbird
5. Black-capped Chickadee
6. American Robin
7. Gray jay
8. Warbling Vireo
9. Western Tanager
10. Red-breasted Nuthatch

The following seven species had higher estimated densities in PS relative to the other four habitats sampled (listed in order of highest to lowest density):

1. Black-capped Chickadee
2. Western Tanager
3. Plumbeous Vireo
4. Townsend's Solitaire
5. Mourning Dove
6. Rock Wren
7. Spotted Towhee

Table 6. Estimated densities of breeding birds in Ponderosa Pine South in Black Hills National Forest, 2001-2009[1].

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| Mourning Dove | 2001 | 1.6 | 0.9 | 3.0 | 38 | 23 |
| | 2002 | 2.3 | 1.2 | 4.4 | 41 | 33 |
| | 2003 | 1.5 | 0.9 | 2.7 | 35 | 23 |
| | 2005 | 3.7 | 1.9 | 7.1 | 41 | 51 |
| | 2007 | 3.6 | 2.3 | 5.6 | 28 | 42 |
| | 2009 | 4.1 | 2.7 | 6.2 | 26 | 38 |
| Hairy Woodpecker | 2001 | 3.7 | 2.3 | 5.9 | 29 | 34 |
| | 2002 | 2.8 | 1.7 | 4.7 | 31 | 27 |
| | 2003 | 4.4 | 3.0 | 6.5 | 24 | 48 |
| | 2005 | 4.4 | 3.0 | 6.3 | 22 | 45 |
| | 2007 | 3.9 | 2.5 | 6.2 | 28 | 30 |
| | 2009 | 4.5 | 2.7 | 7.4 | 32 | 25 |
| Northern Flicker | 2001 | 1.1 | 0.3 | 4.2 | 94 | 26 |
| | 2002 | 0.6 | 0.2 | 1.7 | 67 | 16 |
| | 2003 | 0.7 | 0.3 | 1.7 | 62 | 19 |
| | 2005 | 1.3 | 0.5 | 3.2 | 60 | 35 |
| | 2007 | 1.1 | 0.4 | 3.0 | 69 | 23 |
| | 2009 | 2.7 | 1.2 | 6.1 | 52 | 45 |
| Western Wood-Pewee | 2001 | 0.7 | 0.2 | 2.0 | 74 | 10 |
| | 2002 | 1.3 | 0.5 | 3.3 | 65 | 21 |
| | 2003 | 2.8 | 1.7 | 4.7 | 31 | 52 |
| | 2005 | 2.0 | 0.9 | 4.0 | 46 | 34 |
| | 2007 | 3.7 | 2.0 | 6.8 | 38 | 51 |
| | 2009 | 5.1 | 3.1 | 8.2 | 30 | 54 |
| Dusky Flycatcher | 2001 | 12.5 | 8.8 | 18.0 | 22 | 92 |
| | 2002 | 6.2 | 4.0 | 9.6 | 27 | 48 |
| | 2003 | 16.6 | 11.8 | 23.3 | 21 | 142 |
| | 2005 | 11.7 | 8.2 | 16.6 | 22 | 99 |
| | 2007 | 28.2 | 21.1 | 37.8 | 18 | 176 |
| | 2009 | 13.6 | 8.7 | 21.4 | 28 | 67 |
| Cordilleran Flycatcher | 2001 | 1.2 | 0.7 | 2.2 | 34 | 12 |
| | 2002 | 0.6 | 0.3 | 1.3 | 52 | 6 |
| | 2003 | 3.6 | 2.2 | 5.8 | 29 | 39 |
| | 2005 | 0.1 | 0.0 | 0.5 | 103 | 1 |
| | 2007 | 0.4 | 0.1 | 1.1 | 79 | 3 |
| | 2009 | 1.1 | 0.5 | 2.8 | 59 | 7 |
| Plumbeous Vireo | 2001 | 8.3 | 5.5 | 12.5 | 25 | 95 |
| | 2002 | 7.3 | 5.1 | 10.4 | 22 | 86 |
| | 2003 | 8.4 | 6.0 | 11.8 | 21 | 111 |
| | 2005 | 8.5 | 5.9 | 12.2 | 22 | 110 |
| | 2007 | 8.2 | 5.9 | 11.2 | 20 | 81 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2009 | 7.0 | 4.8 | 10.3 | 23 | 54 |
| Warbling Vireo | 2001 | 8.1 | 2.7 | 23.9 | 74 | 96 |
| | 2002 | 5.8 | 1.4 | 24.8 | 109 | 72 |
| | 2003 | 8.7 | 3.4 | 22.1 | 61 | 122 |
| | 2005 | 8.0 | 3.2 | 20.0 | 60 | 108 |
| | 2007 | 9.7 | 3.6 | 25.8 | 65 | 100 |
| | 2009 | 20.7 | 8.3 | 51.9 | 60 | 164 |
| Gray Jay | 2001 | 13.2 | 2.7 | 64.0 | 121 | 12 |
| | 2002 | 16.0 | 1.4 | 179.4 | 270 | 14 |
| | 2003 | 37.0 | 8.9 | 153.2 | 104 | 32 |
| | 2005 | 19.3 | 2.9 | 128.5 | 163 | 13 |
| | 2007 | 2.6 | 0.4 | 17.5 | 165 | 1 |
| | 2009 | 26.3 | 5.3 | 129.9 | 123 | 11 |
| American Crow | 2001 | 0.3 | 0.2 | 0.6 | 35 | 34 |
| | 2002 | 0.3 | 0.1 | 0.6 | 54 | 30 |
| | 2003 | 0.2 | 0.1 | 0.4 | 38 | 26 |
| | 2005 | 0.3 | 0.1 | 0.5 | 41 | 33 |
| | 2007 | 0.2 | 0.1 | 0.4 | 32 | 22 |
| | 2009 | 0.2 | 0.1 | 0.5 | 48 | 17 |
| Black-capped Chickadee | 2001 | 14.5 | 10.7 | 19.8 | 19 | 137 |
| | 2002 | 15.8 | 10.8 | 23.1 | 23 | 158 |
| | 2003 | 8.3 | 6.1 | 11.3 | 19 | 140 |
| | 2005 | 16.2 | 10.7 | 24.4 | 25 | 161 |
| | 2007 | 14.8 | 10.5 | 20.9 | 21 | 127 |
| | 2009 | 25.2 | 17.9 | 35.7 | 21 | 129 |
| Red-breasted Nuthatch | 2001 | 10.6 | 7.9 | 14.3 | 18 | 146 |
| | 2002 | 16.3 | 12.9 | 20.5 | 14 | 233 |
| | 2003 | 11.7 | 9.0 | 15.4 | 17 | 185 |
| | 2005 | 12.9 | 10.2 | 16.3 | 14 | 201 |
| | 2007 | 18.5 | 14.6 | 23.4 | 14 | 221 |
| | 2009 | 17.1 | 13.3 | 22.0 | 15 | 157 |
| White-breasted Nuthatch | 2001 | 3.8 | 2.5 | 6.0 | 28 | 34 |
| | 2002 | 5.3 | 3.4 | 8.0 | 26 | 49 |
| | 2003 | 10.2 | 7.4 | 14.1 | 20 | 108 |
| | 2005 | 7.7 | 5.5 | 10.6 | 20 | 77 |
| | 2007 | 12.4 | 8.9 | 17.2 | 20 | 97 |
| | 2009 | 6.0 | 4.3 | 8.4 | 20 | 36 |
| Brown Creeper[2] | 2001 | 3.2 | 1.7 | 6.3 | 42 | 12 |
| | 2002 | 4.3 | 2.0 | 9.4 | 49 | 17 |
| | 2003 | 6.0 | 3.4 | 10.8 | 36 | 27 |
| | 2005 | 2.5 | 1.3 | 4.6 | 39 | 10 |
| | 2007 | 1.3 | 0.5 | 3.3 | 62 | 4 |
| | 2009 | 4.0 | 1.9 | 8.6 | 48 | 10 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| Rock Wren | 2001 | 0.2 | 0.1 | 0.6 | 64 | 7 |
| | 2002 | 0.3 | 0.2 | 0.7 | 48 | 11 |
| | 2003 | 0.3 | 0.2 | 0.7 | 44 | 12 |
| | 2005 | 0.9 | 0.5 | 1.6 | 40 | 31 |
| | 2007 | 0.5 | 0.2 | 0.9 | 41 | 13 |
| | 2009 | 1.5 | 0.7 | 3.4 | 53 | 31 |
| Ruby-crowned Kinglet | 2001 | 0.5 | 0.1 | 3.2 | 153 | 5 |
| | 2002 | 0.9 | 0.3 | 2.5 | 68 | 11 |
| | 2003 | 2.0 | 0.7 | 5.9 | 71 | 25 |
| | 2005 | 0.5 | 0.2 | 1.4 | 64 | 7 |
| | 2007 | 1.3 | 0.5 | 3.3 | 61 | 14 |
| | 2009 | 1.1 | 0.4 | 3.1 | 68 | 8 |
| Mountain Bluebird[2] | 2001 | 0.6 | 0.2 | 1.7 | 66 | 6 |
| | 2002 | 1.0 | 0.4 | 2.6 | 62 | 10 |
| | 2003 | 1.4 | 0.5 | 4.0 | 72 | 15 |
| | 2005 | 7.0 | 3.8 | 12.8 | 38 | 71 |
| | 2007 | 5.3 | 2.0 | 13.6 | 62 | 38 |
| | 2009 | 5.8 | 2.7 | 12.6 | 50 | 35 |
| Townsend's Solitaire | 2001 | 5.3 | 4.0 | 6.9 | 17 | 96 |
| | 2002 | 8.1 | 6.3 | 10.3 | 15 | 154 |
| | 2003 | 7.9 | 6.2 | 10.2 | 15 | 168 |
| | 2005 | 5.9 | 4.5 | 7.7 | 16 | 122 |
| | 2007 | 6.9 | 5.1 | 9.2 | 18 | 109 |
| | 2009 | 5.2 | 3.4 | 7.8 | 26 | 62 |
| American Robin | 2001 | 8.5 | 6.0 | 12.1 | 22 | 92 |
| | 2002 | 13.6 | 9.7 | 19.3 | 21 | 156 |
| | 2003 | 18.8 | 13.9 | 25.5 | 19 | 237 |
| | 2005 | 13.5 | 9.9 | 18.6 | 19 | 165 |
| | 2007 | 17.6 | 13.2 | 23.4 | 18 | 163 |
| | 2009 | 21.3 | 16.7 | 27.1 | 15 | 154 |
| Yellow-rumped Warbler | 2001 | 26.5 | 21.8 | 32.2 | 12 | 249 |
| | 2002 | 38.2 | 32.7 | 44.7 | 9 | 373 |
| | 2003 | 43.2 | 35.0 | 53.3 | 13 | 473 |
| | 2005 | 39.0 | 32.4 | 46.9 | 11 | 413 |
| | 2007 | 34.0 | 28.4 | 40.8 | 11 | 276 |
| | 2009 | 34.3 | 27.5 | 42.7 | 13 | 212 |
| Ovenbird | 2001 | 11.7 | 7.6 | 18.0 | 26 | 174 |
| | 2002 | 10.2 | 6.5 | 16.2 | 28 | 166 |
| | 2003 | 8.4 | 5.7 | 12.4 | 24 | 163 |
| | 2005 | 5.2 | 3.5 | 7.8 | 24 | 105 |
| | 2007 | 2.9 | 1.9 | 4.6 | 27 | 66 |
| | 2009 | 10.7 | 5.7 | 20.1 | 39 | 85 |
| Western Tanager | 2001 | 11.8 | 8.6 | 16.4 | 20 | 134 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2002 | 9.7 | 6.7 | 14.1 | 23 | 115 |
| | 2003 | 17.8 | 12.7 | 24.9 | 21 | 231 |
| | 2005 | 9.8 | 7.3 | 13.2 | 18 | 125 |
| | 2007 | 16.6 | 12.1 | 22.8 | 19 | 159 |
| | 2009 | 19.5 | 14.0 | 27.2 | 20 | 145 |
| Spotted Towhee | 2001 | 0.6 | 0.3 | 1.2 | 47 | 10 |
| | 2002 | 1.1 | 0.6 | 2.2 | 43 | 19 |
| | 2003 | 1.6 | 0.8 | 3.5 | 47 | 30 |
| | 2005 | 1.2 | 0.6 | 2.4 | 46 | 21 |
| | 2007 | 2.5 | 1.4 | 4.5 | 37 | 34 |
| | 2009 | 1.2 | 0.6 | 2.4 | 42 | 13 |
| Chipping Sparrow | 2001 | 32.0 | 23.8 | 43.1 | 18 | 129 |
| | 2002 | 45.4 | 34.1 | 60.5 | 18 | 191 |
| | 2003 | 47.7 | 38.1 | 59.9 | 14 | 222 |
| | 2005 | 76.2 | 59.4 | 97.6 | 15 | 329 |
| | 2007 | 69.7 | 53.9 | 90.1 | 16 | 237 |
| | 2009 | 56.0 | 42.9 | 73.2 | 16 | 148 |
| Vesper Sparrow[2] | 2001 | 0.8 | 0.4 | 1.5 | 42 | 16 |
| | 2002 | 0.8 | 0.4 | 1.8 | 50 | 17 |
| | 2003 | 1.0 | 0.5 | 2.0 | 46 | 22 |
| | 2005 | 1.1 | 0.5 | 2.4 | 49 | 24 |
| | 2007 | 2.2 | 1.3 | 3.8 | 33 | 38 |
| | 2009 | 1.7 | 0.8 | 3.8 | 52 | 23 |
| Lark Sparrow | 2001 | 3.5 | 1.1 | 10.8 | 76 | 9 |
| | 2002 | 4.0 | 1.5 | 10.7 | 65 | 11 |
| | 2003 | 4.9 | 1.6 | 14.7 | 74 | 14 |
| | 2005 | 6.8 | 2.4 | 19.3 | 69 | 17 |
| | 2007 | 3.7 | 1.1 | 13.0 | 87 | 9 |
| | 2009 | 2.1 | 0.8 | 5.7 | 64 | 4 |
| Dark-eyed Junco[2] | 2001 | 32.9 | 24.2 | 44.7 | 19 | 156 |
| | 2002 | 30.2 | 22.7 | 40.1 | 17 | 150 |
| | 2003 | 32.3 | 24.2 | 43.0 | 18 | 176 |
| | 2005 | 33.9 | 23.9 | 48.1 | 22 | 178 |
| | 2007 | 67.5 | 51.3 | 88.7 | 17 | 270 |
| | 2009 | 50.0 | 39.6 | 63.1 | 14 | 155 |
| Western Meadowlark[2] | 2001 | 0.1 | 0.0 | 0.3 | 79 | 4 |
| | 2002 | 0.2 | 0.1 | 0.6 | 77 | 9 |
| | 2003 | 0.2 | 0.1 | 0.7 | 72 | 11 |
| | 2005 | 0.8 | 0.3 | 2.2 | 71 | 34 |
| | 2007 | 0.2 | 0.1 | 0.8 | 76 | 9 |
| | 2009 | 0.1 | 0.0 | 0.3 | 71 | 3 |
| Brown-headed Cowbird | 2001 | 17.3 | 12.2 | 24.5 | 21 | 108 |
| | 2002 | 10.2 | 6.7 | 15.5 | 26 | 107 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2003 | 11.6 | 6.2 | 21.8 | 39 | 79 |
| | 2005 | 19.4 | 11.5 | 32.7 | 32 | 140 |
| | 2007 | 18.9 | 9.8 | 36.4 | 41 | 115 |
| | 2009 | 25.8 | 18.5 | 35.9 | 20 | 121 |
| Red Crossbill | 2001 | 15.5 | 9.1 | 26.7 | 34 | 140 |
| | 2002 | 111.7 | 59.3 | 210.2 | 39 | 821 |
| | 2003 | 12.5 | 6.5 | 24.0 | 41 | 92 |
| | 2005 | 24.0 | 15.3 | 37.7 | 28 | 140 |
| | 2007 | 35.5 | 23.1 | 54.7 | 27 | 166 |
| | 2009 | 13.3 | 7.5 | 23.6 | 36 | 63 |
| Pine Siskin | 2001 | 14.0 | 6.8 | 28.9 | 46 | 57 |
| | 2002 | 7.7 | 4.4 | 13.3 | 34 | 32 |
| | 2003 | 2.3 | 1.1 | 5.0 | 49 | 11 |
| | 2005 | 8.8 | 4.8 | 16.3 | 38 | 35 |
| | 2007 | 3.9 | 1.9 | 7.8 | 43 | 11 |
| | 2009 | 8.5 | 4.5 | 16.0 | 40 | 20 |
| American Goldfinch | 2001 | 1.7 | 0.7 | 4.4 | 61 | 10 |
| | 2002 | 0.8 | 0.3 | 2.5 | 77 | 5 |
| | 2003 | 1.1 | 0.5 | 2.3 | 48 | 8 |
| | 2005 | 7.6 | 3.5 | 16.4 | 49 | 40 |
| | 2007 | 4.1 | 2.2 | 7.9 | 41 | 15 |
| | 2009 | 1.8 | 0.7 | 4.9 | 64 | 7 |
| Red Squirrel | 2001 | 7.2 | 2.8 | 18.6 | 62 | 18 |
| | 2002 | 11.1 | 5.5 | 22.4 | 45 | 30 |
| | 2003 | 7.5 | 3.2 | 17.5 | 55 | 23 |
| | 2005 | 8.5 | 3.8 | 18.8 | 51 | 23 |
| | 2007 | 37.3 | 17.2 | 80.9 | 50 | 82 |
| | 2009 | 15.9 | 7.4 | 34.2 | 49 | 27 |

