

Population Densities and Trend Detection of Avian Species on the Black Hills National Forest



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MONITORING THE BIRDS OF THE BLACK HILLS: SUPPLEMENTAL REPORT

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EXECUTIVE SUMMARY

Rocky Mountain Bird Observatory conducted bird monitoring in the Black Hills National Forest using a habitat-stratified sampling design. Ten habitat types were each surveyed in 4-6 years from 2001 through 2007. We provide multi-year density estimates for 65 avian species, including five Black Hills National Forest Management Indicator Species (MIS) and one additional Forest Service Region 2 Sensitive Species (R2SS). Most species were abundant in multiple habitat types, yielding 330 species × habitat density estimates.

We used empirical estimates of density, encounter rate, and detection probability to estimate the number of years required to detect an average 3% annual decline in the population of each species in each habitat type for which we obtained density estimates. Results of power simulation indicated that we would be able to detect a 3% decline within the targeted 30 years for 52 bird species. These include four MIS and one additional R2SS.

The sampling design used in 2001 – 2007 to monitor breeding landbirds on the Black Hills National Forest yielded density estimates for the majority of regularly occurring species. The Grasshopper Sparrow was the only MIS for which we could obtain density estimates but not detect trend within 30 years. It may be necessary to add additional transects in Mixed-grass Prairie (MG) habitat in order to effectively monitor the Grasshopper Sparrow population. An increase in MG transects could be offset by decreasing the number of transects in Ponderosa Pine – Northern Hills and Ponderosa Pine – Southern Hills.

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INTRODUCTION

In 2001-2007, Rocky Mountain Bird Observatory (RMBO) conducted bird monitoring in the Black Hills National Forest using a habitat-stratified sampling design (Panjabi et al. 2001). The monitoring program, entitled Monitoring the Birds of the Black Hills (MBBH), was designed to provide statistically rigorous long-term trend data for populations of most diurnal, regularly breeding landbird species in the Black Hills.

In 2001-2007, RMBO provided the Black Hills National Forest with annual reports containing density estimates of bird species by habitat based on the most recent field season. In addition, annual reports contained species accounts and distribution maps for Forest Service Sensitive Species, Management Indicator Species, and Species of Local Concern.

The MBBH program, as well as other broad-scale monitoring programs conducted by RMBO, was originally designed with sufficient sampling effort to be able to detect population trends for individual avian species (Leukering 2000). In particular, our stated objective was to be able to detect a 3% annual change in a population within 30 years, with $p = 0.10$ and Power = 0.80, given that a trend occurred.

This report is a supplement to the annual MBBH reports. Herein, we present multi-year density estimates across species and habitats. In addition, we used empirical estimates of density and its associated variance to evaluate the ability to detect population trends for each species in each habitat for which we obtained density estimates.

METHODS

Study Area

Ten habitat types were each surveyed in 4-6 years from 2001 through 2007 (Table 1). Habitat types are described in annual reports (Panjabi 2003; Giroir et al. 2007). Wet Meadow habitat was sampled the first year, but dropped because it was not accurately represented.

Table 1. Habitats surveyed in 2001-2007 under *the Monitoring the Birds of the Black Hills* program.

Habitat Type	2001	2002	2003	2004	2005	2006	2007
Aspen	x	x		x			X ^o
Burn Area	x	x	x	x	x		x
Foothills Riparian	x	x			x	x	
Late-successional Pine	x	x		x			x
Mixed-grass Prairie	x	x		x		x	
Montane Riparian	x	x	x		x	x	
Ponderosa Pine - Northern Hills	x	x	x		x		x
Ponderosa Pine - Southern Hills	x	x	x		x		x
Pine-juniper Shrubland	x	x		x			X ^o
White Spruce	x	x	x		x		x
Wet Meadow	x						

^o SDGFP funded sampling of these habitats

Field Methods

Point transect sampling is based on distance sampling theory, which estimates detection probability as a function of the distances between the observer and the birds detected (Buckland et al. 2001). The detection probability is used to adjust the count of birds to account for birds that were present but undetected. Details of field sampling methods appear in the 2007 MBBH annual report (Giroir et al. 2007). Following is a brief summary of the sampling protocol.

Each transect consisted of 15 points located at 250 m intervals along the transect. Each transect was surveyed by one observer collecting data for five minutes per point following protocol established by Leukering (2000) and modified by Panjabi (2003). Technicians conducted all transect surveys in the morning, between ½-hour before sunrise and 11 AM; most surveys were completed before 10 AM.

Data Analysis

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). 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. These assumptions are reasonably well met following the MBBH protocol. 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.

We used Program Distance 5.0 (Thomas et al. 2006) to estimate the density of each bird species. 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 (AICc) and model selection theory to select the most parsimonious detection function for each species (Burnham and Anderson 2002).

The required sample size for estimating a detection function is at least 60-80 independent detections. Fortunately, it is possible using program DISTANCE to construct a common detection function across years, and obtain separate density estimates for each year. It is not valid, however to construct a common detection across dissimilar habitats. Detection probability would be expected to differ, for example, between shrubland and forested habitats for the same species.

We simulated the time to detect population trends for each species in each habitat for which we were able to estimate density. Time to detect trends was evaluated at the target levels of 3% annual population change with power = 0.80 and alpha = 0.10 (Leukering 2000). We used a power simulation created in Program R by Paul Lukacs of the Colorado Division of Wildlife (Kissling et al. 2007). The simulation includes state and observation processes and uses empirical data from the MBBH program as model input. The state model defines the initial population density and trend through time using estimated density and the variance of estimated density. The state model also includes the mean and variance of the trend we are hoping to

detect; here we modeled an average annual change of 3%, allowing the change to vary stochastically between 1% and 5%. The observation model defines the detection process and sample size through time, using the coefficient of variation (CV) of estimated detection probability and the CV of estimated encounter rate. These are the two sources of variation that influence the variation in estimated density. We ran simulations for 5, 10, 15, ..., 40 years with 1000 replications. Although a 3% annual population change (e.g., decline) may seem small, the result of a constant 3% decline over 24 years would be a loss of one-half of a population. Note that these simulations do not evaluate whether or not a change in the population has occurred; rather, they evaluate our power to detect a trend if the trend had occurred. Also note that we would be able to detect a greater rate of population change (e.g., 5% or 10% change annually) in a much shorter amount of time.

RESULTS

Buckland et al. (2001) recommend 60-80 observations to fit a detection curve to distance sampling data. Sample sizes were sufficient to estimate density of 65 bird species and the Red Squirrel in at least one habitat type. Most species were abundant in multiple habitat types, yielding 330 species × habitat density estimates (Tables 2-11).

Aspen

Table 2. Estimated densities of breeding birds in Aspen habitat in the Black Hills, 2001-2007¹.

Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Red-naped Sapsucker	2001	101.2	24.6	415.8	104	46
	2002	87.0	21.8	346.5	101	38
	2004	108.4	27.1	432.7	101	62
	2007	66.6	16.4	270.9	103	27
Hairy Woodpecker	2001	1.5	0.7	3.1	46	6
	2002	5.5	3.3	9.1	32	21
	2004	6.0	3.6	9.8	31	31
	2007	5.9	3.5	10.0	33	20
Northern Flicker	2001	1.1	0.6	1.9	34	17
	2002	0.7	0.4	1.2	34	10
	2004	1.8	1.1	2.9	31	33
	2007	2.6	1.6	4.4	31	36
Western Wood-Pewee	2001	1.2	0.5	2.8	56	10
	2002	1.3	0.6	2.9	50	11
	2004	0.7	0.4	1.4	43	8
	2007	4.0	2.1	7.8	40	31
Dusky Flycatcher	2001	23.4	16.8	32.6	20	120
	2002	39.2	28.3	54.2	20	158
	2004	30.8	22.5	42.1	19	151
	2007	48.2	30.5	76.2	28	93
Cordilleran Flycatcher	2001	7.6	4.1	13.8	37	28
	2002	5.3	2.4	11.9	51	19
	2004	8.1	4.6	14.2	35	39
	2007	6.0	3.1	11.9	42	20
Warbling Vireo	2001	94.1	80.6	109.7	9	389
	2002	70.6	48.6	102.4	23	499
	2004	94.8	80.7	111.3	10	599

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	<i>%CV</i>	<i>n</i>
Gray Jay	2007	53.7	33.9	85.1	28	355
	2001	4.7	2.8	8.0	32	24
	2002	2.9	1.5	5.3	38	14
	2004	3.6	1.9	7.1	42	16
	2007	3.3	1.7	6.4	40	12
American Crow	2001	0.7	0.4	1.1	32	42
	2002	0.3	0.2	0.5	28	18
	2004	0.5	0.3	0.8	28	38
	2007	1.0	0.6	1.5	27	45
Black-capped Chickadee	2001	19.7	14.9	26.0	17	87
	2002	23.5	17.7	31.3	17	100
	2004	22.3	17.2	28.8	15	117
	2007	29.9	23.6	37.9	14	112
Red-breasted Nuthatch	2001	12.0	7.3	19.9	31	110
	2002	16.8	13.2	21.3	14	114
	2004	10.0	7.5	13.4	17	116
	2007	38.7	26.9	55.7	22	177
White-breasted Nuthatch	2001	1.5	0.8	2.9	41	10
	2002	1.7	1.0	2.8	30	11
	2004	1.0	0.5	2.1	43	9
	2007	4.1	2.5	6.8	29	25
Ruby-crowned Kinglet	2001	1.8	1.0	3.4	39	27
	2002	4.9	2.8	8.6	34	70
	2004	5.2	3.1	8.5	30	99
	2007	6.0	3.6	10.1	32	77
Townsend's Solitaire	2001	2.5	1.8	3.6	20	33
	2002	3.5	2.4	4.9	21	43
	2004	5.8	4.7	7.2	12	97
	2007	4.5	3.3	6.1	18	52
Swainson's Thrush	2001	5.3	3.5	8.0	25	52
	2002	3.5	1.9	6.6	39	33
	2004	5.6	3.4	9.3	31	71
	2007	2.1	1.1	3.9	39	18
American Robin	2001	28.1	19.9	39.6	21	146
	2002	9.6	7.1	13.0	18	101
	2004	31.1	23.4	41.5	18	177
	2007	45.9	34.7	60.7	17	206
Yellow-rumped Warbler	2001	22.1	14.9	32.7	24	130
	2002	17.0	7.8	37.1	50	147
	2004	22.3	17.6	28.2	14	155
	2007	40.2	29.0	55.7	20	219
American Redstart	2001	25.3	15.4	41.6	31	51
	2002	19.6	10.1	38.1	41	38
	2004	18.7	10.2	34.5	38	49
	2007	7.2	2.9	18.3	59	13
Ovenbird	2001	50.0	39.3	63.5	14	333
	2002	36.7	28.1	48.1	16	289
	2004	41.4	33.4	51.1	13	413
	2007	24.8	16.5	37.5	24	191

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
MacGillivray's Warbler	2001	8.7	5.1	14.8	33	33
	2002	18.4	10.1	33.3	37	51
	2004	40.4	22.7	71.9	36	50
	2007	10.8	4.9	23.8	49	23
Common Yellowthroat	2001	2.0	1.1	3.8	39	14
	2002	3.0	1.5	5.9	42	20
	2004	2.3	1.1	4.8	45	21
	2007	0.5	0.2	1.2	58	3
Western Tanager	2001	4.3	2.7	6.7	27	54
	2002	2.3	1.5	3.5	26	28
	2004	3.7	2.7	5.1	19	61
	2007	5.3	3.6	7.8	23	60
Spotted Towhee	2001	2.4	1.1	5.5	51	12
	2002	3.8	1.5	9.5	58	18
	2004	2.4	1.0	5.4	53	14
	2007	4.6	2.5	8.4	37	20
Chipping Sparrow	2001	43.7	20.8	91.9	47	76
	2002	41.3	20.6	82.9	44	69
	2004	66.4	31.9	138.6	47	140
	2007	91.6	45.7	183.6	44	139
Dark-eyed Junco	2001	30.8	23.6	40.2	16	147
	2002	15.7	11.4	21.8	20	113
	2004	35.9	25.7	50.0	20	175
	2007	52.7	41.4	67.2	15	217
Black-headed Grosbeak	2001	4.9	2.9	8.3	31	31
	2002	8.4	5.5	12.9	26	51
	2004	2.6	1.5	4.4	32	20
	2007	4.3	1.9	9.8	51	24
Brown-headed Cowbird	2001	5.8	3.7	9.0	27	38
	2002	6.5	4.3	9.8	25	49
	2004	13.0	4.1	41.5	78	40
	2007	17.9	10.5	30.6	33	69
Red Crossbill	2001	19.6	12.1	31.5	29	130
	2002	21.5	10.5	44.3	46	107
	2004	13.9	7.8	24.7	36	70
	2007	51.2	33.6	77.9	26	84
Pine Siskin	2001	14.0	8.0	24.4	34	37
	2002	17.3	10.2	29.5	33	44
	2004	1.7	0.8	3.8	49	5
	2007	8.5	4.7	15.3	36	19
Red Squirrel	2001	12.9	8.3	20.0	27	21
	2002	14.0	8.0	24.5	34	22
	2004	11.3	6.6	19.3	33	24
	2007	70.0	41.1	119.3	32	102

[†] *D* = estimated density (birds/km²); *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*.