[1]D = estimated density (birds/km$^2$); LCL and UCL = lower and upper 90% confidence limits on D; %CV = percent coefficient of variation of D; n = number of observations used to estimate D. Note: if n<10, then we omitted the density estimates.
[2]Priority species in Black Hills National Forest.

## White Spruce (WS)

We estimated densities of 26 species in WS for 2009. The pooled 2001-2009 data from WS yielded precise density estimates of all 26 species (Table 3). These species represent 45% of species recorded in WS in 2009 and 93% of all individual birds recorded. The following species had the highest estimated densities of all species recorded in WS (listed in order of highest to lowest density):

1. Chipping Sparrow
2. American Robin
3. Ruby-crowned Kinglet
4. Yellow-rumped Warbler
5. Dark-eyed Junco
6. Red Squirrel
7. Song Sparrow
8. Golden-crowned Kinglet
9. Red-breasted Nuthatch
10. Gray Jay

The following 11 species had higher estimated densities in WS relative to the other four habitats sampled (listed in order of highest to lowest density):

1. Chipping Sparrow
2. American Robin
3. Ruby-crowned Kinglet
4. Yellow-rumped Warbler
5. Dark-eyed Junco
6. Red Squirrel
7. Song Sparrow
8. Golden-crowned Kinglet
9. Swainson's Thrush
10. Common Yellowthroat
11. American Crow

Table 7. Estimated densities of breeding birds in White Spruce in Black Hills National Forest, 2001-2009[1].

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| Red-naped Sapsucker | 2001 | 19.3 | 5.8 | 64.3 | 83 | 21 |
| | 2002 | 11.2 | 2.9 | 42.7 | 95 | 12 |
| | 2003 | 15.7 | 4.5 | 54.5 | 86 | 20 |
| | 2005 | 6.0 | 0.7 | 53.4 | 216 | 8 |
| | 2007 | 11.3 | 3.0 | 43.0 | 95 | 13 |
| | 2009 | 11.3 | 2.9 | 43.9 | 97 | 10 |
| Hairy Woodpecker | 2001 | 4.9 | 2.9 | 8.2 | 32 | 32 |
| | 2002 | 4.2 | 2.6 | 6.7 | 29 | 30 |
| | 2003 | 4.2 | 3.0 | 6.0 | 22 | 36 |
| | 2005 | 4.0 | 2.7 | 6.0 | 24 | 33 |
| | 2007 | 6.8 | 4.6 | 10.0 | 24 | 47 |
| | 2009 | 4.5 | 2.8 | 7.1 | 28 | 22 |
| American Three-toed Woodpecker[2] | 2001 | 0.7 | 0.3 | 1.9 | 62 | 4 |
| | 2002 | 3.1 | 1.7 | 5.7 | 38 | 20 |
| | 2003 | 3.9 | 2.3 | 6.3 | 30 | 28 |
| | 2005 | 3.9 | 2.6 | 5.9 | 25 | 29 |
| | 2007 | 1.4 | 0.7 | 2.8 | 45 | 9 |
| | 2009 | 1.3 | 0.6 | 3.0 | 51 | 6 |
| Northern Flicker | 2001 | 3.7 | 2.4 | 5.7 | 27 | 39 |
| | 2002 | 1.5 | 1.0 | 2.3 | 26 | 18 |
| | 2003 | 1.3 | 0.8 | 2.1 | 28 | 18 |
| | 2005 | 1.1 | 0.7 | 1.8 | 32 | 15 |
| | 2007 | 1.6 | 0.8 | 3.2 | 43 | 19 |
| | 2009 | 3.8 | 2.5 | 6.0 | 28 | 30 |
| Dusky Flycatcher | 2001 | 1.8 | 0.8 | 3.9 | 49 | 8 |
| | 2002 | 4.8 | 2.7 | 8.5 | 36 | 23 |
| | 2003 | 2.1 | 1.0 | 4.4 | 46 | 12 |
| | 2005 | 3.8 | 2.0 | 7.0 | 39 | 22 |
| | 2007 | 9.1 | 5.5 | 15.2 | 31 | 44 |
| | 2009 | 6.5 | 3.0 | 14.2 | 50 | 21 |
| Cordilleran Flycatcher | 2001 | 8.5 | 5.2 | 13.9 | 30 | 40 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2002 | 13.3 | 8.7 | 20.3 | 26 | 71 |
| | 2003 | 15.0 | 9.8 | 23.2 | 27 | 94 |
| | 2005 | 9.6 | 6.3 | 14.8 | 26 | 57 |
| | 2007 | 18.1 | 11.5 | 28.7 | 28 | 95 |
| | 2009 | 4.3 | 2.3 | 8.1 | 39 | 16 |
| Warbling Vireo | 2001 | 8.3 | 5.4 | 12.8 | 27 | 49 |
| | 2002 | 9.7 | 6.8 | 14.0 | 22 | 62 |
| | 2003 | 10.1 | 7.0 | 14.5 | 23 | 77 |
| | 2005 | 7.4 | 4.9 | 11.1 | 25 | 53 |
| | 2007 | 11.8 | 7.7 | 18.0 | 26 | 76 |
| | 2009 | 7.1 | 4.4 | 11.6 | 30 | 32 |
| Gray Jay | 2001 | 32.3 | 14.6 | 71.3 | 51 | 70 |
| | 2002 | 18.9 | 9.1 | 39.1 | 46 | 46 |
| | 2003 | 18.8 | 8.9 | 40.0 | 48 | 53 |
| | 2005 | 11.7 | 5.5 | 24.9 | 48 | 23 |
| | 2007 | 13.8 | 6.8 | 28.2 | 45 | 23 |
| | 2009 | 20.9 | 10.0 | 44.0 | 47 | 28 |
| American Crow | 2001 | 0.6 | 0.3 | 1.3 | 46 | 18 |
| | 2002 | 0.5 | 0.2 | 1.2 | 60 | 15 |
| | 2003 | 0.4 | 0.2 | 0.7 | 46 | 14 |
| | 2005 | 0.8 | 0.4 | 1.6 | 41 | 27 |
| | 2007 | 0.8 | 0.4 | 1.7 | 49 | 21 |
| | 2009 | 1.1 | 0.4 | 2.8 | 63 | 17 |
| Black-capped Chickadee | 2001 | 17.7 | 13.5 | 23.1 | 16 | 110 |
| | 2002 | 11.6 | 8.9 | 15.2 | 16 | 79 |
| | 2003 | 17.1 | 14.0 | 21.0 | 12 | 140 |
| | 2005 | 12.8 | 9.8 | 16.8 | 17 | 93 |
| | 2007 | 14.5 | 9.5 | 22.1 | 26 | 90 |
| | 2009 | 15.0 | 10.4 | 21.4 | 22 | 68 |
| Red-breasted Nuthatch | 2001 | 26.1 | 19.8 | 34.3 | 17 | 214 |
| | 2002 | 17.0 | 12.9 | 22.3 | 17 | 154 |
| | 2003 | 21.6 | 16.9 | 27.6 | 15 | 230 |
| | 2005 | 11.3 | 8.7 | 14.8 | 16 | 117 |
| | 2007 | 28.4 | 21.2 | 38.1 | 18 | 250 |
| | 2009 | 24.1 | 18.0 | 32.1 | 17 | 145 |
| White-breasted Nuthatch | 2001 | 0.3 | 0.1 | 1.0 | 76 | 2 |
| | 2002 | 1.1 | 0.5 | 2.3 | 47 | 7 |
| | 2003 | 1.8 | 0.8 | 3.8 | 48 | 15 |
| | 2005 | 0.6 | 0.3 | 1.6 | 60 | 5 |
| | 2007 | 4.0 | 1.5 | 10.7 | 65 | 25 |
| | 2009 | 3.8 | 1.8 | 8.2 | 49 | 17 |
| Brown Creeper[2] | 2001 | 7.8 | 4.5 | 13.5 | 34 | 26 |
| | 2002 | 11.8 | 7.3 | 19.1 | 30 | 43 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2003 | 12.2 | 7.9 | 18.8 | 27 | 53 |
| | 2005 | 8.5 | 5.5 | 13.2 | 27 | 35 |
| | 2007 | 2.1 | 1.0 | 4.6 | 49 | 8 |
| | 2009 | 3.9 | 1.8 | 8.5 | 49 | 10 |
| Golden-crowned Kinglet[2] | 2001 | 25.4 | 17.2 | 37.4 | 24 | 63 |
| | 2002 | 22.9 | 15.7 | 33.3 | 23 | 62 |
| | 2003 | 58.1 | 43.0 | 78.4 | 18 | 183 |
| | 2005 | 63.6 | 49.8 | 81.3 | 15 | 188 |
| | 2007 | 4.8 | 1.9 | 11.9 | 60 | 13 |
| | 2009 | 23.0 | 16.2 | 32.7 | 22 | 42 |
| Ruby-crowned Kinglet | 2001 | 50.6 | 29.4 | 86.9 | 34 | 271 |
| | 2002 | 47.3 | 35.7 | 62.5 | 17 | 397 |
| | 2003 | 40.8 | 29.2 | 56.9 | 20 | 356 |
| | 2005 | 67.6 | 48.6 | 94.2 | 20 | 461 |
| | 2007 | 36.3 | 25.8 | 51.1 | 21 | 270 |
| | 2009 | 88.9 | 67.6 | 117.0 | 17 | 358 |
| Townsend's Solitaire | 2001 | 3.1 | 1.9 | 5.1 | 31 | 52 |
| | 2002 | 3.3 | 2.3 | 4.6 | 20 | 62 |
| | 2003 | 3.6 | 2.6 | 4.9 | 19 | 75 |
| | 2005 | 2.4 | 1.7 | 3.4 | 21 | 51 |
| | 2007 | 2.1 | 1.4 | 3.3 | 27 | 40 |
| | 2009 | 1.8 | 1.1 | 3.0 | 32 | 22 |
| Swainson's Thrush | 2001 | 13.9 | 10.5 | 18.4 | 17 | 149 |
| | 2002 | 15.5 | 12.5 | 19.1 | 13 | 182 |
| | 2003 | 18.9 | 15.7 | 22.8 | 11 | 267 |
| | 2005 | 13.0 | 10.3 | 16.4 | 14 | 177 |
| | 2007 | 15.5 | 12.5 | 19.2 | 13 | 180 |
| | 2009 | 15.3 | 10.6 | 22.0 | 22 | 124 |
| American Robin | 2001 | 59.1 | 39.4 | 88.7 | 25 | 253 |
| | 2002 | 38.8 | 30.0 | 50.2 | 16 | 266 |
| | 2003 | 35.2 | 24.4 | 50.7 | 22 | 240 |
| | 2005 | 38.4 | 29.2 | 50.5 | 17 | 261 |
| | 2007 | 79.2 | 62.7 | 100.2 | 14 | 302 |
| | 2009 | 94.6 | 65.1 | 137.5 | 23 | 281 |
| Yellow-rumped Warbler | 2001 | 30.1 | 22.2 | 41.0 | 19 | 205 |
| | 2002 | 37.7 | 24.4 | 58.3 | 27 | 244 |
| | 2003 | 47.7 | 36.2 | 62.7 | 17 | 363 |
| | 2005 | 27.4 | 20.5 | 36.7 | 18 | 261 |
| | 2007 | 42.2 | 28.4 | 62.6 | 24 | 252 |
| | 2009 | 83.6 | 58.4 | 119.7 | 22 | 249 |
| Ovenbird | 2001 | 0.3 | 0.1 | 0.8 | 61 | 4 |
| | 2002 | 0.2 | 0.1 | 0.7 | 70 | 3 |
| | 2003 | 1.4 | 0.6 | 2.9 | 47 | 22 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2005 | 1.0 | 0.5 | 1.9 | 44 | 15 |
| | 2007 | 1.4 | 0.7 | 2.8 | 44 | 19 |
| | 2009 | 1.4 | 0.6 | 3.3 | 53 | 13 |
| Common Yellowthroat | 2001 | 2.4 | 0.8 | 6.7 | 69 | 6 |
| | 2002 | 1.3 | 0.4 | 4.5 | 85 | 4 |
| | 2003 | 4.9 | 2.3 | 10.5 | 49 | 17 |
| | 2005 | 10.9 | 4.1 | 28.7 | 64 | 34 |
| | 2007 | 11.7 | 5.5 | 24.9 | 48 | 33 |
| | 2009 | 10.5 | 4.5 | 24.1 | 54 | 21 |
| Western Tanager | 2001 | 0.3 | 0.1 | 0.6 | 55 | 3 |
| | 2002 | 0.2 | 0.1 | 0.4 | 69 | 2 |
| | 2003 | 0.9 | 0.5 | 1.8 | 43 | 14 |
| | 2005 | 1.2 | 0.6 | 2.3 | 40 | 18 |
| | 2007 | 2.4 | 1.4 | 4.1 | 34 | 30 |
| | 2009 | 1.1 | 0.5 | 2.4 | 48 | 10 |
| Chipping Sparrow | 2001 | 66.6 | 44.9 | 98.8 | 24 | 111 |
| | 2002 | 44.8 | 34.0 | 59.1 | 17 | 82 |
| | 2003 | 72.6 | 53.4 | 98.7 | 19 | 156 |
| | 2005 | 73.6 | 55.9 | 97.0 | 17 | 148 |
| | 2007 | 169.3 | 128.4 | 223.2 | 17 | 295 |
| | 2009 | 172.4 | 135.0 | 220.0 | 15 | 203 |
| Song Sparrow[2] | 2001 | 6.4 | 3.2 | 12.8 | 44 | 21 |
| | 2002 | 5.4 | 2.5 | 12.0 | 51 | 20 |
| | 2003 | 9.5 | 4.9 | 18.3 | 41 | 41 |
| | 2005 | 16.6 | 9.2 | 29.9 | 37 | 70 |
| | 2007 | 12.2 | 7.0 | 21.2 | 35 | 45 |
| | 2009 | 26.6 | 13.3 | 53.0 | 44 | 64 |
| Dark-eyed Junco[2] | 2001 | 25.8 | 19.8 | 33.8 | 16 | 148 |
| | 2002 | 33.8 | 17.5 | 65.4 | 42 | 156 |
| | 2003 | 45.9 | 28.6 | 73.7 | 29 | 222 |
| | 2005 | 40.0 | 25.8 | 62.1 | 27 | 169 |
| | 2007 | 101.3 | 69.7 | 147.3 | 23 | 313 |
| | 2009 | 68.0 | 45.2 | 102.1 | 25 | 141 |
| Brown-headed Cowbird | 2001 | 1.8 | 0.7 | 4.7 | 64 | 8 |
| | 2002 | 3.5 | 1.0 | 12.5 | 89 | 18 |
| | 2003 | 2.5 | 0.7 | 9.1 | 91 | 14 |
| | 2005 | 2.3 | 0.6 | 9.2 | 99 | 14 |
| | 2007 | 6.2 | 2.1 | 18.8 | 74 | 31 |
| | 2009 | 2.2 | 0.4 | 12.2 | 110 | 5 |
| Red Crossbill | 2001 | 57.9 | 34.1 | 98.3 | 32 | 315 |
| | 2002 | 49.7 | 25.4 | 97.3 | 42 | 233 |
| | 2003 | 57.8 | 34.7 | 96.4 | 32 | 348 |
| | 2005 | 12.8 | 7.0 | 23.3 | 37 | 62 |