Burn Area

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Table 3. Estimated densities of breeding birds in Burn Area habitat in the Black Hills, 2001-2007¹.

Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Mourning Dove	2001	0.2	0.1	0.6	57	8
	2002	1.2	0.7	1.8	26	36
	2003	1.1	0.7	1.7	29	35
	2004	2.2	1.6	3.2	22	68
	2005	0.6	0.3	1.1	43	17
	2007	2.4	1.7	3.4	21	45
Red-headed Woodpecker	2001	0.3	0.1	0.7	52	14
	2002	0.6	0.3	1.0	37	25
	2003	0.7	0.5	1.1	26	33
	2004	0.6	0.4	1.0	28	27
	2005	1.0	0.7	1.5	24	43
	2007	1.5	1.0	2.2	23	36
Hairy Woodpecker	2001	2.4	1.6	3.5	24	24
	2002	15.5	11.6	20.7	17	148
	2003	13.6	10.9	17.1	13	136
	2004	15.5	12.7	19.0	12	142
	2005	10.9	9.1	13.2	11	105
	2007	20.5	16.2	25.9	14	113
Black-backed Woodpecker	2001	0.4	0.2	1.0	53	5
	2002	5.5	3.7	8.1	24	57
	2003	3.7	2.4	5.7	26	40
	2004	3.3	2.2	4.9	24	35
	2005	2.7	1.7	4.2	27	29
	2007	2.4	1.2	4.9	42	16
Northern Flicker	2001	1.6	1.1	2.3	23	35
	2002	2.3	1.7	3.3	21	48
	2003	3.0	2.1	4.2	21	64
	2004	4.8	3.7	6.1	15	99
	2005	9.2	7.4	11.3	13	191
	2007	7.5	6.0	9.4	14	94
Western Wood-Pewee	2001	1.3	0.6	2.9	48	30
	2002	2.1	1.1	3.8	37	44
	2003	5.4	3.9	7.5	19	119
	2004	9.9	8.0	12.2	12	214
	2005	4.4	3.1	6.3	21	97
	2007	13.4	10.7	16.8	13	173
Dusky Flycatcher	2001	7.0	4.7	10.3	23	72
	2002	11.6	8.6	15.7	18	98
	2003	12.9	9.7	17.2	18	139
	2004	12.6	8.7	18.5	23	96
	2005	11.4	6.2	20.7	38	140
	2007	26.3	17.6	39.2	24	102
Plumbeous Vireo	2001	4.6	3.0	6.8	24	51
	2002	4.9	3.3	7.1	23	51
	2003	6.4	4.1	10.1	27	70
	2004	3.4	2.1	5.4	28	37
	2005	4.7	3.0	7.5	28	51

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	<i>%CV</i>	<i>n</i>
Warbling Vireo	2007	4.7	2.9	7.8	30	31
	2001	3.5	2.0	5.9	33	55
	2002	3.4	1.8	6.1	37	50
	2003	3.2	1.9	5.3	31	50
	2004	5.6	3.5	8.8	28	84
	2005	3.1	1.8	5.1	32	47
	2007	8.3	5.1	13.5	29	77
Gray Jay	2001	3.9	2.0	7.9	44	26
	2002	4.8	2.6	8.9	38	30
	2003	4.2	2.2	8.0	41	27
	2004	3.0	1.5	5.8	42	15
	2005	2.3	1.2	4.7	43	11
	2007	0.5	0.1	2.2	103	1
American Crow	2001	0.2	0.1	0.3	33	39
	2002	0.1	0.1	0.2	25	26
	2003	0.2	0.2	0.4	25	47
	2004	0.2	0.1	0.3	29	26
	2005	0.1	0.1	0.2	32	24
	2007	0.2	0.1	0.3	26	26
Violet-green Swallow	2001	0.5	0.1	2.1	107	1
	2002	5.2	1.3	20.8	99	10
	2003	10.9	4.4	27.3	59	22
	2004	14.5	6.3	33.7	54	16
	2005	9.1	3.3	25.0	67	9
	2007	4.1	1.4	12.3	73	3
Black-capped Chickadee	2001	8.5	6.1	11.9	20	94
	2002	12.6	9.8	16.2	15	137
	2003	5.7	3.9	8.5	24	72
	2004	27.0	18.6	39.2	23	79
	2005	5.1	3.6	7.2	21	67
	2007	8.7	6.0	12.6	23	55
Red-breasted Nuthatch	2001	2.8	2.1	3.9	19	57
	2002	5.3	3.8	7.4	20	100
	2003	2.6	1.8	3.7	22	51
	2004	2.2	1.5	3.3	24	42
	2005	3.7	2.6	5.3	22	72
	2007	3.3	2.2	4.9	24	39
White-breasted Nuthatch	2001	7.1	2.4	21.2	74	31
	2002	12.5	4.3	36.0	71	51
	2003	17.8	6.4	49.9	69	76
	2004	14.6	5.3	40.7	69	62
	2005	16.6	6.0	46.0	68	70
	2007	25.7	9.1	72.8	70	66
Rock Wren	2001	0.1	0.0	0.2	75	3
	2002	0.2	0.1	0.5	69	6
	2003	0.4	0.2	0.7	37	15
	2004	1.9	1.3	2.8	25	73
	2005	2.3	1.4	3.7	29	88
	2007	0.5	0.3	0.9	32	12

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
House Wren	2001	0.1	0.0	0.5	98	2
	2002	0.5	0.2	1.0	42	7
	2003	1.4	0.9	2.3	29	21
	2004	6.2	4.7	8.1	16	90
	2005	7.4	5.1	10.6	22	108
	2007	11.6	8.2	16.5	20	104
	Eastern Bluebird	2001	1.4	0.6	3.2	51
2002		2.3	1.3	4.0	34	36
2003		2.8	1.8	4.2	25	45
2004		3.3	2.1	5.2	27	54
2005		3.3	2.4	4.6	19	51
2007		2.3	1.2	4.3	37	23
Mountain Bluebird		2001	8.4	5.5	12.9	26
	2002	12.9	8.0	20.8	29	56
	2003	12.8	8.8	18.6	23	58
	2004	26.5	20.4	34.4	16	110
	2005	41.1	31.1	54.5	17	170
	2007	47.8	35.2	64.8	18	111
	Townsend's Solitaire	2001	7.0	5.7	8.5	12
2002		8.4	6.7	10.4	13	172
2003		8.3	6.6	10.4	13	178
2004		7.1	5.9	8.7	12	151
2005		3.4	2.5	4.5	17	71
2007		5.2	3.6	7.4	21	66
American Robin		2001	16.1	12.9	20.2	13
	2002	19.8	16.1	24.3	12	325
	2003	22.9	19.9	26.4	8	383
	2004	22.3	19.6	25.4	8	310
	2005	20.2	17.1	23.7	10	321
	2007	13.4	10.4	17.3	15	123
	Yellow-rumped Warbler	2001	27.6	22.9	33.1	11
2002		27.3	19.4	38.6	21	359
2003		12.5	9.9	15.9	14	252
2004		6.8	5.1	9.1	18	118
2005		7.6	5.4	10.6	20	142
2007		9.2	6.1	13.8	25	105
Western Tanager		2001	16.7	10.7	26.0	27
	2002	18.8	12.3	28.7	26	167
	2003	31.5	21.4	46.4	24	292
	2004	16.7	11.1	25.1	25	147
	2005	17.1	11.3	25.9	26	156
	2007	15.8	10.1	24.6	27	88
	Chipping Sparrow	2001	47.9	35.5	64.5	18
2002		37.6	28.0	50.6	18	246
2003		93.1	78.2	111.0	11	407
2004		117.5	89.2	154.9	17	346
2005		136.2	100.8	184.1	18	482
2007		157.7	116.8	212.9	18	229
Vesper Sparrow		2001	1.7	1.0	2.9	34

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
	2002	2.7	1.6	4.4	30	56
	2003	3.5	2.4	4.9	22	76
	2004	4.7	3.6	6.2	17	102
	2005	6.6	4.9	8.9	18	143
	2007	14.4	10.4	19.8	19	190
Dark-eyed Junco	2001	22.4	15.2	33.1	24	227
	2002	19.6	15.9	24.3	13	252
	2003	62.2	48.1	80.3	16	295
	2004	79.1	59.5	105.0	17	336
	2005	65.9	49.9	87.0	17	337
	2007	88.1	65.9	118.3	18	293
Western Meadowlark	2002	0.2	0.1	0.6	63	11
	2003	0.4	0.2	0.8	44	20
	2004	1.8	1.1	3.0	32	92
	2005	2.0	1.1	3.4	33	102
	2007	1.6	1.0	2.6	29	50
Brown-headed Cowbird	2001	26.3	20.6	33.7	15	150
	2002	20.8	15.5	28.0	18	146
	2003	18.3	14.1	23.8	16	191
	2004	42.5	29.4	61.6	23	148
	2005	22.1	16.6	29.4	17	173
	2007	34.8	26.6	45.6	16	136
Red Crossbill	2001	30.6	19.1	49.2	29	275
	2002	83.5	58.5	119.1	21	702
	2003	3.4	1.4	8.5	57	30
	2004	86.9	61.1	123.6	21	236
	2005	10.3	5.3	19.7	41	34
	2007	55.6	42.0	73.7	17	109
Pine Siskin	2001	6.9	4.3	11.3	29	48
	2002	13.9	9.2	21.0	25	90
	2003	4.6	2.8	7.6	31	31
	2004	0.6	0.2	1.5	60	4
	2005	6.7	3.9	11.5	33	35
	2007	2.7	1.1	6.7	56	10
American Goldfinch	2001	1.5	1.0	2.5	29	14
	2002	3.0	1.7	5.5	37	26
	2003	4.6	3.1	6.9	24	41
	2004	0.5	0.2	1.0	48	4
	2005	3.1	1.9	5.0	30	26
	2007	3.7	1.8	7.9	46	16
Red Squirrel	2002	1.6	0.6	4.2	61	7
	2003	1.3	0.6	3.1	53	6
	2004	2.2	1.1	4.4	42	10
	2005	0.9	0.3	2.3	61	4
	2007	9.9	5.8	16.9	32	27

¹*D* = estimated density (birds/km²); *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*.

Foothills RiparianTable 4. Estimated densities of breeding birds in Foothills Riparian habitat in the Black Hills, 2001-2007¹.

Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Turkey Vulture	2001	0.4	0.1	1.2	58	2
	2002	1.3	0.6	2.8	48	28
	2005	0.9	0.5	1.6	33	24
	2006	0.5	0.3	1.0	41	13
Mourning Dove	2001	24.4	7.1	83.6	79	24
	2002	9.5	4.9	18.3	41	65
	2005	5.5	1.4	22.1	100	51
	2006	3.9	2.3	6.5	32	63
White-throated Swift	2001	1.5	0.2	9.1	103	2
	2002	6.8	3.5	13.0	40	41
	2005	20.9	9.8	44.6	48	34
	2006	19.3	9.0	41.1	48	63
Hairy Woodpecker	2001	0.0				0
	2002	0.8	0.3	1.7	50	5
	2005	2.5	1.7	3.8	25	26
	2006	2.9	1.9	4.4	25	27
Northern Flicker	2001	0.9	0.2	3.3	75	2
	2002	1.5	0.8	2.8	40	15
	2005	1.2	0.6	2.3	39	19
	2006	2.0	1.1	3.7	38	29
Western Wood-Pewee	2001	8.6	2.7	27.2	59	19
	2002	5.7	3.0	10.8	39	57
	2005	3.0	1.9	4.7	27	45
	2006	4.0	2.4	6.7	31	58
Dusky Flycatcher	2001	2.6	0.7	10.0	70	3
	2002	9.4	5.6	15.7	30	49
	2005	18.3	12.6	26.6	22	147
	2006	12.9	7.4	22.8	34	98
Cordilleran Flycatcher	2001	32.3	13.8	75.3	42	17
	2002	32.1	18.3	56.6	34	77
	2005	58.3	44.6	76.1	16	215
	2006	49.6	37.0	66.5	18	172
Eastern Kingbird	2001	31.6	11.3	88.4	55	22
	2002	19.6	10.0	38.7	42	62
	2005	1.8	0.5	6.7	89	9
	2006	2.8	0.8	9.8	84	13
Plumbeous Vireo	2001	5.9	2.3	15.3	48	6
	2002	3.9	1.8	8.3	46	18
	2005	4.9	3.3	7.3	24	35
	2006	5.3	3.6	8.0	24	36
Warbling Vireo	2001	10.0	2.9	34.7	64	9
	2002	20.5	13.8	30.6	23	84
	2005	61.4	50.5	74.6	12	385
	2006	28.0	20.2	39.0	20	166

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Red-eyed Vireo	2001	27.4	10.8	69.6	48	19
	2002	26.0	16.3	41.6	28	82
	2005	25.7	17.5	37.7	23	124
	2006	15.9	9.4	27.0	32	73
Blue Jay	2001	2.1	0.3	13.2	104	7
	2002	1.1	0.6	2.3	43	17
	2005	0.8	0.4	1.5	39	16
	2006	1.4	0.8	2.4	34	26
Violet-green Swallow	2001	76.9	33.2	178.3	43	62
	2002	49.7	30.4	81.3	30	182
	2005	30.0	16.8	53.5	36	67
	2006	37.1	23.7	58.3	28	104
Black-capped Chickadee	2001	38.6	12.7	117.6	71	11
	2002	35.5	14.8	85.1	57	46
	2005	73.7	32.4	167.2	53	141
	2006	74.8	32.7	170.9	53	130
Red-breasted Nuthatch	2001	2.4	0.9	6.4	50	3
	2002	4.1	2.6	6.7	29	24
	2005	15.6	12.1	20.1	15	130
	2006	15.2	10.8	21.3	20	126
White-breasted Nuthatch	2001	1.2	0.3	4.9	73	3
	2002	0.8	0.4	1.7	45	9
	2005	0.8	0.4	1.4	37	13
	2006	4.6	2.8	7.4	29	73
Rock Wren	2001	1.0	0.2	4.5	86	3
	2002	1.5	0.5	4.3	69	21
	2005	0.8	0.4	1.7	50	17
	2006	0.6	0.3	1.4	48	13
Canyon Wren	2001	1.1	0.3	4.3	71	3
	2002	2.1	1.3	3.4	28	26
	2005	0.8	0.3	1.8	54	14
	2006	1.5	0.9	2.4	29	26
House Wren	2001	7.0	2.5	19.5	52	7
	2002	18.0	10.8	30.2	31	82
	2005	1.6	0.7	3.4	47	11
	2006	1.4	0.6	3.0	50	9
Ruby-crowned Kinglet	2001	0.0				0
	2002	2.0	0.7	5.8	69	11
	2005	8.1	5.0	13.2	29	69
	2006	3.9	2.2	6.7	34	31
Townsend's Solitaire	2001	0.9	0.1	5.6	109	2
	2002	0.9	0.4	2.1	51	10
	2005	3.0	2.0	4.5	24	49
	2006	2.5	1.5	4.1	31	38
Swainson's Thrush	2001	0.9	0.1	5.6	110	1
	2002	2.5	1.1	5.6	51	13
	2005	7.6	4.8	11.9	27	61
	2006	15.5	9.7	24.8	29	118
American Robin	2001	57.4	26.8	123.2	40	42

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	<i>%CV</i>	<i>n</i>
	2002	44.2	28.7	67.9	26	101
	2005	70.8	54.0	92.8	16	280
	2006	54.0	32.0	91.3	33	259
Cedar Waxwing	2001	66.8	15.4	289.2	80	21
	2002	56.7	31.1	103.3	37	81
	2005	12.7	5.0	32.4	60	10
	2006	8.7	2.8	26.4	73	15
Yellow Warbler	2001	56.3	19.5	162.7	57	45
	2002	49.0	29.6	81.1	30	144
	2005	27.3	12.8	58.1	47	57
	2006	5.5	2.4	12.4	51	38
Yellow-rumped Warbler	2001	2.8	0.5	16.7	102	4
	2002	3.5	1.8	6.6	39	23
	2005	10.4	7.4	14.6	20	106
	2006	11.7	8.3	16.4	20	112
American Redstart	2001	4.0	0.7	24.1	103	2
	2002	24.5	14.9	40.4	30	56
	2005	77.2	54.3	109.9	21	272
	2006	50.5	33.8	75.5	24	168
Ovenbird	2001	42.5	16.0	112.8	54	32
	2002	21.8	12.6	37.6	33	148
	2005	49.7	39.2	63.1	14	374
	2006	42.0	26.1	67.7	29	206
MacGillivray's Warbler	2001	2.9	0.4	18.6	110	1
	2002	5.1	2.4	10.6	45	8
	2005	23.1	13.1	40.8	35	55
	2006	7.8	4.4	14.1	36	18
Common Yellowthroat	2001	0.0				0
	2002	42.5	20.9	86.6	44	70
	2005	31.9	16.5	61.7	41	81
	2006	20.9	10.0	43.7	47	47
Yellow-breasted Chat	2001	6.3	1.2	33.4	93	10
	2002	8.5	4.5	16.0	38	61
	2005	2.2	0.7	6.4	71	24
	2006	1.7	0.5	6.1	86	18
Western Tanager	2001	7.4	3.4	16.3	39	13
	2002	3.0	1.9	4.9	28	24
	2005	7.9	5.8	10.7	18	96
	2006	10.2	7.6	13.8	18	117
Spotted Towhee	2001	29.3	11.8	72.8	47	24
	2002	21.5	14.3	32.5	25	80
	2005	16.4	10.0	26.9	30	94
	2006	18.1	10.4	31.7	34	98
Chipping Sparrow	2001	23.3	7.6	71.6	58	6
	2002	29.9	19.1	46.7	27	35
	2005	79.3	57.1	110.2	20	133
	2006	51.6	37.1	72.0	20	87
Lark Sparrow	2001	6.8	1.3	36.0	93	5
	2002	13.5	6.8	27.1	42	45

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	<i>%CV</i>	<i>n</i>
	2005	1.6	0.5	5.0	78	8
	2006	4.1	1.3	13.2	77	20
Song Sparrow	2001	12.1	2.0	72.0	101	6
	2002	14.7	8.3	26.1	35	33
	2005	19.4	11.7	32.1	31	67
	2006	16.5	10.4	26.2	28	54
Dark-eyed Junco	2001	78.7	8.4	737.5	225	3
	2002	109.7	13.2	910.6	204	19
	2005	322.3	39.3	2645.8	201	83
	2006	226.1	27.3	1870.1	203	56
Black-headed Grosbeak	2001	64.4	26.9	154.5	48	36
	2002	25.7	15.5	42.6	31	104
	2005	37.4	24.7	56.5	25	127
	2006	10.5	6.8	16.2	26	94
Lazuli Bunting	2001	10.6	2.4	46.7	80	9
	2002	9.8	5.1	19.0	40	38
	2005	1.7	0.6	4.4	62	10
	2006	3.0	1.2	7.5	57	17
Red-winged Blackbird	2001	11.9	2.7	51.8	79	17
	2002	19.7	10.2	37.9	40	128
	2005	4.3	1.7	10.8	59	39
	2006	0.5	0.2	1.7	79	5
Western Meadowlark	2001	3.1	0.6	16.3	95	10
	2002	3.4	1.8	6.7	41	50
	2005	1.2	0.4	3.7	76	25
	2006	0.2	0.1	0.6	79	4
Common Grackle	2001	45.7	10.9	191.8	77	29
	2002	18.1	7.1	45.8	58	52
	2005	0.7	0.2	2.7	98	3
	2006	0.0				0
Brown-headed Cowbird	2001	16.5	7.1	38.4	42	19
	2002	12.1	8.9	16.3	18	63
	2005	11.7	8.5	16.1	19	88
	2006	6.0	3.9	9.4	27	46
Red Crossbill	2001	0.9	0.3	2.8	57	2
	2002	19.4	6.7	56.1	68	188
	2005	5.8	3.5	9.8	32	54
	2006	3.1	1.8	5.3	32	35
Pine Siskin	2001	4.4	1.2	16.5	70	4
	2002	1.5	0.7	2.9	42	6
	2005	11.6	8.1	16.5	22	67
	2006	6.7	4.0	11.2	31	37
American Goldfinch	2001	39.1	11.1	137.3	65	31
	2002	18.6	11.1	31.1	31	67
	2005	4.1	2.2	7.9	39	19
	2006	6.5	3.2	13.2	44	29
Red Squirrel	2001	0.0				0
	2002	5.3	1.8	15.0	68	14
	2005	3.7	1.7	7.7	47	14

Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
	2006	10.1	5.2	19.5	41	39

¹*D* = estimated density (birds/km²); *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*.

Late-successional Pine

Table 5. Estimated densities of breeding birds in Late-successional Pine habitat in the Black Hills, 2001-2007¹.

Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Red-naped Sapsucker	2001	10.9	3.1	38.1	88	19
	2002	10.6	3.2	35.5	84	19
	2004	19.1	5.8	62.9	82	40
	2007	22.8	6.3	82.8	91	20
Hairy Woodpecker	2001	1.7	1.0	2.9	34	12
	2002	5.2	3.4	7.8	25	38
	2004	4.9	3.3	7.3	24	39
	2007	7.8	5.2	11.8	24	27
Western Wood-Pewee	2001	1.4	0.4	4.1	73	15
	2002	2.7	1.1	6.6	56	31
	2004	2.2	1.3	3.8	33	29
	2007	6.7	2.9	15.0	48	37
Dusky Flycatcher	2001	7.8	5.1	11.8	25	42
	2002	10.1	6.7	15.2	25	56
	2004	10.9	7.2	16.6	25	71
	2007	15.8	10.4	24.0	24	43
Cordilleran Flycatcher	2001	6.8	4.0	11.6	33	27
	2002	11.5	6.8	19.5	33	47
	2004	9.0	5.3	15.1	32	43
	2007	5.0	2.5	10.0	42	10
Warbling Vireo	2001	15.5	11.4	21.1	19	181
	2002	14.0	9.6	20.5	23	163
	2004	24.3	16.8	35.0	22	253
	2007	27.6	18.7	40.7	23	125
Red-eyed Vireo	2001	1.8	0.8	4.0	52	10
	2002	3.9	1.9	8.1	45	23
	2004	2.8	1.2	6.2	51	16
	2007	1.7	0.7	4.5	59	5
Gray Jay	2001	4.4	2.2	8.8	43	20
	2002	5.4	3.0	9.5	36	25
	2004	7.6	3.7	15.3	44	22
	2007	3.1	1.1	8.3	64	5
Black-capped Chickadee	2001	11.7	8.9	15.4	16	83
	2002	13.9	10.5	18.2	16	101
	2004	13.2	10.2	17.1	16	109
	2007	12.9	9.3	18.0	19	45
Red-breasted Nuthatch	2001	16.1	12.8	20.3	14	182
	2002	14.1	11.3	17.7	14	203
	2004	31.3	23.5	41.6	17	204
	2007	42.3	32.4	55.2	16	150

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
White-breasted Nuthatch	2001	6.2	2.5	15.6	60	13
	2002	6.5	2.8	15.4	55	14
	2004	10.4	3.8	28.0	66	24
	2007	15.2	6.1	37.9	59	13
Brown Creeper	2001	12.3	8.5	17.9	22	34
	2002	13.4	9.2	19.5	23	38
	2004	16.9	11.7	24.4	22	56
	2007	2.9	1.0	8.0	62	4
Ruby-crowned Kinglet	2001	2.0	1.0	3.9	42	20
	2002	6.2	3.5	11.1	35	65
	2004	7.4	4.7	11.7	27	90
	2007	6.2	3.3	11.7	37	32
Townsend's Solitaire	2001	5.9	4.5	7.5	15	87
	2002	7.8	5.9	10.3	17	119
	2004	8.9	6.9	11.5	16	155
	2007	3.5	2.1	5.7	28	26
Swainson's Thrush	2001	4.0	2.4	6.5	30	49
	2002	3.9	2.2	6.7	34	49
	2004	4.8	3.0	7.7	28	71
	2007	5.8	2.5	13.6	52	36
American Robin	2001	13.8	9.1	20.9	25	116
	2002	17.2	12.6	23.4	19	165
	2004	28.2	22.0	36.2	15	212
	2007	23.3	14.2	38.3	29	79
Yellow-rumped Warbler	2001	38.7	30.3	49.4	15	244
	2002	22.8	16.4	31.6	20	282
	2004	29.1	23.3	36.4	13	266
	2007	51.7	34.4	77.5	25	167
American Redstart	2001	3.3	1.6	7.1	47	23
	2002	1.7	0.8	3.5	45	12
	2004	3.4	1.6	7.0	45	28
	2007	2.6	0.9	7.6	67	9
Ovenbird	2001	25.8	17.5	37.9	23	250
	2002	22.0	15.4	31.4	21	219
	2004	21.5	14.9	31.0	22	250
	2007	27.1	14.3	51.4	37	132
MacGillivray's Warbler	2001	3.4	1.5	7.7	52	16
	2002	3.5	1.9	6.4	37	17
	2004	4.0	1.9	8.7	47	23
	2007	5.9	2.2	15.8	61	14
Western Tanager	2001	8.2	5.4	12.6	26	93
	2002	6.3	4.4	9.0	21	109
	2004	9.4	6.3	14.0	24	97
	2007	11.8	7.5	18.5	27	63
Chipping Sparrow	2001	13.1	7.0	24.5	39	53
	2002	21.0	7.2	61.3	72	86
	2004	68.2	35.5	131.1	41	152
	2007	34.2	16.5	71.0	46	63
Dark-eyed Junco	2001	15.8	12.6	19.9	14	171

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
	2002	50.4	22.9	111.0	51	193
	2004	59.6	31.2	113.7	41	208
	2007	46.2	31.8	67.2	22	125
Brown-headed Cowbird	2001	4.5	2.8	7.2	29	26
	2002	5.6	2.9	10.5	39	33
	2004	3.8	2.1	6.8	36	26
	2007	9.3	5.8	14.8	28	27
Red Crossbill	2001	35.0	21.4	57.3	30	205
	2002	18.3	11.3	29.5	29	160
	2004	26.1	18.6	36.7	21	108
	2007	29.2	17.6	48.3	30	73
Pine Siskin	2001	11.9	7.6	18.7	27	53
	2002	8.8	5.1	15.0	33	40
	2004	2.3	0.9	5.4	56	12
	2007	6.3	3.1	12.8	42	13
Red Squirrel	2001	16.3	10.9	24.5	24	41
	2002	20.5	12.6	33.4	29	53
	2004	11.9	7.9	18.2	25	36
	2007	77.6	48.5	124.2	27	98

¹*D* = estimated density (birds/km²); *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*.

Mixed-grass Prairie

Table 6. Estimated densities of breeding birds in Mixed-grass Prairie habitat in the Black Hills, 2001-2007¹.

Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Mourning Dove	2001	18.9	4.6	77.3	103	42
	2002	14.7	3.6	59.7	102	46
	2004	10.2	2.5	41.7	103	56
	2006	13.7	3.4	55.2	102	69
Northern Flicker	2001	0.9	0.4	1.9	42	5
	2002	0.4	0.2	1.0	60	3
	2004	0.9	0.6	1.4	28	14
	2006	2.9	1.7	5.2	34	39
Western Wood-Pewee	2001	0.0				0
	2002	0.1	0.0	0.4	102	1
	2004	1.4	0.6	3.4	56	35
	2006	1.3	0.6	3.2	56	29
Dusky Flycatcher	2001	8.4	4.3	16.6	39	34
	2002	6.7	2.6	17.1	58	38
	2004	3.4	1.7	6.7	41	40
	2006	1.1	0.4	3.1	64	12
Plumbeous Vireo	2001	8.8	4.4	17.7	42	48
	2002	5.0	2.5	9.9	42	38
	2004	0.6	0.3	1.3	44	10
	2006	0.5	0.2	1.2	55	7
Pinyon Jay	2001	0.0	0.0	0.2	98	1
	2002	1.2	0.3	5.5	108	9

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
American Crow	2004	0.5	0.2	1.1	51	14
	2006	0.4	0.2	0.8	49	13
	2001	0.2	0.1	0.3	36	11
	2002	0.3	0.2	0.4	22	26
	2004	0.4	0.3	0.5	17	73
Black-capped Chickadee	2006	0.3	0.2	0.5	22	37
	2001	4.9	3.2	7.6	25	34
	2002	2.7	1.2	5.7	46	26
	2004	1.9	1.2	3.1	29	37
Red-breasted Nuthatch	2006	4.4	3.2	6.0	18	78
	2001	2.0	1.0	4.2	42	18
	2002	3.2	2.0	5.3	30	40
	2004	0.9	0.5	1.5	32	23
White-breasted Nuthatch	2006	2.9	1.6	5.3	37	63
	2001	11.4	0.8	154.6	317	7
	2002	4.6	0.3	63.7	322	4
	2004	8.4	0.6	114.1	316	15
Rock Wren	2006	11.3	0.8	153.5	317	15
	2001	0.0				0
	2002	0.4	0.2	0.9	50	6
	2004	2.4	1.5	3.8	28	72
Mountain Bluebird	2006	1.6	1.0	2.7	29	44
	2001	5.2	2.6	10.6	41	20
	2002	4.7	2.8	7.7	30	25
	2004	7.6	5.4	10.6	20	77
Townsend's Solitaire	2006	18.8	14.1	24.9	17	151
	2001	0.5	0.1	2.0	85	
	2002	1.0	0.4	2.1	48	15
	2004	0.8	0.5	1.5	33	27
Yellow-rumped Warbler	2006	0.4	0.2	0.9	55	10
	2001	9.7	6.5	14.3	23	68
	2002	9.6	6.3	14.6	25	95
	2004	3.8	2.8	5.2	19	77
Ovenbird	2006	4.7	3.3	6.7	21	86
	2001	1.1	0.4	2.7	55	14
	2002	1.2	0.5	2.8	54	22
	2004	0.3	0.2	0.6	37	13
Western Tanager	2006	0.4	0.2	0.9	51	13
	2001	4.9	2.8	8.4	31	52
	2002	1.8	1.1	3.0	29	27
	2004	1.7	1.2	2.4	22	50
Spotted Towhee	2006	2.0	1.2	3.2	29	54
	2001	7.2	2.4	21.5	67	25
	2002	7.2	3.0	17.3	54	35
	2004	3.6	1.9	6.6	38	36
Chipping Sparrow	2006	3.6	1.8	6.9	41	31
	2001	59.9	30.8	116.5	41	40
	2002	48.5	19.1	123.0	61	82
	2004	129.2	56.2	296.9	54	130

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Vesper Sparrow	2006	46.7	31.6	69.2	24	185
	2001	51.0	19.7	132.4	63	83
	2002	67.1	26.2	171.4	62	153
	2004	45.8	18.5	113.0	59	216
Lark Sparrow	2006	58.9	23.9	145.2	59	241
	2001	1.2	0.2	5.8	113	1
	2002	4.3	1.4	12.8	74	5
	2004	33.8	12.9	88.6	64	73
Grasshopper Sparrow	2006	42.5	15.9	113.6	65	71
	2001	1.3	0.3	5.6	96	3
	2002	14.8	7.2	30.4	43	48
	2004	15.5	9.5	25.3	30	104
Dark-eyed Junco	2006	59.5	43.1	82.0	19	353
	2001	4.0	2.4	6.7	30	24
	2002	3.0	1.7	5.4	36	25
	2004	1.7	1.1	2.7	26	28
Western Meadowlark	2006	1.4	0.5	3.4	58	17
	2001	4.5	1.3	15.3	83	51
	2002	18.9	12.0	29.8	27	298
	2004	388.9	211.7	714.5	38	642
Brown-headed Cowbird	2006	10.5	7.8	14.3	18	346
	2001	4.7	2.4	9.1	39	19
	2002	10.7	6.5	17.7	30	61
	2004	4.1	2.6	6.4	27	40
Red Crossbill	2006	2.1	1.2	3.6	33	20
	2001	2.8	0.8	9.4	75	8
	2002	155.4	80.2	301.2	40	289
	2004	10.5	6.0	18.4	35	37
American Goldfinch	2006	8.7	4.6	16.3	39	29
	2001	8.7	4.3	17.3	40	20
	2002	6.2	3.6	10.5	32	20
	2004	2.7	1.6	4.5	32	18
	2006	3.3	1.4	8.1	55	20

¹*D* = estimated density (birds/km²); *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*.

Montane Riparian

Table 7. Estimated densities of breeding birds in Montane Riparian habitat in the Black Hills, 2001-2007¹.

Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Mourning Dove	2001	1.1	0.3	3.7	77	7
	2002	1.1	0.6	2.0	40	17
	2003	0.6	0.4	1.2	38	10
	2005	0.2	0.1	0.7	79	3
	2006	1.6	0.6	4.2	62	21
White-throated Swift	2001	0.0				0
	2002	77.0	20.2	294.6	96	54
	2003	60.1	15.0	241.2	101	41

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
	2005	177.4	49.8	631.3	90	25
	2006	31.2	8.4	115.7	93	19
Red-naped Sapsucker	2001	2.8	1.4	5.6	40	8
	2002	5.2	3.4	7.8	25	37
	2003	8.3	5.4	12.7	26	58
	2005	6.2	4.2	9.2	24	40
	2006	12.0	8.6	16.8	20	78
Hairy Woodpecker	2001	2.2	1.1	4.2	39	9
	2002	2.1	1.3	3.3	29	22
	2003	1.7	1.1	2.8	28	18
	2005	3.2	2.1	5.0	26	31
	2006	3.1	2.1	4.6	24	29
Northern Flicker	2001	0.6	0.3	1.3	48	5
	2002	0.9	0.5	1.6	36	19
	2003	1.0	0.5	1.7	36	20
	2005	2.3	1.5	3.5	27	44
	2006	3.5	2.2	5.8	30	60
Western Wood-Pewee	2001	0.4	0.1	1.3	76	4
	2002	2.1	1.3	3.3	29	53
	2003	1.9	1.1	3.2	32	47
	2005	1.8	1.1	2.9	31	41
	2006	3.8	2.3	6.4	31	90
Dusky Flycatcher	2001	43.5	28.4	66.6	25	88
	2002	57.7	46.3	71.9	13	292
	2003	33.4	25.3	44.2	17	216
	2005	39.8	27.4	57.8	23	243
	2006	44.1	29.3	66.6	25	194
Cordilleran Flycatcher	2001	30.9	14.7	64.7	46	29
	2002	19.9	13.2	29.9	25	93
	2003	15.3	10.9	21.4	20	121
	2005	15.3	10.8	21.7	21	93
	2006	27.2	15.9	46.8	33	114
Plumbeous Vireo	2001	1.7	0.5	5.3	73	4
	2002	2.8	1.4	5.7	44	17
	2003	0.9	0.3	2.1	59	5
	2005	4.8	2.3	10.0	47	26
	2006	4.9	2.4	9.9	45	27
Warbling Vireo	2001	38.6	29.1	51.1	16	138
	2002	50.8	42.6	60.7	11	461
	2003	23.9	18.2	31.4	16	271
	2005	49.4	35.6	68.4	20	455
	2006	15.2	11.2	20.8	18	329
Red-eyed Vireo	2001	5.0	1.8	14.1	65	11
	2002	12.7	7.5	21.6	33	72
	2003	12.5	6.8	23.0	38	69
	2005	10.0	5.4	18.6	38	51
	2006	5.8	2.9	11.7	44	30
Blue Jay	2001	1.3	0.4	3.7	68	12
	2002	0.7	0.4	1.3	37	17

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
American Crow	2003	0.6	0.3	1.1	41	14
	2005	0.3	0.2	0.6	44	7
	2006	0.9	0.4	1.6	40	19
	2001	1.3	0.7	2.6	41	22
	2002	0.6	0.3	1.1	40	24
	2003	1.0	0.5	2.0	42	42
Violet-green Swallow	2005	0.5	0.3	0.9	39	18
	2006	1.1	0.6	2.0	40	36
	2001	5.5	2.4	12.9	50	9
	2002	29.2	14.4	58.9	43	121
	2003	18.8	10.4	33.9	36	76
Black-capped Chickadee	2005	32.9	17.5	61.8	39	33
	2006	40.6	23.1	71.3	34	91
	2001	6.9	3.7	12.9	36	14
	2002	22.3	16.7	29.8	18	115
	2003	20.1	14.4	28.0	20	101
Red-breasted Nuthatch	2005	22.8	17.1	30.4	17	103
	2006	28.1	21.0	37.7	18	131
	2001	2.5	1.8	3.5	19	23
	2002	5.0	3.9	6.4	15	119
	2003	3.3	2.4	4.5	19	76
White-breasted Nuthatch	2005	5.6	4.2	7.3	16	119
	2006	6.3	4.6	8.6	19	137
	2001	0.7	0.3	1.4	43	4
	2002	1.2	0.7	2.0	33	18
	2003	2.6	1.8	3.8	22	39
House Wren	2005	1.5	0.8	2.8	39	20
	2006	2.1	1.1	4.3	43	30
	2001	1.0	0.3	3.6	78	2
	2002	3.9	2.2	6.8	34	19
	2003	6.7	2.9	15.7	54	32
Ruby-crowned Kinglet	2005	6.8	2.6	17.7	61	30
	2006	4.9	1.8	13.5	65	21
	2001	3.7	1.7	7.9	47	27
	2002	11.8	7.9	17.6	24	140
	2003	7.4	5.3	10.3	20	142
Mountain Bluebird	2005	17.2	10.7	27.8	29	169
	2006	5.8	3.8	8.7	25	128
	2001	2.5	0.8	7.6	68	9
	2002	0.6	0.2	1.4	60	5
	2003	1.5	0.6	3.8	60	13
Townsend's Solitaire	2005	2.2	0.6	7.5	83	16
	2006	3.6	1.7	7.6	47	23
	2001	1.2	0.6	2.3	39	11
	2002	1.4	0.9	2.2	26	34
	2003	2.7	2.0	3.6	18	63
Veery	2005	1.7	1.1	2.7	26	37
	2006	2.8	2.0	3.9	20	59
	2001	3.8	1.7	8.6	49	24

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
	2002	3.0	1.8	5.0	31	57
	2003	9.8	5.5	17.4	35	89
	2005	5.8	3.0	11.0	40	45
	2006	2.9	1.2	7.1	56	38
Swainson's Thrush	2001	1.7	0.8	3.7	45	10
	2002	3.9	2.5	6.1	26	58
	2003	8.5	6.1	11.9	20	123
	2005	5.8	3.7	9.1	28	77
	2006	9.2	6.1	13.8	25	124
American Robin	2001	33.1	21.3	51.4	26	113
	2002	65.8	34.6	125.3	41	324
	2003	44.8	23.4	85.8	41	321
	2005	33.9	26.4	43.5	15	316
	2006	90.0	65.2	124.3	20	439
Gray Catbird	2001	4.7	1.6	13.6	65	5
	2002	3.3	1.4	7.8	54	9
	2003	8.6	4.9	15.1	34	23
	2005	8.9	4.1	19.5	48	22
	2006	14.4	6.5	31.9	49	36
Cedar Waxwing	2001	5.1	1.3	20.1	89	8
	2002	6.5	3.3	12.5	40	26
	2003	7.9	3.2	19.6	58	31
	2005	4.4	2.1	9.1	45	9
	2006	8.7	4.8	15.8	36	23
Yellow Warbler	2001	5.1	1.8	14.6	65	9
	2002	4.9	2.4	9.6	42	22
	2003	7.7	4.2	14.2	37	34
	2005	8.3	4.3	16.1	40	33
	2006	4.1	1.6	10.4	59	17
Yellow-rumped Warbler	2001	13.7	7.6	24.7	36	43
	2002	8.0	5.9	10.7	18	128
	2003	10.4	8.0	13.4	15	159
	2005	13.1	8.5	20.2	26	126
	2006	6.8	4.8	9.6	21	123
American Redstart	2001	69.7	41.2	117.9	31	113
	2002	57.8	38.8	86.0	24	254
	2003	33.5	21.5	52.2	27	192
	2005	63.7	41.0	98.8	27	233
	2006	54.4	27.7	106.7	42	134
Ovenbird	2001	10.9	6.1	19.4	35	73
	2002	17.8	13.0	24.4	19	251
	2003	13.2	9.7	18.1	19	274
	2005	21.3	14.8	30.8	22	271
	2006	35.9	20.8	62.0	34	246
MacGillivray's Warbler	2001	81.2	47.3	139.4	32	65
	2002	31.8	22.5	44.9	21	120
	2003	61.4	41.4	91.1	24	131
	2005	25.4	17.8	36.1	21	91
	2006	19.3	10.0	37.1	41	65

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Common Yellowthroat	2001	16.3	9.6	27.8	32	50
	2002	54.6	36.2	82.4	25	145
	2003	63.7	43.4	93.5	23	177
	2005	56.9	38.4	84.4	24	144
	2006	56.3	39.4	80.4	22	141
Western Tanager	2001	4.6	2.2	9.6	45	26
	2002	7.3	4.7	11.4	27	67
	2003	3.6	2.1	6.3	34	60
	2005	3.6	2.1	6.4	35	53
	2006	3.0	1.8	5.1	32	66
Spotted Towhee	2001	10.4	4.0	26.8	61	28
	2002	12.0	6.7	21.3	35	58
	2003	17.8	10.1	31.3	35	90
	2005	9.6	5.3	17.7	37	58
	2006	32.4	16.8	62.4	40	55
Chipping Sparrow	2001	43.1	17.0	108.8	59	31
	2002	21.3	5.6	80.6	95	114
	2003	77.2	30.2	197.4	62	156
	2005	47.8	28.9	79.1	31	142
	2006	48.5	28.6	82.2	33	154
Song Sparrow	2001	12.1	7.0	20.8	32	40
	2002	36.7	24.7	54.5	24	165
	2003	55.5	39.7	77.5	20	179
	2005	59.8	40.3	88.8	24	198
	2006	47.8	33.2	68.7	22	191
Dark-eyed Junco	2001	12.9	8.2	20.4	27	27
	2002	16.6	11.3	24.6	24	89
	2003	14.4	9.8	21.1	23	75
	2005	18.1	12.7	25.7	21	86
	2006	17.8	9.9	31.8	35	85
Black-headed Grosbeak	2001	10.9	3.6	32.8	69	25
	2002	15.1	9.8	23.4	27	89
	2003	14.5	9.4	22.3	26	83
	2005	13.2	7.8	22.4	32	70
	2006	9.1	5.6	14.8	30	49
Bobolink	2001	0.0				0
	2002	1.2	0.4	4.0	80	15
	2003	0.7	0.2	2.9	107	8
	2005	0.6	0.2	2.6	100	6
	2006	3.9	1.6	9.5	57	39
Red-winged Blackbird	2001	3.2	0.8	12.9	91	15
	2002	5.3	2.6	10.8	44	64
	2003	3.7	1.6	8.3	50	43
	2005	5.0	2.5	9.8	42	54
	2006	6.8	3.4	13.6	42	72
Brown-headed Cowbird	2001	15.0	7.9	28.4	37	39
	2002	16.1	11.4	22.8	21	75
	2003	7.7	4.5	13.1	33	80
	2005	6.2	3.8	10.0	29	56

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Red Crossbill	2006	2.9	2.0	4.3	23	57
	2001	5.3	1.9	14.8	63	21
	2002	15.1	9.4	24.3	29	154
	2003	8.4	4.9	14.1	32	83
	2005	6.5	3.8	11.4	34	40
	2006	6.3	4.3	9.2	23	56
Pine Siskin	2001	23.9	10.1	56.5	51	34
	2002	35.0	23.5	52.1	24	127
	2003	10.7	6.0	19.4	36	38
	2005	37.0	25.4	53.8	23	110
	2006	32.8	20.9	51.5	27	100
American Goldfinch	2001	4.4	1.0	18.4	95	6
	2002	0.9	0.3	2.5	69	3
	2003	3.8	1.5	9.9	61	13
	2005	5.0	2.5	10.0	42	12
	2006	9.9	5.6	17.6	35	26
Red Squirrel	2001	13.1	6.5	26.6	43	16
	2002	9.6	4.8	19.3	43	30
	2003	2.0	0.9	4.6	53	6
	2005	2.1	1.0	4.6	48	6
	2006	21.4	11.9	38.4	36	61

¹*D* = estimated density (birds/km²); *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*.