| Species | Year | D | LCL | UCL | %CV | n |
|---|---|---|---|---|---|---|
| | 2007 | 75.5 | 41.9 | 136.2 | 37 | 128 |
| | 2009 | 20.1 | 8.0 | 50.2 | 58 | 32 |
| Pine Siskin | 2001 | 32.7 | 25.1 | 42.6 | 16 | 157 |
| | 2002 | 26.1 | 19.3 | 35.2 | 18 | 134 |
| | 2003 | 5.7 | 3.3 | 10.1 | 35 | 37 |
| | 2005 | 15.4 | 9.7 | 24.5 | 29 | 77 |
| | 2007 | 14.8 | 9.3 | 23.4 | 28 | 51 |
| | 2009 | 9.2 | 3.7 | 23.2 | 57 | 17 |
| Red Squirrel | 2001 | 57.9 | 34.1 | 98.3 | 32 | 79 |
| | 2002 | 49.7 | 25.4 | 97.3 | 42 | 80 |
| | 2003 | 57.8 | 34.7 | 96.4 | 32 | 180 |
| | 2005 | 12.8 | 7.0 | 23.3 | 37 | 13 |
| | 2007 | 75.5 | 41.9 | 136.2 | 37 | 257 |
| | 2009 | 20.1 | 8.0 | 50.2 | 58 | 118 |

[1]D = estimated density (birds/km$^2$); LCL and UCL = lower and upper 90% confidence limits on D; %CV = percent coefficient of variation of D; n = number of observations used to estimate D. Note: if n<10, then we omitted the density estimates.
[2]Priority species in Black Hills National Forest.

## BCR-based Results

RMBO surveyed 57 of 60 (95%) assigned transects throughout BHNF in 2009. We conducted 671 point counts within these 57 transects between 23 May and 14 July 2009. We detected 6,172 birds of 96 species throughout BHNF (Appendix B). We did not survey 3 assigned transects in BHNF this year; two transects were inaccessible due to terrain and were not replaced before the end of the season, and we ran out of time at the end of the season to survey the other transect.

We estimated BHNF-wide density estimates for 44 bird species. The data produced precise density estimates of 36. These species represent 38% of all species recorded on BCR-based transects in 2009, and 92% of all birds observed.

For the first time, we estimated occupancy rates for low-density species in BHNF using BCR-based data. We estimated the proportion of transects occupied (Psi) by 42 species within BHNF, including 7 prority species (Table 9). We required a minimum of ten detections per species in order to estimate occupancy. However, for species with fewer than ten detections in BHNF, we were able to estimate detection rates using additional detections throughout BCR 17.

The following species had the highest estimated densities of all species recorded in BHNF (listed in order of highest to lowest density) using BCR-based data:

1. Chipping Sparrow
2. Yellow-rumped Warbler
3. Dark-eyed Junco
4. Warbling Vireo
5. American Robin
6. Ovenbird
7. Red-breasted Nuthatch
8. Brown-headed Cowbird
9. Dusky Flycatcher
10. Ruby-crowned Kinglet

Table 8. Estimated densities of breeding birds using IMBCR data in Black Hills National Forest, 2009[1]. Comparison of the Badlands and Prairies BCR (BCR 17) to the Black Hills National Forest.

| | Bird Conservation Region 17 | | | | | Black Hills NF | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **D** | **LCL** | **UCL** | **%CV** | **n** | **D** | **LCL** | **UCL** | **%CV** | **n** |
| Canada Goose | 0.14 | 0.05 | 0.38 | 65 | 75 | 0.01 | 0.00 | 0.03 | 88 | 2 |
| Ring-necked Pheasant | 1.27 | 0.71 | 2.27 | 36 | 293 | -- | -- | -- | -- | 0 |
| Killdeer | 2.80 | 1.00 | 7.85 | 69 | 174 | 0.05 | 0.02 | 0.18 | 87 | 1 |
| Upland Sandpiper[2] | 4.43 | 1.84 | 10.68 | 58 | 272 | -- | -- | -- | -- | 1 |
| Mourning Dove | 4.74 | 3.18 | 7.07 | 25 | 918 | 0.98 | 0.67 | 1.45 | 24 | 51 |
| Red-naped Sapsucker | 0.14 | 0.09 | 0.21 | 26 | 65 | 7.72 | 5.09 | 11.73 | 26 | 65 |
| Hairy Woodpecker | 0.64 | 0.27 | 1.51 | 57 | 68 | 7.84 | 5.97 | 10.30 | 17 | 57 |
| Northern Flicker | 0.90 | 0.47 | 1.71 | 41 | 240 | 3.48 | 2.40 | 5.05 | 23 | 120 |
| Western Wood-Pewee | 0.51 | 0.30 | 0.84 | 32 | 230 | 7.90 | 5.87 | 10.63 | 18 | 149 |
| Dusky Flycatcher | 1.44 | 0.85 | 2.45 | 33 | 174 | 16.99 | 12.38 | 23.31 | 19 | 144 |
| Western Kingbird | 7.84 | 4.50 | 13.64 | 35 | 124 | 0.07 | 0.02 | 0.24 | 88 | 1 |
| Eastern Kingbird | 5.17 | 2.71 | 9.86 | 41 | 140 | 0.28 | 0.12 | 0.63 | 54 | 4 |
| Plumbeous Vireo | 0.18 | 0.12 | 0.28 | 26 | 90 | 7.25 | 4.19 | 12.56 | 34 | 75 |
| Warbling Vireo | 0.64 | 0.53 | 0.77 | 12 | 395 | 32.88 | 27.06 | 39.95 | 12 | 378 |
| Black-billed Magpie[2] | 0.31 | 0.16 | 0.61 | 42 | 67 | 0.03 | 0.01 | 0.08 | 70 | 3 |
| American Crow | 0.13 | 0.08 | 0.21 | 31 | 164 | 0.78 | 0.51 | 1.20 | 26 | 67 |
| Horned Lark | 27.49 | 19.85 | 38.08 | 20 | 1185 | -- | -- | -- | -- | 0 |
| Barn Swallow | 10.37 | 3.81 | 28.25 | 67 | 73 | 0.19 | 0.06 | 0.65 | 85 | 2 |
| Black-capped Chickadee | 1.82 | 1.04 | 3.21 | 35 | 306 | 14.87 | 12.44 | 17.78 | 11 | 209 |
| Red-breasted Nuthatch | 0.60 | 0.45 | 0.79 | 17 | 379 | 19.61 | 16.72 | 23.01 | 10 | 332 |
| White-breasted Nuthatch | 1.03 | 0.39 | 2.71 | 64 | 135 | 11.27 | 8.68 | 14.64 | 16 | 118 |
| Rock Wren | 1.64 | 0.95 | 2.83 | 34 | 195 | 0.80 | 0.44 | 1.45 | 38 | 24 |
| House Wren | 6.78 | 3.73 | 12.32 | 38 | 438 | 6.67 | 4.08 | 10.91 | 31 | 73 |
| Ruby-crowned Kinglet | 0.29 | 0.22 | 0.39 | 18 | 239 | 15.38 | 11.47 | 20.63 | 18 | 230 |
| Mountain Bluebird[2] | 2.76 | 1.74 | 4.38 | 29 | 212 | 13.96 | 10.12 | 19.26 | 20 | 108 |
| Townsend's Solitaire | 0.24 | 0.12 | 0.44 | 40 | 109 | 3.74 | 2.75 | 5.07 | 19 | 89 |
| Swainson's Thrush | 0.22 | 0.11 | 0.45 | 46 | 86 | 6.04 | 3.76 | 9.69 | 29 | 80 |
| Hermit Thrush | 0.12 | 0.05 | 0.31 | 62 | 80 | -- | -- | -- | -- | 0 |
| American Robin | 5.92 | 4.04 | 8.68 | 24 | 800 | 32.44 | 26.78 | 39.30 | 12 | 489 |
| Yellow Warbler | 4.54 | 2.44 | 8.45 | 39 | 242 | 2.05 | 1.23 | 3.42 | 32 | 14 |
| Yellow-rumped Warbler | 3.90 | 2.23 | 6.82 | 35 | 652 | 43.22 | 31.80 | 58.75 | 19 | 455 |
| American Redstart | 0.37 | 0.23 | 0.60 | 30 | 103 | 11.73 | 7.49 | 18.39 | 28 | 75 |
| Ovenbird | 0.59 | 0.45 | 0.76 | 16 | 347 | 22.64 | 18.40 | 27.86 | 13 | 287 |
| Common Yellowthroat | 0.46 | 0.21 | 1.02 | 52 | 69 | 0.31 | 0.16 | 0.58 | 40 | 7 |
| Yellow-breasted Chat | 0.33 | 0.19 | 0.59 | 36 | 90 | -- | -- | -- | -- | 0 |
| Western Tanager | 0.60 | 0.38 | 0.95 | 29 | 237 | 10.53 | 8.34 | 13.31 | 14 | 193 |
| Spotted Towhee | 3.00 | 1.72 | 5.25 | 35 | 438 | 2.91 | 1.90 | 4.44 | 26 | 54 |
| Chipping Sparrow | 7.87 | 5.40 | 11.47 | 23 | 780 | 65.13 | 55.01 | 77.12 | 10 | 477 |
| Clay-colored Sparrow | 1.84 | 0.77 | 4.41 | 57 | 88 | -- | -- | -- | -- | 0 |