Ponderosa Pine – Northern Hills

Table 8. Estimated densities of breeding birds in Ponderosa Pine – Northern Hills habitat in the Black Hills, 2001-2007¹.

Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Red-naped Sapsucker	2001	17.3	9.4	31.5	38	50
	2002	16.6	9.5	29.0	35	45
	2003	22.9	13.1	39.9	35	70
	2005	19.6	11.5	33.3	33	58
	2007	14.3	6.9	29.8	46	27
Hairy Woodpecker	2001	4.4	2.6	7.6	33	27
	2002	5.4	3.4	8.8	30	31
	2003	5.0	3.1	7.9	28	32
	2005	8.8	5.6	14.0	28	54
	2007	7.8	4.7	13.0	31	30
Northern Flicker	2001	0.9	0.5	1.6	37	24
	2002	0.4	0.2	0.9	47	11
	2003	0.6	0.4	1.0	29	18
	2005	1.5	0.9	2.5	31	43
	2007	0.7	0.4	1.2	34	12
Western Wood-Pewee	2001	2.3	1.1	4.7	45	39
	2002	4.5	2.6	7.8	33	82
	2003	3.5	2.1	5.8	31	95
	2005	3.2	1.9	5.4	32	84
	2007	13.1	7.9	21.7	31	108

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Dusky Flycatcher	2001	21.0	14.6	30.1	22	161
	2002	27.3	20.2	36.8	18	153
	2003	16.1	11.9	21.8	18	144
	2005	13.2	9.4	18.4	20	141
	2007	38.8	25.1	59.9	27	99
Cordilleran Flycatcher	2001	3.2	2.1	5.0	27	22
	2002	3.4	2.0	5.9	33	22
	2003	5.5	3.4	9.0	30	40
	2005	6.1	3.7	9.9	30	43
	2007	3.1	1.9	5.1	29	14
Plumbeous Vireo	2001	2.3	1.3	4.2	36	29
	2002	0.8	0.4	1.6	47	9
	2003	0.9	0.5	1.6	32	12
	2005	1.6	1.0	2.6	28	21
	2007	0.7	0.3	1.8	54	6
Warbling Vireo	2001	35.1	27.3	45.2	15	393
	2002	36.9	29.0	46.8	14	358
	2003	35.5	23.3	53.9	26	345
	2005	48.0	36.3	63.4	17	383
	2007	45.3	35.6	57.7	14	261
Red-eyed Vireo	2001	5.7	2.9	11.2	41	36
	2002	2.9	1.3	6.6	51	17
	2003	2.9	1.2	6.8	55	19
	2005	3.1	1.5	6.4	46	20
	2007	1.2	0.4	3.4	64	5
Gray Jay	2001	27.9	9.9	78.9	69	40
	2002	11.9	4.1	35.1	73	16
	2003	15.2	5.3	43.2	70	23
	2005	18.8	6.5	54.7	72	18
	2007	19.3	6.6	56.6	72	12
American Crow	2001	0.5	0.3	0.8	27	34
	2002	0.2	0.1	0.4	38	15
	2003	0.3	0.2	0.5	27	25
	2005	0.2	0.1	0.3	45	11
	2007	0.5	0.3	0.9	34	19
Black-capped Chickadee	2001	10.5	8.1	13.6	15	105
	2002	12.0	9.7	14.8	13	114
	2003	11.9	9.4	15.1	14	127
	2005	20.7	15.9	26.9	16	183
	2007	19.0	13.4	26.9	21	75
Red-breasted Nuthatch	2001	14.7	11.9	18.3	13	220
	2002	19.3	15.6	23.9	13	230
	2003	15.5	11.5	21.0	18	175
	2005	14.4	11.7	17.7	13	197
	2007	24.9	18.7	33.2	18	163
White-breasted Nuthatch	2001	2.1	1.4	3.2	24	20
	2002	3.2	1.8	5.4	33	28
	2003	6.4	4.3	9.4	23	64
	2005	1.8	1.1	3.0	31	17

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Brown Creeper	2007	4.2	2.9	6.1	22	26
	2001	3.1	1.6	6.0	41	14
	2002	5.2	3.1	8.9	33	22
	2003	6.5	4.0	10.5	30	31
	2005	6.2	3.8	10.1	30	29
Ruby-crowned Kinglet	2007	2.4	1.1	5.2	48	7
	2001	3.6	1.9	6.5	38	54
	2002	9.5	6.2	14.5	26	97
	2003	4.6	2.8	7.7	31	76
	2005	22.3	13.1	37.7	33	94
Townsend's Solitaire	2007	9.0	5.7	14.2	28	58
	2001	6.6	5.1	8.4	15	112
	2002	16.9	9.3	30.9	38	115
	2003	9.6	6.5	14.2	24	192
	2005	4.5	3.2	6.3	20	115
Swainson's Thrush	2007	9.0	6.8	11.9	17	84
	2001	2.4	1.4	4.2	34	41
	2002	2.7	1.9	3.8	21	43
	2003	3.2	2.1	4.8	24	58
	2005	1.8	1.2	2.7	24	32
American Robin	2007	2.3	1.5	3.7	27	26
	2001	21.5	17.6	26.3	12	241
	2002	19.7	16.3	23.9	11	229
	2003	20.4	17.0	24.5	11	257
	2005	27.4	22.3	33.8	13	246
Yellow-rumped Warbler	2007	44.3	33.5	58.6	17	185
	2001	40.7	33.7	49.0	11	328
	2002	43.0	35.2	52.6	12	352
	2003	43.2	31.8	58.6	19	336
	2005	44.6	37.2	53.3	11	408
American Redstart	2007	38.5	20.7	71.7	39	243
	2001	9.0	5.0	16.4	37	49
	2002	5.9	2.7	12.7	48	30
	2003	6.3	3.0	13.1	46	36
	2005	8.1	4.6	14.3	34	46
Ovenbird	2007	8.2	3.6	18.6	50	29
	2001	17.7	12.3	25.5	22	286
	2002	18.6	12.8	27.1	23	226
	2003	25.8	16.7	40.1	27	301
	2005	27.2	17.7	41.8	26	289
MacGillivray's Warbler	2007	11.2	6.2	20.5	36	136
	2001	13.5	8.3	22.2	30	40
	2002	9.8	5.3	18.1	38	27
	2003	11.5	6.0	22.4	41	36
	2005	11.7	6.6	20.9	35	35
Western Tanager	2007	8.8	4.0	19.6	49	17
	2001	8.7	5.9	12.7	23	96
	2002	10.2	7.1	14.6	22	95
	2003	12.5	7.2	21.9	35	155

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Chipping Sparrow	2005	15.1	9.5	24.0	28	137
	2007	8.4	5.4	13.1	27	84
	2001	34.8	24.9	48.6	20	142
	2002	23.4	18.2	30.1	15	144
	2003	58.2	44.1	76.8	17	230
	2005	63.4	47.4	84.6	18	250
	2007	50.2	37.8	66.7	17	164
Dark-eyed Junco	2001	27.5	23.1	32.6	10	244
	2002	47.9	33.6	68.4	22	184
	2003	51.2	38.8	67.7	17	302
	2005	28.1	22.6	34.9	13	245
	2007	56.6	45.9	69.8	13	232
Black-headed Grosbeak	2001	3.1	1.6	5.7	39	33
	2002	1.3	0.7	2.4	40	13
	2003	1.2	0.6	2.6	47	14
	2005	1.5	0.8	2.8	38	17
	2007	1.6	0.7	3.6	52	11
Brown-headed Cowbird	2001	23.0	14.0	37.9	31	85
	2002	10.0	6.1	16.4	30	64
	2003	9.4	6.3	14.1	25	94
	2005	8.1	5.1	12.7	28	62
	2007	28.1	19.3	41.0	23	71
Red Crossbill	2001	66.2	41.2	106.5	29	255
	2002	151.0	94.8	240.6	28	293
	2003	11.1	7.3	17.0	26	176
	2005	15.2	9.9	23.1	26	112
	2007	45.5	31.5	65.7	22	84
Pine Siskin	2001	30.3	21.1	43.6	22	119
	2002	24.0	15.8	36.4	25	88
	2003	4.8	2.3	10.1	46	20
	2005	19.4	12.4	30.3	27	63
	2007	23.9	14.4	39.7	31	30
Red Squirrel	2001	17.7	12.4	25.3	21	58
	2002	13.1	8.4	20.4	27	40
	2003	9.8	4.0	24.1	57	34
	2005	4.7	2.9	7.7	29	15
	2007	47.0	31.5	70.2	24	99

¹*D* = estimated density (birds/km²); *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*.

Ponderosa Pine – Southern Hills

Table 9. Estimated densities of breeding birds in Ponderosa Pine – Southern Hills habitat in the Black Hills, 2001-2007¹.

Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Wild Turkey	2001	0.1	0.1	0.2	74	10
	2002	0.1	0.1	0.1	44	8
	2003	0.1	0.1	0.1	47	13
	2005	0.1	0.1	0.1	46	11

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
	2007	0.1	0.1	0.1	76	3
Mourning Dove	2001	1.7	1.0	3.1	36	29
	2002	2.0	1.1	3.6	35	36
	2003	1.4	0.9	2.4	31	28
	2005	3.6	2.2	5.8	30	61
	2007	3.7	2.7	5.2	20	53
Hairy Woodpecker	2001	2.7	1.6	4.3	30	35
	2002	4.1	2.5	6.6	30	27
	2003	3.5	2.4	5.0	22	48
	2005	3.4	2.4	5.0	22	54
	2007	9.5	5.8	15.6	30	41
Northern Flicker	2001	0.9	0.5	1.7	39	29
	2002	0.5	0.3	0.9	36	16
	2003	0.5	0.3	0.8	29	19
	2005	1.1	0.7	1.8	28	42
	2007	0.8	0.5	1.4	32	23
Western Wood-Pewee	2001	0.7	0.3	1.5	52	14
	2002	1.0	0.4	2.7	65	22
	2003	2.8	2.0	4.1	22	69
	2005	2.0	1.1	3.8	39	49
	2007	3.5	2.1	5.8	31	62
Dusky Flycatcher	2001	9.6	6.1	15.0	28	95
	2002	4.7	2.9	7.4	28	49
	2003	11.9	8.3	17.1	22	145
	2005	7.5	5.0	11.5	26	100
	2007	47.9	36.3	63.1	17	176
Cordilleran Flycatcher	2001	0.8	0.4	1.3	32	11
	2002	0.3	0.1	0.9	62	5
	2003	2.1	1.4	3.1	24	35
	2005	0.1	0.0	0.2	100	1
	2007	0.2	0.0	1.2	117	3
Plumbeous Vireo	2001	7.7	5.3	11.2	22	106
	2002	6.4	4.9	8.3	16	92
	2003	7.8	5.7	10.8	19	125
	2005	7.5	5.5	10.3	19	119
	2007	8.2	6.2	10.8	16	97
Warbling Vireo	2001	7.1	4.9	10.3	22	101
	2002	5.0	2.8	8.8	34	74
	2003	7.8	5.1	11.7	25	128
	2005	6.8	4.5	10.3	25	111
	2007	8.5	5.9	12.1	21	104
Gray Jay	2001	5.4	3.2	9.2	33	17
	2002	9.1	5.2	16.0	35	30
	2003	16.2	10.1	25.8	28	59
	2005	8.0	4.7	13.6	33	21
	2007	2.9	1.3	6.6	51	4
American Crow	2001	0.3	0.2	0.6	31	40
	2002	0.4	0.2	0.7	34	31
	2003	0.1	0.1	0.2	29	34