| | Bird Conservation Region 17 | | | | | Black Hills NF | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **D** | **LCL** | **UCL** | **%CV** | **n** | **D** | **LCL** | **UCL** | **%CV** | **n** |
| Brewer's Sparrow | 8.93 | 5.38 | 14.84 | 32 | 440 | -- | -- | -- | -- | 0 |
| Field Sparrow | 0.98 | 0.57 | 1.68 | 34 | 181 | -- | -- | -- | -- | 0 |
| Vesper Sparrow[2] | 7.17 | 7.13 | 7.22 | 0 | 696 | 4.45 | 2.59 | 7.64 | 34 | 112 |
| Lark Sparrow | 13.77 | 9.99 | 18.98 | 20 | 487 | 6.23 | 3.95 | 9.80 | 28 | 46 |
| Lark Bunting[2] | 15.80 | 10.63 | 23.50 | 24 | 2284 | -- | -- | -- | -- | 0 |
| Grasshopper Sparrow[2] | 62.49 | 35.19 | 110.96 | 36 | 994 | 0.36 | 0.15 | 0.89 | 59 | 5 |
| Dark-eyed Junco[2] | 2.35 | 1.45 | 3.80 | 30 | 544 | 38.28 | 32.77 | 44.72 | 9 | 393 |
| Chestnut-collared Longspur | 34.00 | 20.24 | 57.13 | 32 | 303 | -- | -- | -- | -- | 0 |
| Bobolink | 2.27 | 0.68 | 7.62 | 85 | 79 | -- | -- | -- | -- | 0 |
| Red-winged Blackbird | 9.21 | 7.20 | 11.77 | 15 | 487 | 0.52 | 0.27 | 0.99 | 41 | 12 |
| Western Meadowlark[2] | 41.01 | 36.07 | 46.62 | 8 | 4550 | 0.66 | 0.36 | 1.24 | 39 | 42 |
| Brewer's Blackbird | 1.52 | 0.93 | 2.51 | 31 | 168 | 0.20 | 0.06 | 0.68 | 88 | 3 |
| Brown-headed Cowbird | 47.61 | 28.47 | 79.62 | 32 | 1007 | 19.54 | 15.87 | 24.05 | 13 | 160 |
| Red Crossbill | 0.29 | 0.22 | 0.38 | 17 | 142 | 10.80 | 8.45 | 13.81 | 15 | 119 |
| Pine Siskin | 0.18 | 0.13 | 0.25 | 21 | 82 | 7.03 | 4.58 | 10.79 | 26 | 56 |
| American Goldfinch | 3.25 | 1.70 | 6.23 | 41 | 100 | 1.65 | 0.88 | 3.10 | 40 | 17 |
| Red Squirrel | 0.88 | 0.67 | 1.16 | 17 | 159 | 43.73 | 32.47 | 58.88 | 18 | 141 |

[1]D = estimated density (birds/km$^2$); LCL and UCL = lower and upper 90% confidence limits on D; %CV = percent coefficient of variation of D; n = number of observations used to estimate D.
[2]Prority species in Black Hills National Forest.

Table 9. Estimated site occupancy (Psi; proportion of sample units occupied), percent coefficient of variation of Psi (%CV) and number of transects with detections (n Tran) of priority species in Black Hills National Forest.

| Species | Psi | %CV | n Tran | Data used |
|---|---|---|---|---|
| Wild Turkey | 0.161 | 37 | 7 | All BCR 17 |
| Turkey Vulture | 0.264 | 50 | 6 | All BCR 17 |
| Red-tailed Hawk | 0.196 | 51 | 5 | All BCR 17 |
| American Kestrel | 0.181 | 57 | 4 | All BCR 17 |
| Killdeer | 0.024 | 99 | 1 | All BCR 17 |
| Mourning Dove | 0.386 | 19 | 19 | BH only |
| Common Nighthawk | 0.174 | 45 | 5 | All BCR 17 |
| Red-headed Woodpecker* | 0.078 | 48 | 4 | BH only |
| Hairy Woodpecker | 0.670 | 17 | 26 | BH only |
| Black-backed Woodpecker* | 0.186 | 44 | 7 | BH only |
| Cordilleran Flycatcher | 0.164 | 41 | 6 | BH only |
| Western Kingbird | 0.021 | 99 | 1 | All BCR 17 |
| Eastern Kingbird | 0.064 | 54 | 3 | All BCR 17 |
| Red-eyed Vireo | 0.037 | 69 | 2 | All BCR 17 |
| Gray Jay | 0.459 | 22 | 18 | BH only |
| Blue Jay | 0.158 | 51 | 5 | All BCR 17 |
| Clark's Nutcracker | 0.079 | 48 | 4 | All BCR 17 |
| Black-billed Magpie* | 0.034 | 102 | 1 | All BCR 17 |
| American Crow | 0.261 | 24 | 13 | BH only |
| Tree Swallow | 0.025 | 100 | 1 | All BCR 17 |
| Violet-green Swallow | 0.116 | 43 | 5 | All BCR 17 |
| Northern Rough-winged Swallow* | 0.025 | 100 | 1 | All BCR 17 |
| Barn Swallow | 0.050 | 69 | 2 | All BCR 17 |
| Brown Creeper* | 0.268 | 34 | 10 | BH only |
| Rock Wren | 0.135 | 36 | 7 | BH only |
| Veery | 0.056 | 56 | 3 | All BCR 17 |
| Gray Catbird | 0.030 | 101 | 1 | All BCR 17 |
| Brown Thrasher | 0.024 | 100 | 1 | All BCR 17 |
| Cedar Waxwing | 0.170 | 77 | 3 | All BCR 17 |
| Yellow Warbler | 0.204 | 26 | 11 | All BCR 17 |
| MacGillivray's Warbler | 0.117 | 43 | 5 | BH only |
| Common Yellowthroat | 0.110 | 43 | 5 | All BCR 17 |
| Spotted Towhee | 0.345 | 21 | 17 | BH only |
| Lark Sparrow | 0.200 | 27 | 11 | BH only |
| Song Sparrow* | 0.163 | 54 | 5 | All BCR 17 |
| Black-headed Grosbeak | 0.249 | 26 | 12 | BH only |
| Red-winged Blackbird | 0.114 | 38 | 6 | All BCR 17 |
| Western Meadowlark* | 0.132 | 41 | 6 | BH only |
| Brewer's Blackbird | 0.021 | 99 | 1 | All BCR 17 |
| Bullock's Oriole | 0.021 | 99 | 1 | All BCR 17 |
| Pine Siskin | 0.380 | 20 | 18 | BH only |
| American Goldfinch | 0.218 | 34 | 9 | BH only |

*Priority species in Black Hills National Forest.

## Habitat/BCR comparison

The BCR-based sampling design did not use habitat type as a basis for stratification. The samples were post stratified using USFS vegetation layers in GIS then we estimated avian densities by habitat (for species with large enough sample size). We post-stratified the BCR-based data from 2009 and analyzed all data from points that were identified as Ponderosa Pine in the GIS layer. We combined and analyzed habitat-based data collected from the three different Ponderosa Pine habitats surveyed this year (North, South, and Late-successional) so we could compare the BCR-based Ponderosa Pine data with the habitat-based data (Table 10).

Table 10. Density estimates of breeding birds in Ponderosa Pine habitat, using habitat-based data and BCR-based data, Black Hills National Forest, 2009[1].

| | Habitat-based | | | | | BCR-based | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Species** | **D** | **LCL** | **UCL** | **%CV** | **n** | **D** | **LCL** | **UCL** | **%CV** | **n** |
| Western Wood-pewee | 11.8 | 10.4 | 13.4 | 8 | 180 | 7.9 | 5.9 | 10.6 | 18 | 115 |
| Dusky Flycatcher | 19.1 | 16.5 | 22.2 | 9 | 184 | 17.0 | 12.4 | 23.3 | 19 | 110 |
| Plumbeous Vireo | 4.0 | 3.2 | 5.0 | 13 | 76 | 7.3 | 4.2 | 12.6 | 34 | 62 |
| Warbling Vireo | 41.3 | 37.7 | 45.3 | 6 | 508 | 32.9 | 27.1 | 40.0 | 12 | 296 |
| Black-capped Chickadee | 17.1 | 15.0 | 19.5 | 8 | 243 | 14.9 | 12.4 | 17.8 | 11 | 147 |
| Red-breasted Nuthatch | 20.7 | 14.7 | 29.2 | 21 | 398 | 19.6 | 16.7 | 23.0 | 10 | 277 |
| White-breasted Nuthatch | 8.1 | 6.7 | 9.8 | 11 | 119 | 11.3 | 8.7 | 14.6 | 16 | 88 |
| Ruby-crowned Kinglet | 11.4 | 9.7 | 13.5 | 10 | 168 | 15.4 | 11.5 | 20.6 | 18 | 161 |
| Townsend's Solitare | 6.3 | 5.0 | 8.0 | 15 | 105 | 3.7 | 2.8 | 5.1 | 19 | 76 |
| American Robin | 38.9 | 35.2 | 43.1 | 6 | 451 | 32.4 | 26.8 | 39.3 | 12 | 342 |
| Yellow-rumped Warbler | 44.1 | 40.0 | 48.6 | 6 | 524 | 43.2 | 31.8 | 58.8 | 19 | 368 |
| Ovenbird | 38.2 | 30.4 | 47.9 | 14 | 411 | 22.6 | 18.4 | 27.9 | 13 | 237 |
| Western Tanager | 18.1 | 15.8 | 20.8 | 8 | 252 | 10.5 | 8.3 | 13.3 | 14 | 149 |
| Chipping Sparrow | 45.3 | 39.3 | 52.1 | 9 | 390 | 65.1 | 55.0 | 77.1 | 10 | 306 |
| Dark-eyed Junco[2] | 45.3 | 39.6 | 51.9 | 8 | 424 | 38.3 | 32.8 | 44.7 | 9 | 310 |
| Brown-headed Cowbird | 27.5 | 21.0 | 36.1 | 17 | 233 | 19.5 | 15.9 | 24.1 | 13 | 109 |
| Red Crossbill | 24.7 | 19.4 | 31.5 | 15 | 161 | 10.8 | 8.5 | 13.8 | 15 | 95 |
| Red Squirrel | 45.9 | 29.7 | 70.9 | 27 | 135 | 43.7 | 32.5 | 58.9 | 18 | 108 |

[1]D = estimated density (birds/km$^2$); LCL and UCL = lower and upper 90% confidence limits on D; %CV = percent coefficient of variation of D; n = number of observations used to estimate D.
[2]Priority species in Black Hills National Forest.

We also used USFS GIS data to post stratify the habitat-based point transects in order to determine if the habitat based-points occurred within the appropriate habitat. We combined data for several of the categories since there were few points that could be classified into broader categories (Table 11).

Table 11. Post stratification of the habitat-based points by dominant cover types as determined by GIS.

| | Dominant Cover Type | | | | | | |
|---|---|---|---|---|---|---|---|
| Habitat Stratum | Aspen / Birch | Hardwood | Ponderosa Pine | White Spruce | Grassland | Unknown[1] | **Total** |
| Burn (Jasper Burn) | 4 | | 232 | | 18 | 3 | **257** |
| Late-succesional Ponderosa Pine | 3 | 7 | 217 | 4 | 4 | 7 | **242** |
| Ponderosa Pine (North) | 22 | 7 | 215 | 7 | 16 | 2 | **269** |
| Ponderosa Pine (South) | 8 | 1 | 215 | | 25 | 11 | **260** |
| White Spruce | 2 | 3 | 129 | 88 | 15 | 12 | **249** |
| **Total** | **39** | **18** | **1008** | **99** | **78** | **35** | **1277** |

[1]Point located on private land; cover type unavailable from USFS GIS layer.

## DISCUSSION AND RECOMMENDATIONS

In Tables 3-7, we provide density estimates for all years' data (2001-2009). We did this for two reasons: 1) to provide a comparison of the nine years' density estimates, and more importantly, 2) to provide more statistically rigorous estimates for 2001-2008. Each year of data added to this program's dataset will improve our ability estimate densities of and determine positive or negative trends of the species that occupy the Black Hills. Please note that the density estimates presented in this report replace the estimates provided in the 2001-2008 reports.

One monitoring objective of the USFS is to determine the population status and trends of breeding landbird species in a variety of habitats in BHNF. Determining landbird population trends is a long-term goal, and we will not be able to make definitive statements about population trends for any species for several years. However, in the short term, this program provides information needed to effectively manage and conserve landbird populations in BHNF, including the spatial distribution, abundance, and relationships to important habitat characteristics for each species (please visit http://www.rmbo.org/public/monitoring to query this information).

In 2007, the North American Bird Conservation Initiative (NABCI) monitoring subcommittee outlined four recommendations for improving monitoring programs (NABCI 2007). First, monitoring programs should integrate an adaptive management approach into the monitoring process to incorporate management and conservation priorities. We could implement this approach by post stratifying the grid-based points to observe the effects of land management on landbird populations within the Black Hills NF. We have demonstrated an example of post stratifying the points by habitat to compare with historical data. These results are similar to the estimates generated using the habitat-based approach. In the future, we can use the present and historical design to look at management implications and trends within the Black Hills.

The second recommendation of NABCI was to coordinate landbird monitoring among organizations and across spatial scales to make monitoring more efficient and effective. RMBO coordinates with a variety of Federal, State, and local agencies throughout 12 different states in an effort to monitor landbird populations across a broad region using a spatially-balanced study design. Monitoring at different spatial scales is important in understanding population trends (NABCI 2007), and the NABCI report recommends using Bird Conservation Regions (BCRs) as a starting point for integrated landbird monitoring. We are working towards monitoring at the BCR level, and for the first time in 2009, we surveyed an entire BCR (BCR17 – Badlands and Prairies) which includes the Black Hills NF.

The third recommendation was to improve statistical design and review the chosen design periodically to make sure it meets the desired needs. From 2008-2010 across 12 states, we have transitioned or are in the process of transitioning from habitat-based monitoring to BCR-based monitoring using a spatially balanced study design (the IMBCR design). This design is more statistically rigorous and will allow us to analyze data at a variety of spatial scales. The IMBCR design allows post stratification of data by cover type (or any other mappable variable) so that we can continue to make inferences to avian densities and distributions with respect to habitat as we did under the habitat-stratified design. The IMBCR design also allows us to make inferences to geographic areas without regard to habitat, which the habitat-stratified design does not. Another limitation of the habitat-stratified design is that individual survey points frequently fell outside of the targeted habitat This heterogeneity in habitat along transects is apparent in the White Spruce habitat where 52% of the points were classified as ponderosa pine. Post-stratification with the new design will give us more precise estimates that will be used to help direct management on the Black Hills NF.

The fourth recommendation of NABCI (2007) was to create a database where all data resides and that is available to those who need it to make informed management decisions. We currently have an online database (http://www.rmbo.org/public/monitoring), where land managers, as well as the general public, can view distribution maps, species counts by project, past monitoring reports, and species accounts. In addition, RMBO is a partner of the Avian Knowledge Network (AKN) whose goal is to 1) compile bird monitoring data from various contributor organizations and organize them into one format and 2) make this data available to land managers, scientists, and the public for decision-making, research, and educational purposes.

We surveyed 100 transects using the habitat-based design, and used these data and past data (2001-2009) to estimate densities of 42 species. We surveyed 57 transects using the BCR-based design in 2009 and estimated densities of 44 species. We sampled a greater variety of habitats, including grasslands surrounding BHNF, and thus encountered a greater variety of species, surveying BCR-based transects than habitat-based transects in BHNF.

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# APPENDIX A

Priority species recorded in Black Hills National Forest by management designation, along with species totals by habitat, 2001 – 2009.

| | PIF[1] | State Agencies[2] | USFS[3] | | USFWS[4] |
|---|---|---|---|---|---|
| **Species** | **BCR 17** | **SDGFP** | **Region 2** | **Black Hills NF** | **BCR 17** |
| Ruffed Grouse | | | | MIS | |
| Sharp-tailed Grouse | CS,RS | | | | |
| American White Pelican | | SGCN | | | |
| American Bittern | | | R2SS | | BCC |
| Osprey | | SGCN, ST | | | |
| Northern Harrier | RC | | R2SS | | |
| Sharp-shinned Hawk | | | | SOLC | |
| Cooper's Hawk | | | | SOLC | |
| Northern Goshawk | RC | SGCN | R2SS | | |
| Broad-winged Hawk | | | | SOLC | |
| Swainson's Hawk | CC | | | | |
| Ferruginous Hawk | RC,RS | SGCN | R2SS | | BCC |
| Golden Eagle | RC | | | | BCC |
| Prairie Falcon | | | | | BCC |
| Upland Sandpiper | | | | | BCC |
| Long-billed Curlew | | SGCN | | | BCC |
| Burrowing Owl | RC | SGCN | R2SS | | |
| Northern Saw-whet Owl | | | | SOLC | |
| White-throated Swift | CC | | | | |
| Lewis's Woodpecker | CC,RC | SGCN | R2SS | | BCC |
| Red-headed Woodpecker | CC,RC | | | | BCC |
| American Three-toed Woodpecker | | SGCN | R2SS | | |

| | PIF[1] | State Agencies[2] | USFS[3] | | USFWS[4] |
|---|---|---|---|---|---|
| **Species** | **BCR 17** | **SDGFP** | **Region 2** | **Black Hills NF** | **BCR 17** |
| Black-backed Woodpecker | RC | SGCN | R2SS | MIS | |
| Say's Phoebe | RS | | | | |
| Loggerhead Shrike | RC | | R2SS | | BCC |
| Pinyon Jay | CC,RC | | | | BCC |
| Black-billed Magpie | RC | | | | |
| Northern Rough-winged Swallow | RC | | | | |
| Pygmy Nuthatch | | | | SOLC | |
| Brown Creeper | | | | MIS | |
| American Dipper | | SGCN, ST | | SOLC | |
| Golden-crowned Kinglet | | | | MIS | |
| Mountain Bluebird | RC | | | | |
| Black-and-White Warbler | | | | SOLC | |
| Brewer's Sparrow | CC,RC | | R2SS | | BCC |
| Vesper Sparrow | RC | | | | |
| Lark Bunting | RC,CS,RS | SGCN | | | |
| Grasshopper Sparrow | RC,CS,RS | | R2SS | MIS | BCC |
| Song Sparrow | | | | MIS | |
| Dark-eyed Junco (White-winged) | | SGCN | | | |
| Dickcissel | CC,RC | | | | BCC |
| Western Meadowlark | RS | | | | |

[1] PIF = Partners In Flight, BCR 17 = Bird Conservation Region 17 (Badlands and Prairies), CC = Continental Concern Species, RC = Regional Concern Species, CS = Continental Stewardship Species, RS = Regional Stewardship Species (Partners In Flight 2005).

[2] State Agency, SDGFP = South Dakota Department of Game, Fish, and Parks, SGCN = Species of Greatest Conservation Need, ST = State Threatened Species (SDGFP 2006, SDGFP 2008).

[3] USFS = United States Forest Service, BHNF = Black Hills National Forest, MIS = Black Hills National Forest Management Indicator Species, SOLC = Species of Local Concern, Region 2 = USFS Region 2, R2SS = US Forest Service Region 2 Sensitive Species, (BHNF 2006, USFS 2008).

[4] USFWS = United States Fish and Wildlife Service, BCC = Bird of Conservation Concern for Badlands and Prairies Bird Conservation Region (17) (USFWS 2008).

# APPENDIX B

All birds observed during point-count surveys in BHNF, with species totals by habitat in 2009, and annual species totals from 2001-2009.

| | Number of individuals observed, 2009[1] | | | | | | Number of individuals observed by year[2] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **BU** | **LS** | **PN** | **PS** | **WS** | **BCR 17** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** |
| Canada Goose | | | | | | 16 | | 35 | 1 | 2 | 1 | | 4 | | 16 |
| Wood Duck | | | | | | | | 13 | | | 1 | | | | |
| Gadwall | | | | | | | | 1 | | | | | | | |
| Mallard | | | | | 8 | 2 | 13 | 81 | 5 | 3 | 22 | 9 | 3 | 7 | 10 |
| Blue-winged Teal | | | | | | | | | | 1 | | | | | |
| Ring-necked Duck | | | | | | | 2 | | | | | | | | |
| Hooded Merganser | | | | | | | | 1 | | | | | | | |
| Common Merganser | | | | | | | 8 | 9 | | | 9 | 1 | | | |
| Gray Partridge | | | | | | | 1 | 4 | | | | | | | |
| Ring-necked Pheasant | | | | | | | 2 | 2 | | | | | | | |
| Ruffed Grouse[3] | | | 7 | | | 1 | 36 | 62 | 15 | 6 | 6 | 1 | 2 | 2 | 8 |
| Sharp-tailed Grouse[3] | 19 | | | | | 1 | | 2 | | 25 | 1 | 4 | | 5 | 20 |
| Wild Turkey | 2 | 17 | 9 | 12 | 5 | 33 | 101 | 67 | 42 | 47 | 29 | 52 | 25 | 49 | 78 |
| Northern Bobwhite | | | | | | | | 1 | | | | | | | |
| Western Grebe | | | | | | 1 | | 1 | | | | | | | 1 |
| American White Pelican[3] | | | | | | | | | | 20 | | | | | |
| American Bittern[3] | | | | | | | | 1 | | | | | | | |
| Great Blue Heron | | | | | 8 | 3 | 4 | 23 | 18 | 4 | 12 | 13 | 3 | 18 | 11 |
| Turkey Vulture | 7 | 4 | 4 | 2 | 8 | 20 | 54 | 98 | 15 | 43 | 88 | 47 | 53 | 58 | 45 |
| Osprey[3] | | | | | | 1 | 1 | | | | 4 | | | 2 | 1 |
| Northern Harrier[3] | | | | | | | 1 | | | | | 1 | | | |
| Sharp-shinned Hawk[3] | | | | | 4 | | 2 | 4 | 3 | 7 | 3 | | 1 | 1 | 4 |
| Cooper's Hawk[3] | | | | | | | 6 | 4 | 3 | 7 | 9 | 2 | 3 | 5 | |
| Northern Goshawk[3] | | | | 1 | | 8 | 11 | 5 | 7 | 10 | 15 | 3 | 6 | | 9 |
| Broad-winged Hawk[3] | | 1 | | | | 1 | 4 | 6 | | 24 | 19 | 3 | 2 | 5 | 2 |
| Swainson's Hawk[3] | | | | | | | | | | | 1 | 1 | | 2 | |