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Violet-green Swallow	2005	0.3	0.1	0.4	33	37
	2007	0.2	0.1	0.4	33	23
	2001	2.8	0.7	11.8	106	3
	2002	10.6	2.8	40.2	95	12
	2003	28.1	8.2	96.7	86	35
	2005	27.5	7.7	97.6	89	26
Black-capped Chickadee	2007	7.5	1.9	29.7	99	3
	2001	14.1	11.3	17.5	13	140
	2002	15.8	12.1	20.7	16	160
	2003	8.3	6.5	10.7	15	143
	2005	15.5	12.2	19.8	15	161
Red-breasted Nuthatch	2007	14.4	10.9	18.9	17	130
	2001	10.1	7.7	13.1	16	146
	2002	15.3	13.0	18.2	10	233
	2003	11.3	9.0	14.3	14	190
	2005	12.1	9.8	14.8	12	200
White-breasted Nuthatch	2007	18.0	14.7	22.0	12	224
	2001	3.9	2.4	6.3	29	31
	2002	5.7	3.9	8.4	23	48
	2003	11.0	8.6	14.2	15	102
	2005	8.0	6.2	10.5	16	73
Brown Creeper	2007	13.6	9.8	18.9	19	94
	2001	3.2	1.8	5.6	35	12
	2002	4.3	2.0	9.3	48	17
	2003	6.1	3.3	11.3	37	27
	2005	2.3	1.2	4.2	37	10
Rock Wren	2007	1.2	0.5	3.1	59	4
	2001	0.2	0.1	0.5	63	7
	2002	0.3	0.2	0.8	52	13
	2003	0.3	0.2	0.6	38	14
	2005	0.8	0.5	1.5	37	34
Ruby-crowned Kinglet	2007	0.5	0.2	0.9	40	14
	2001	0.4	0.1	1.7	99	7
	2002	0.7	0.3	1.8	63	12
	2003	1.3	0.6	2.8	47	25
	2005	0.4	0.2	1.0	55	8
Mountain Bluebird	2007	1.0	0.4	2.4	57	14
	2001	0.9	0.4	1.9	46	8
	2002	1.3	0.6	2.6	42	12
	2003	1.7	0.8	4.0	52	18
	2005	8.4	5.6	12.6	24	76
Townsend's Solitaire	2007	6.0	3.1	11.5	39	43
	2001	6.8	5.0	9.2	18	98
	2002	6.4	4.2	9.8	26	163
	2003	10.4	7.8	13.7	17	188
	2005	5.5	4.2	7.2	17	135
American Robin	2007	7.2	5.4	9.6	17	119
	2001	6.2	4.6	8.3	17	104
	2002	10.5	7.8	14.2	18	185

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
	2003	14.1	11.4	17.5	13	275
	2005	9.4	7.4	11.9	14	182
	2007	11.9	9.7	14.6	12	170
Yellow-rumped Warbler	2001	19.9	16.4	24.3	12	250
	2002	30.8	25.6	37.1	11	379
	2003	43.7	33.5	57.0	16	475
	2005	41.4	33.6	51.0	13	414
	2007	24.1	19.8	29.3	12	277
Ovenbird	2001	11.9	8.4	16.8	21	183
	2002	9.3	6.3	13.6	23	194
	2003	9.1	6.6	12.7	20	178
	2005	4.7	3.3	6.8	21	129
	2007	3.1	2.0	4.7	26	81
Western Tanager	2001	10.1	7.3	13.9	19	135
	2002	8.7	6.0	12.7	23	122
	2003	15.1	10.9	21.0	20	234
	2005	8.3	6.0	11.6	20	128
	2007	14.5	10.4	20.2	20	164
Spotted Towhee	2001	0.6	0.3	1.4	54	9
	2002	1.1	0.6	2.3	42	18
	2003	1.7	0.8	3.8	49	30
	2005	1.0	0.5	2.2	48	18
	2007	2.6	1.5	4.7	35	34
Chipping Sparrow	2001	57.5	41.5	79.9	20	130
	2002	47.0	33.0	66.9	22	194
	2003	66.9	51.9	86.3	16	225
	2005	108.8	82.0	144.5	17	324
	2007	46.9	35.3	62.2	17	236
Vesper Sparrow	2001	0.7	0.4	1.2	37	16
	2002	0.7	0.4	1.5	43	18
	2003	1.0	0.5	1.9	41	26
	2005	1.0	0.5	2.1	46	26
	2007	2.0	1.2	3.4	32	40
Lark Sparrow	2001	3.5	1.1	11.1	77	10
	2002	4.4	1.5	12.9	72	13
	2003	4.6	1.6	13.2	70	15
	2005	6.5	2.5	16.8	62	18
	2007	4.5	1.3	15.2	83	11
Dark-eyed Junco	2001	32.6	24.8	42.9	17	181
	2002	29.2	22.8	37.5	15	170
	2003	32.8	25.8	41.7	15	211
	2005	31.3	24.8	39.5	14	196
	2007	64.7	50.3	83.1	15	301
Western Meadowlark	2001	0.1	0.1	0.1	59	4
	2002	0.1	0.1	0.3	50	11
	2003	0.1	0.1	0.3	58	11
	2005	0.4	0.2	1.0	53	41
	2007	0.1	0.1	0.3	56	9
Brown-headed Cowbird	2001	24.6	17.9	33.9	19	118

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
	2002	13.6	9.2	20.1	23	126
	2003	8.9	6.3	12.4	21	105
	2005	18.6	13.9	25.1	18	170
	2007	19.8	14.4	27.1	19	144
Red Crossbill	2001	13.9	8.6	22.5	29	140
	2002	104.5	67.4	162.1	26	101
	2003	11.1	6.4	19.0	33	129
	2005	21.4	16.3	28.3	17	138
	2007	32.0	23.9	43.0	18	160
Pine Siskin	2001	12.4	6.4	24.2	41	58
	2002	6.9	4.4	11.0	28	34
	2003	2.6	1.5	4.6	35	14
	2005	8.2	4.9	13.8	32	38
	2007	4.0	2.1	7.6	39	13
American Goldfinch	2001	1.6	0.7	3.6	52	10
	2002	0.9	0.4	2.1	55	6
	2003	1.1	0.5	2.2	43	8
	2005	6.8	4.0	11.6	33	39
	2007	4.2	2.5	7.1	33	17
Red Squirrel	2001	4.4	2.0	9.3	47	20
	2002	6.9	4.5	10.6	26	33
	2003	4.5	2.6	7.9	34	24
	2005	4.9	2.9	8.3	32	24
	2007	21.8	15.9	29.9	19	87

¹*D* = estimated density (birds/km²); *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*.

Pine-Juniper Shrubland

Table 10. Estimated densities of breeding birds in Pine-Juniper Shrubland habitat in the Black Hills, 2001-2007¹.

Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Mourning Dove	2001	6.5	4.0	10.7	29	42
	2002	8.3	6.2	11.2	18	98
	2004	7.3	5.0	10.7	22	89
	2007	7.1	5.7	8.8	13	77
White-throated Swift	2001	2.8	1.2	6.8	54	9
	2002	21.7	9.5	49.7	51	126
	2004	15.8	8.5	29.2	38	29
	2007	10.2	6.0	17.3	33	24
Dusky Flycatcher	2001	88.1	60.0	129.2	22	156
	2002	105.0	83.0	132.7	14	339
	2004	77.8	63.8	94.8	12	299
	2007	134.1	114.2	157.6	10	389
Plumbeous Vireo	2001	11.2	7.2	17.4	26	35
	2002	14.4	10.2	20.3	20	82
	2004	12.3	9.5	16.0	16	84
	2007	14.8	11.5	19.1	15	78
Warbling Vireo	2001	6.7	1.9	23.3	82	19

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
American Crow	2002	5.0	2.8	9.0	35	26
	2004	7.8	4.5	13.3	32	48
	2007	13.5	7.3	24.9	36	65
American Crow	2001	0.6	0.4	0.9	26	20
	2002	0.2	0.1	0.5	44	14
	2004	0.1	0.1	0.3	50	11
	2007	0.3	0.2	0.4	28	15
Violet-green Swallow	2001	21.4	11.1	41.3	40	22
	2002	70.3	50.3	98.3	20	132
	2004	58.0	35.2	95.6	31	49
	2007	32.2	18.6	55.5	33	34
Black-capped Chickadee	2001	11.4	8.0	16.1	20	34
	2002	15.4	11.8	20.2	16	84
	2004	11.1	8.1	15.2	19	68
	2007	24.4	19.8	30.0	12	111
Red-breasted Nuthatch	2001	2.4	1.0	5.5	51	12
	2002	9.8	7.3	13.1	17	89
	2004	2.9	1.5	5.4	39	30
	2007	13.1	9.8	17.5	17	106
White-breasted Nuthatch	2001	2.8	1.6	4.8	33	14
	2002	5.1	3.4	7.5	24	47
	2004	2.8	1.8	4.4	27	31
	2007	5.8	4.0	8.4	22	50
Rock Wren	2001	0.3	0.1	1.1	72	3
	2002	1.9	1.0	3.6	39	30
	2004	1.3	0.8	2.3	33	25
	2007	1.4	0.7	2.8	45	20
Mountain Bluebird	2001	6.3	3.2	12.2	40	11
	2002	4.1	2.1	8.1	41	13
	2004	16.3	9.8	27.0	30	53
	2007	14.5	7.4	28.1	40	42
Townsend's Solitaire	2001	2.6	1.1	6.0	52	11
	2002	3.2	1.8	5.8	35	25
	2004	6.2	4.0	9.6	26	51
	2007	5.5	3.4	8.9	28	40
American Robin	2001	5.1	2.7	9.9	40	30
	2002	5.1	3.1	8.2	29	38
	2004	6.6	4.4	10.0	25	47
	2007	15.5	9.7	24.8	29	107
Virginia's Warbler	2001	21.9	12.0	40.0	36	32
	2002	27.8	16.6	46.5	31	74
	2004	36.8	25.2	53.6	23	116
	2007	29.8	19.6	45.2	25	74
Yellow-rumped Warbler	2001	20.6	14.9	28.6	19	66
	2002	28.1	21.5	36.6	15	164
	2004	20.2	14.5	28.1	19	136
	2007	30.3	24.2	38.0	13	164
Ovenbird	2001	7.9	4.8	12.8	29	64
	2002	11.1	8.2	15.1	18	165

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Western Tanager	2004	9.6	7.3	12.6	16	170
	2007	9.2	6.6	12.8	19	127
	2001	15.5	10.3	23.1	23	64
	2002	17.0	13.7	21.1	13	128
	2004	10.2	7.9	13.2	15	90
Spotted Towhee	2007	14.1	10.3	19.2	18	96
	2001	80.8	56.5	115.6	21	172
	2002	64.7	48.7	86.0	17	345
	2004	137.4	105.8	178.5	16	335
	2007	72.2	57.6	90.6	13	337
Chipping Sparrow	2001	189.2	156.7	228.5	11	114
	2002	201.2	166.6	243.0	11	221
	2004	218.1	172.5	275.7	14	237
	2007	263.6	208.4	333.5	14	251
	Vesper Sparrow	2001	4.4	2.8	6.9	27
2002		2.7	1.6	4.6	32	29
2004		1.9	0.9	3.8	43	24
2007		3.1	1.3	7.2	52	31
Dark-eyed Junco		2001	4.9	2.4	9.9	44
	2002	15.1	7.9	28.9	40	43
	2004	37.6	21.1	67.0	35	30
	2007	42.6	32.1	56.5	17	150
	Western Meadowlark	2001	1.4	0.7	2.9	43
2002		2.0	1.1	3.7	36	34
2004		1.4	0.7	2.7	41	28
2007		0.4	0.2	1.1	58	7
Brown-headed Cowbird		2001	51.7	36.4	73.4	21
	2002	38.9	24.9	60.6	27	74
	2004	35.2	27.0	45.9	16	75
	2007	58.0	44.2	76.1	16	100
	Red Crossbill	2001	14.8	7.4	29.8	43
2002		37.2	20.5	67.5	35	379
2004		17.3	9.5	31.6	38	46
2007		29.6	20.1	43.4	23	66
American Goldfinch		2001	4.3	2.7	7.0	29
	2002	8.3	4.1	16.7	43	35
	2004	4.6	2.2	9.2	44	19
	2007	8.1	5.1	12.9	28	21

¹*D* = estimated density (birds/km²); *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*.