| | Number of individuals observed, 2009[1] | | | | | | Number of individuals observed by year[2] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **BU** | **LS** | **PN** | **PS** | **WS** | **BCR 17** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** |
| Red-tailed Hawk | 14 | 5 | 4 | 6 | 7 | 17 | 27 | 41 | 32 | 44 | 55 | 36 | 23 | 32 | 53 |
| Ferruginous Hawk[3] | | | | | | | | | | | | | | 1 | |
| Golden Eagle[3] | | | | | | | | 2 | 1 | | 2 | 6 | | 10 | |
| American Kestrel | 15 | | | 1 | | 11 | 6 | 12 | 11 | 22 | 20 | 11 | 8 | 19 | 27 |
| Merlin | | | | | | | | 1 | | | | | | 1 | |
| Prairie Falcon[3] | | | | 1 | | | 2 | 6 | 2 | 6 | 9 | 6 | | 5 | 1 |
| Sora | | | | | | | | | | | | 2 | | 4 | |
| Killdeer | | | | | | 1 | 4 | 18 | 1 | 9 | 4 | 2 | 1 | 12 | 1 |
| Spotted Sandpiper | | 2 | | | | | | 6 | 4 | | | 1 | | 5 | 2 |
| Upland Sandpiper[3] | | | | | | 1 | 4 | 20 | | 19 | | 12 | 1 | 21 | 1 |
| Long-billed Curlew[3] | | | | | | | | | | | | 7 | | 3 | |
| Pectoral Sandpiper | | | | | | | 25 | | | | | | | | |
| Wilson's Snipe | | | | | | | 5 | 8 | 6 | | 5 | 8 | | 10 | |
| Franklin's Gull | | | | | | | | 1 | | | | | | | |
| Rock Pigeon | | | | | | | 1 | 9 | 4 | 1 | 8 | 10 | | 36 | |
| Eurasian Collared-Dove | | | | | | | | | | | | | | 1 | |
| Mourning Dove | 27 | 18 | 13 | 39 | 4 | 54 | 174 | 359 | 118 | 275 | 153 | 189 | 239 | 236 | 155 |
| Great Horned Owl | | 1 | | | | 2 | 2 | 2 | 2 | 2 | 2 | 4 | 3 | 5 | 3 |
| Burrowing Owl[3] | | | | | | | | | | 1 | | | | | |
| Long-eared Owl | | | | | | | 1 | | | | | | | | |
| Northern Saw-whet Owl[3] | | | | | | | 1 | | | 1 | | | | | |
| Common Nighthawk | | 6 | 12 | 8 | | 8 | 22 | 20 | 8 | 37 | 34 | 42 | 24 | 20 | 34 |
| Common Poorwill | | | | | | | | | | | | | 1 | | |
| Chimney Swift | | | | | | | | | | | 1 | | | | |
| White-throated Swift[3] | | | | | 5 | 6 | 35 | 260 | 93 | 157 | 460 | 203 | 83 | 302 | 11 |
| Broad-tailed Hummingbird | 1 | | | 1 | | | | 3 | 3 | | 6 | 1 | 3 | 5 | 2 |
| Belted Kingfisher | | | | | 1 | | 6 | 16 | 10 | 1 | 18 | 15 | | 8 | 1 |
| Lewis's Woodpecker[3] | 22 | | | | | 12 | 3 | 4 | 9 | 4 | 8 | 6 | 9 | 1 | 34 |
| Red-headed Woodpecker[3] | 118 | | | 1 | | 30 | 24 | 38 | 50 | 54 | 66 | 8 | 48 | 6 | 149 |
| Red-naped Sapsucker | 18 | 27 | 64 | 10 | 19 | 74 | 306 | 222 | 244 | 210 | 210 | 118 | 118 | 122 | 212 |
| Downy Woodpecker | 11 | 5 | 4 | 1 | 2 | 16 | 28 | 28 | 25 | 18 | 38 | 25 | 16 | 15 | 39 |

| | Number of individuals observed, 2009[1] | | | | | | Number of individuals observed by year[2] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **BU** | **LS** | **PN** | **PS** | **WS** | **BCR 17** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** |
| Hairy Woodpecker | 56 | 25 | 23 | 35 | 28 | 69 | 298 | 464 | 440 | 361 | 381 | 93 | 361 | 85 | 236 |
| American Three-toed Woodpecker[3] | | | | | 10 | 2 | 9 | 27 | 44 | 8 | 47 | | 11 | | 12 |
| Black-backed Woodpecker[3] | 30 | 10 | 3 | 2 | 2 | 14 | 21 | 131 | 75 | 70 | 47 | 3 | 38 | 7 | 61 |
| Northern Flicker | 171 | 33 | 27 | 46 | 36 | 120 | 206 | 235 | 226 | 266 | 446 | 174 | 223 | 175 | 433 |
| Western Wood-Pewee | 90 | 64 | 88 | 56 | 14 | 149 | 142 | 350 | 373 | 350 | 370 | 181 | 457 | 207 | 461 |
| Alder Flycatcher | | | | | | 1 | | 1 | 1 | | 1 | 2 | | | 1 |
| Least Flycatcher | | | 2 | | | | 2 | 9 | 6 | 2 | 11 | 7 | 1 | 5 | 2 |
| Hammond's Flycatcher | | | | | | | | | | | 5 | 3 | 2 | 2 | |
| Dusky Flycatcher | 55 | 39 | 97 | 68 | 22 | 144 | 839 | 1407 | 723 | 720 | 933 | 359 | 980 | 565 | 425 |
| Cordilleran Flycatcher | | 3 | 11 | 7 | 16 | 12 | 245 | 362 | 325 | 99 | 454 | 342 | 151 | 208 | 49 |
| Eastern Phoebe | | | | | | 3 | 3 | 1 | | 2 | | | | 4 | 3 |
| Say's Phoebe[3] | | | | | | | | | | 1 | | 3 | | 2 | |
| Cassin's Kingbird | | | | | | | | | | 1 | | | | 2 | |
| Western Kingbird | 2 | | | | 1 | 1 | 6 | 7 | 5 | 18 | 8 | 3 | | 8 | 4 |
| Eastern Kingbird | | | | | | 4 | 15 | 74 | 8 | 20 | 4 | 17 | | 25 | 4 |
| Loggerhead Shrike[3] | | | | | | | 1 | | | | | | | | |
| Plumbeous Vireo | 27 | 15 | 9 | 56 | | 75 | 311 | 384 | 230 | 166 | 273 | 82 | 244 | 175 | 182 |
| Warbling Vireo | 39 | 96 | 306 | 172 | 33 | 381 | 1458 | 1959 | 960 | 1,074 | 1,590 | 574 | 1,186 | 917 | 1,027 |
| Red-eyed Vireo | | 3 | 8 | 1 | | 10 | 152 | 228 | 102 | 35 | 216 | 122 | 12 | 128 | 22 |
| Gray Jay | 15 | 13 | 25 | 29 | 43 | 55 | 252 | 197 | 211 | 129 | 135 | 16 | 114 | 41 | 180 |
| Blue Jay | | 2 | 2 | | | 9 | 74 | 64 | 34 | 22 | 38 | 52 | 13 | 52 | 13 |
| Pinyon Jay[3] | | | | | | 7 | 13 | 47 | 7 | 55 | 3 | 24 | | 69 | 7 |
| Clark's Nutcracker | 8 | | | 7 | 5 | 7 | 34 | 214 | 10 | 31 | 33 | 4 | 14 | 8 | 27 |
| Black-billed Magpie[3] | 1 | | | 2 | | 5 | 2 | 1 | | 26 | 2 | 18 | | 14 | 8 |
| American Crow | 28 | 12 | 35 | 18 | 26 | 73 | 275 | 258 | 194 | 183 | 142 | 137 | 183 | 212 | 192 |
| Horned Lark | | | | | | | 7 | 4 | | 11 | | 38 | | 34 | |
| Tree Swallow | 6 | | | | 2 | 1 | 13 | 30 | 8 | 4 | 7 | 22 | 7 | 30 | 9 |
| Violet-green Swallow | 7 | 3 | | 2 | 4 | 26 | 175 | 566 | 162 | 265 | 393 | 405 | 125 | 348 | 42 |
| Northern Rough-winged Swallow[3] | | | | | | 1 | | 15 | | 13 | 4 | 8 | | 5 | 1 |
| Bank Swallow | | | | | | | | 1 | | 10 | | 2 | | | |
| Cliff Swallow | | | | | | | 21 | 7 | | 28 | 3 | 23 | 3 | 30 | |

| | Number of individuals observed, 2009[1] | | | | | | Number of individuals observed by year[2] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **BU** | **LS** | **PN** | **PS** | **WS** | **BCR 17** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** |
| Barn Swallow | | | | | 3 | 2 | 4 | 24 | 5 | 8 | 10 | 24 | 2 | 33 | 5 |
| Black-capped Chickadee | 66 | 86 | 56 | 138 | 74 | 234 | 817 | 1,120 | 672 | 481 | 936 | 400 | 744 | 515 | 654 |
| Red-breasted Nuthatch | 36 | 127 | 142 | 160 | 154 | 335 | 1,210 | 1,519 | 817 | 470 | 1,014 | 358 | 1,267 | 387 | 954 |
| White-breasted Nuthatch | 24 | 55 | 36 | 38 | 18 | 121 | 180 | 263 | 335 | 163 | 232 | 145 | 339 | 99 | 292 |
| Pygmy Nuthatch[3] | | | | 3 | | | 3 | 2 | | 1 | 4 | 1 | 6 | | 3 |
| Brown Creeper[3] | 4 | 22 | 7 | 14 | 11 | 25 | 152 | 143 | 135 | 97 | 131 | 7 | 35 | 2 | 83 |
| Rock Wren | 17 | 4 | 1 | 32 | | 24 | 31 | 102 | 44 | 196 | 158 | 78 | 48 | 101 | 78 |
| Canyon Wren | | 1 | | 2 | | 1 | 10 | 59 | 21 | 18 | 27 | 43 | 18 | 28 | 4 |
| House Wren | 101 | 9 | 3 | 16 | 2 | 74 | 30 | 144 | 74 | 134 | 181 | 65 | 155 | 63 | 205 |
| Winter Wren | | | | | 4 | | | 2 | 1 | | 3 | | | | 4 |
| Marsh Wren | | | | | | | | | | | | | | 1 | |
| American Dipper[3] | | | | | | 1 | | 3 | 4 | | 5 | 3 | | 6 | 1 |
| Golden-crowned Kinglet[3] | 1 | 24 | 4 | | 45 | 8 | 112 | 99 | 224 | 55 | 346 | 7 | 21 | 10 | 82 |
| Ruby-crowned Kinglet | 1 | 96 | 72 | 9 | 391 | 230 | 454 | 912 | 716 | 219 | 1,005 | 198 | 529 | 164 | 799 |
| Blue-gray Gnatcatcher | | | | | | 2 | 2 | 2 | 1 | 15 | | | 20 | 34 | 2 |
| Eastern Bluebird | 18 | | | 3 | | 4 | 47 | 57 | 57 | 73 | 63 | 3 | 28 | 5 | 25 |
| Mountain Bluebird[3] | 147 | 5 | 12 | 46 | 8 | 119 | 131 | 169 | 116 | 292 | 333 | 254 | 265 | 277 | 337 |
| Townsend's Solitaire | 31 | 40 | 28 | 63 | 24 | 95 | 643 | 850 | 783 | 547 | 610 | 119 | 491 | 106 | 281 |
| Veery | | 3 | 7 | | 9 | 5 | 48 | 94 | 104 | 28 | 73 | 63 | 32 | 83 | 24 |
| Swainson's Thrush | | 23 | 34 | 6 | 131 | 89 | 436 | 448 | 507 | 170 | 405 | 291 | 311 | 134 | 283 |
| Hermit Thrush | | | | | | | 2 | 1 | 1 | 4 | 2 | | 1 | | |
| American Robin | 124 | 118 | 224 | 164 | 312 | 508 | 1,557 | 2,120 | 1,671 | 1,002 | 1,920 | 898 | 1,307 | 955 | 1,450 |
| Gray Catbird | | | | | | 1 | 13 | 20 | 27 | | 43 | 60 | 3 | 67 | 1 |
| Brown Thrasher | | | 1 | | | 1 | 2 | 1 | 3 | 3 | | 1 | | 1 | 2 |
| European Starling | 3 | | | | | | 1 | 20 | | 18 | 30 | 9 | | 17 | 3 |
| American Pipit | | | | | | | | | | 1 | | | | | |
| Cedar Waxwing | | | 3 | 1 | 2 | 5 | 47 | 121 | 61 | 46 | 49 | 56 | 29 | 35 | 11 |
| Golden-winged Warbler | | | | | | | | | | | 3 | | | | |
| Tennessee Warbler | | | | | | | | 31 | | 3 | | | | 1 | |
| Orange-crowned Warbler | | 4 | | | | | | 1 | | | | | | | 4 |
| Virginia's Warbler | | | | 1 | | 4 | 44 | 80 | 2 | 185 | 6 | | 79 | 64 | 5 |

| | Number of individuals observed, 2009[1] | | | | | | Number of individuals observed by year[2] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **BU** | **LS** | **PN** | **PS** | **WS** | **BCR 17** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** |
| Northern Parula | | | | | | | 1 | | 1 | | 1 | | | | |
| Yellow Warbler | | 7 | 3 | 1 | | 14 | 33 | 191 | 35 | 17 | 88 | 67 | 35 | 182 | 25 |
| Chestnut-sided Warbler | | | | | | 1 | 8 | 2 | 2 | | 3 | | 2 | 4 | 1 |
| Black-throated Blue Warbler | | | | | | | | 1 | | | | | | | |
| Yellow-rumped Warbler | 37 | 145 | 190 | 219 | 261 | 460 | 1,863 | 2,471 | 1,831 | 873 | 1,675 | 355 | 1,577 | 497 | 1,312 |
| Black-and-white Warbler[3] | | | 2 | | | | 6 | 8 | 2 | 4 | 6 | 7 | | 1 | 2 |
| American Redstart | | 9 | 62 | | 7 | 86 | 282 | 407 | 242 | 97 | 609 | 396 | 63 | 500 | 164 |
| Ovenbird | 2 | 118 | 263 | 87 | 13 | 287 | 1,393 | 1,717 | 838 | 951 | 1,191 | 563 | 801 | 1,070 | 770 |
| MacGillivray's Warbler | | 9 | 27 | | 7 | 13 | 229 | 267 | 206 | 102 | 227 | 105 | 87 | 160 | 56 |
| Common Yellowthroat | | 2 | 3 | 4 | 25 | 8 | 81 | 275 | 219 | 42 | 320 | 228 | 46 | 207 | 42 |
| Yellow-breasted Chat | | | 1 | | | | 2 | 54 | 4 | 37 | 8 | 5 | 23 | 25 | 1 |
| Western Tanager | 77 | 77 | 72 | 152 | 10 | 196 | 764 | 920 | 856 | 540 | 692 | 262 | 649 | 336 | 584 |
| Spotted Towhee | 17 | 6 | 17 | 13 | 1 | 55 | 287 | 618 | 152 | 443 | 211 | 201 | 441 | 774 | 109 |
| Chipping Sparrow | 226 | 118 | 170 | 162 | 263 | 503 | 1,028 | 1,624 | 1,523 | 1,346 | 2,027 | 614 | 1,693 | 1,262 | 1,442 |
| Clay-colored Sparrow | | | | | | | | 2 | | 4 | | | | 6 | |
| Brewer's Sparrow[3] | | | | | | | | | | | | | | 3 | |
| Field Sparrow | | | | | | | 1 | | 1 | 5 | | | 1 | 11 | |
| Vesper Sparrow[3] | 189 | | | 23 | 11 | 112 | 184 | 362 | 131 | 394 | 204 | 264 | 289 | 303 | 335 |
| Lark Sparrow | 4 | 1 | | 5 | | 46 | 19 | 84 | 21 | 109 | 44 | 145 | 21 | 192 | 56 |
| Lark Bunting[3] | | | | | | | 2 | | | 2 | 5 | 9 | | 111 | |
| Grasshopper Sparrow[3] | | | | | | 5 | 6 | 75 | | 121 | | 382 | | 197 | 5 |
| Song Sparrow[3] | | 6 | 2 | 10 | 75 | 6 | 97 | 266 | 258 | 35 | 396 | 288 | 64 | 203 | 99 |
| Lincoln's Sparrow | | | | | | 1 | | | | | | | | | 1 |
| White-crowned Sparrow | | | | | | | | | 1 | | | | | 2 | |
| Dark-eyed Junco (White-winged)[3] | 112 | 153 | 150 | 169 | 152 | 413 | 1,419 | 1,500 | 1,320 | 936 | 1,335 | 196 | 1,882 | 375 | 1,149 |
| Northern Cardinal | | | | | | | | | 1 | | | | | | |
| Rose-breasted Grosbeak | | | | | | | 1 | 1 | 1 | | | | | | |
| Black-headed Grosbeak | | 14 | 39 | 9 | 5 | 33 | 160 | 315 | 116 | 40 | 250 | 188 | 57 | 158 | 100 |
| Blue Grosbeak | | | | | | | 1 | | | | | | | | |
| Lazuli Bunting | | | | | | 1 | 1 | 35 | 13 | 8 | 14 | 18 | 16 | 28 | 1 |
| Indigo Bunting | | | | | | | | | | | | 1 | 1 | 1 | |

| | Number of individuals observed, 2009[1] | | | | | | Number of individuals observed by year[2] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Common Name** | **BU** | **LS** | **PN** | **PS** | **WS** | **BCR 17** | **2001** | **2002** | **2003** | **2004** | **2005** | **2006** | **2007** | **2008** | **2009** |
| Dickcissel[3] | | | | | | | | | | | | 31 | | | |
| Bobolink | | | | | | | | 17 | 10 | 6 | 11 | 64 | | 10 | |
| Red-winged Blackbird | | 7 | 6 | | 4 | 12 | 57 | 278 | 84 | 21 | 112 | 102 | 25 | 72 | 29 |
| Western Meadowlark[3] | 53 | 1 | 1 | 3 | | 42 | 79 | 467 | 44 | 881 | 187 | 460 | 70 | 683 | 100 |
| Yellow-headed Blackbird | | | | | | | | 5 | | 1 | | | | | |
| Brewer's Blackbird | 7 | | | | | 13 | 12 | 33 | 13 | 74 | 22 | 38 | | 67 | 20 |
| Common Grackle | | 1 | | | | | 39 | 64 | 6 | 10 | 4 | 5 | | 29 | 1 |
| Brown-headed Cowbird | 104 | 49 | 99 | 131 | 8 | 181 | 602 | 825 | 591 | 489 | 686 | 176 | 677 | 570 | 572 |
| Orchard Oriole | | | | | | | 4 | 9 | 1 | | | 2 | | 2 | |
| Bullock's Oriole | | | | | | 1 | 15 | 20 | | 1 | 10 | 9 | | 6 | 1 |
| Pine Grosbeak | | | | | | | | | | | | | | 3 | |
| Cassin's Finch | 2 | 1 | | 3 | | 1 | 21 | 7 | 4 | 4 | 12 | 1 | 8 | 5 | 7 |
| House Finch | | | | | | | 1 | 11 | | | | | | 7 | |
| Red Crossbill | 59 | 89 | 159 | 85 | 84 | 205 | 2,674 | 5,282 | 1,158 | 1,824 | 931 | 228 | 1,829 | 602 | 681 |
| White-winged Crossbill | | | | | 2 | 4 | 13 | 12 | 14 | | 15 | | 11 | | 6 |
| Pine Siskin | 12 | 28 | 29 | 26 | 36 | 67 | 608 | 657 | 165 | 38 | 519 | 231 | 261 | 198 | 198 |
| Lesser Goldfinch | | | | | | | | | | | | | | 1 | |
| American Goldfinch | 9 | 3 | 4 | 9 | 2 | 30 | 82 | 209 | 76 | 62 | 126 | 101 | 123 | 205 | 57 |
| Evening Grosbeak | | | | | | | 6 | | | | 1 | 2 | | | |
| House Sparrow | | | | | | | 2 | 1 | | | | | | | |
| Red Squirrel | 15 | 47 | 82 | 32 | 140 | 145 | 379 | 315 | 271 | 122 | 89 | 128 | 787 | 222 | 461 |

[1] Habitats: BU = burned area; LS = late-successional ponderosa pine; PN = ponderosa pine north; PS = ponderosa pine south; WS = white spruce
[2] The number and types of habitats sampled each year varied.
[3] Priority species in Black Hills National Forest (see Appendix A).