White Spruce

Table 11. Estimated densities of breeding birds in White Spruce habitat in the Black Hills, 2001-2007¹.

Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
Red-naped Sapsucker	2001	7.3	4.1	13.0	35	22
	2002	4.4	2.6	7.5	32	15
	2003	7.6	4.4	13.2	33	30

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Hairy Woodpecker	2005	3.6	1.7	7.7	47	13
	2007	4.5	2.6	7.9	34	15
	2001	5.1	2.4	10.5	46	34
	2002	5.2	2.9	9.6	37	31
	2003	1.8	1.4	2.3	16	38
	2005	2.5	1.7	3.6	23	42
American Three-toed Woodpecker	2007	11.2	7.0	18.1	29	56
	2001	0.9	0.4	2.0	50	5
	2002	3.3	1.9	5.9	35	21
	2003	4.6	3.1	6.8	24	34
	2005	5.5	3.7	8.3	25	39
Northern Flicker	2007	1.6	0.8	3.2	41	10
	2001	6.1	3.8	9.9	29	46
	2002	1.7	1.0	2.8	31	19
	2003	1.0	0.6	1.6	31	33
	2005	1.7	0.9	3.4	43	36
Dusky Flycatcher	2007	1.5	0.8	2.7	39	23
	2001	1.8	0.8	3.9	49	8
	2002	4.8	2.6	8.7	37	24
	2003	2.0	0.9	4.5	49	12
	2005	4.0	2.2	7.1	35	23
Cordilleran Flycatcher	2007	8.9	5.9	13.2	24	44
	2001	8.5	4.5	15.9	39	43
	2002	6.9	4.2	11.3	30	76
	2003	15.9	9.1	27.6	34	98
	2005	9.0	4.5	18.0	43	65
Warbling Vireo	2007	20.0	12.8	31.1	27	97
	2001	8.3	5.2	13.2	28	55
	2002	9.3	6.6	13.2	21	69
	2003	10.3	7.5	14.3	19	89
	2005	7.2	4.8	10.8	24	61
Gray Jay	2007	11.7	8.0	17.0	23	85
	2001	46.9	29.7	74.0	28	74
	2002	9.0	5.8	14.0	27	50
	2003	12.5	7.3	21.1	33	57
	2005	4.1	2.0	8.3	44	23
American Crow	2007	9.9	5.9	16.7	32	29
	2001	0.3	0.2	0.5	33	19
	2002	0.3	0.1	0.5	36	18
	2003	0.3	0.2	0.5	32	22
	2005	0.4	0.2	0.8	37	29
Black-capped Chickadee	2007	0.4	0.2	0.7	33	21
	2001	15.9	11.5	22.0	20	124
	2002	8.1	6.1	10.7	17	86
	2003	13.3	9.5	18.6	21	155
	2005	13.3	9.3	18.9	22	113
Red-breasted Nuthatch	2007	21.5	14.2	32.4	25	104
	2001	18.9	15.1	23.5	13	242
	2002	15.4	12.2	19.5	14	176

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
	2003	15.2	12.7	18.2	11	251
	2005	6.9	5.4	8.6	14	135
	2007	35.8	29.3	43.9	12	268
White-breasted Nuthatch	2001	0.2	0.1	0.7	69	2
	2002	0.8	0.4	1.8	49	8
	2003	1.4	0.6	3.0	48	15
	2005	0.6	0.2	1.3	55	6
	2007	3.1	1.6	6.0	40	28
Brown Creeper	2001	6.3	3.9	10.2	29	26
	2002	9.3	6.2	13.9	25	43
	2003	10.6	7.2	15.6	24	57
	2005	8.1	5.3	12.6	27	42
	2007	2.2	1.1	4.4	42	10
Golden-crowned Kinglet	2001	24.1	16.6	34.8	22	65
	2002	23.2	16.3	33.0	21	70
	2003	55.9	43.9	71.2	15	196
	2005	66.7	55.6	80.0	11	222
	2007	5.4	2.2	13.2	56	16
Ruby-crowned Kinglet	2001	49.9	30.2	82.3	31	274
	2002	42.3	34.6	51.8	12	408
	2003	39.1	27.0	56.7	23	367
	2005	59.8	42.4	84.4	21	470
	2007	34.4	28.1	42.1	12	281
Townsend's Solitaire	2001	3.0	1.8	5.0	31	55
	2002	3.1	2.3	4.2	18	65
	2003	3.5	2.8	4.4	14	84
	2005	2.5	1.8	3.3	17	58
	2007	2.1	1.5	2.9	21	42
Swainson's Thrush	2001	13.4	10.2	17.6	16	149
	2002	14.6	12.3	17.4	10	182
	2003	18.5	15.8	21.6	9	267
	2005	12.4	10.3	15.0	11	177
	2007	15.5	12.8	18.9	11	189
American Robin	2001	50.0	41.2	60.7	12	257
	2002	47.6	39.3	57.6	11	273
	2003	37.2	30.8	44.8	11	248
	2005	44.7	36.1	55.2	13	281
	2007	54.7	44.2	67.9	13	301
Yellow-rumped Warbler	2001	26.1	19.1	35.7	19	207
	2002	37.6	30.7	46.1	12	246
	2003	47.1	38.6	57.6	12	366
	2005	25.8	20.8	31.9	13	270
	2007	41.3	34.0	50.3	12	255
Ovenbird	2001	0.3	0.1	0.7	58	4
	2002	0.2	0.1	0.6	58	4
	2003	1.1	0.5	2.4	47	22
	2005	0.8	0.4	1.5	42	15
	2007	1.2	0.6	2.4	43	20
Common Yellowthroat	2001	2.4	0.8	6.8	68	6

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Species	Year	<i>D</i>	<i>LCL</i>	<i>UCL</i>	% <i>CV</i>	<i>n</i>
	2002	1.4	0.4	4.7	81	4
	2003	5.2	2.2	12.4	56	17
	2005	10.6	4.0	28.1	63	34
	2007	12.0	5.2	27.5	53	33
Western Tanager	2001	0.2	0.1	0.5	59	3
	2002	0.1	0.0	0.4	68	2
	2003	0.9	0.4	2.0	49	17
	2005	1.2	0.5	2.7	52	21
	2007	2.3	1.2	4.3	39	35
Chipping Sparrow	2001	69.9	49.8	98.3	20	136
	2002	57.1	44.8	72.8	14	124
	2003	87.9	68.9	112.2	15	222
	2005	95.8	75.4	121.8	14	229
	2007	162.0	126.9	206.7	15	330
Song Sparrow	2001	5.4	2.7	10.9	43	22
	2002	4.4	2.1	9.1	45	20
	2003	8.5	4.2	17.3	44	45
	2005	14.8	8.2	26.5	36	77
	2007	10.7	5.8	19.8	37	48
Dark-eyed Junco	2001	27.0	20.8	35.0	16	151
	2002	24.9	19.0	32.6	16	156
	2003	46.3	33.0	65.0	21	226
	2005	42.4	29.2	61.6	23	175
	2007	88.1	70.4	110.3	13	314
Brown-headed Cowbird	2001	1.7	0.9	3.0	35	9
	2002	3.0	1.8	5.2	33	18
	2003	2.6	1.7	4.1	28	18
	2005	3.1	1.7	5.5	36	17
	2007	6.0	4.0	8.9	24	34
Red Crossbill	2001	64.1	48.1	85.4	17	424
	2002	47.5	33.8	66.8	20	351
	2003	51.1	42.0	62.2	12	439
	2005	12.2	8.8	16.9	20	69
	2007	65.0	48.6	86.8	18	133
Pine Siskin	2001	43.4	27.0	69.8	29	176
	2002	30.3	21.8	42.2	20	142
	2003	5.7	2.9	11.2	42	36
	2005	12.9	8.1	20.3	28	77
	2007	15.1	8.8	25.9	34	50
Red Squirrel	2001	37.9	26.9	53.4	20	90
	2002	33.2	23.8	46.3	20	88
	2003	62.3	47.4	81.8	16	192
	2005	5.6	2.9	10.7	40	17
	2007	107.0	84.2	136.0	14	277

¹ *D* = estimated density (birds/km²); *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*.

Management Indicator Species and Sensitive Species

We were able to estimate densities of five Black Hills National Forest Management Indicator Species – Black-backed Woodpecker, Brown Creeper, Golden-crowned Kinglet, Grasshopper Sparrow, and Song Sparrow. In addition, we were able to estimate densities of one Forest Service Region 2 Sensitive Species – American Three-toed Woodpecker (Figures 1-6). We estimated density of Brown Creepers in four coniferous habitat types. We estimated density of Song Sparrows in two riparian habitat types and in White Spruce habitat.

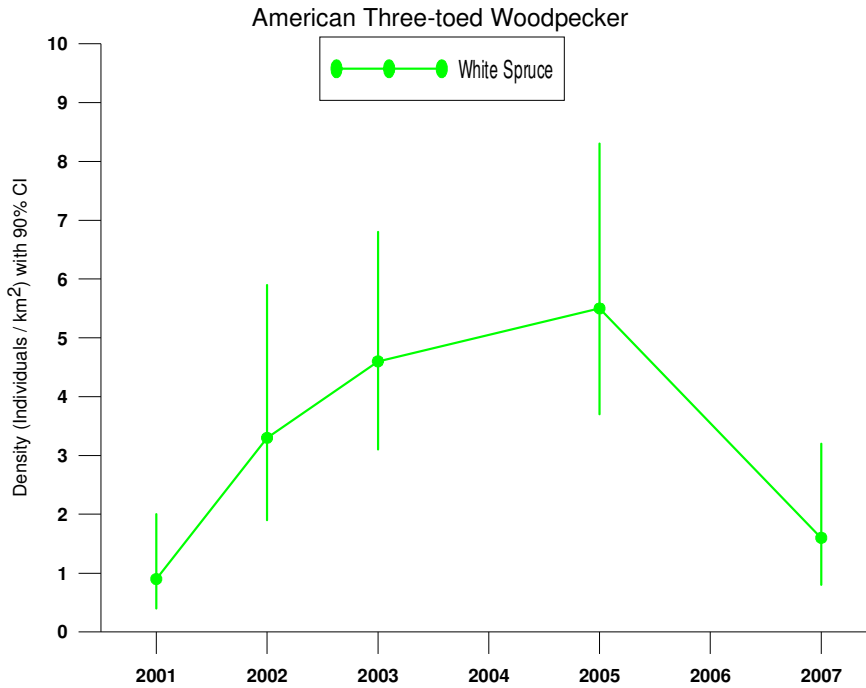


Figure 1. Density of American Three-toed Woodpeckers in White Spruce habitat on the Black Hills National Forest, 2001-2007.

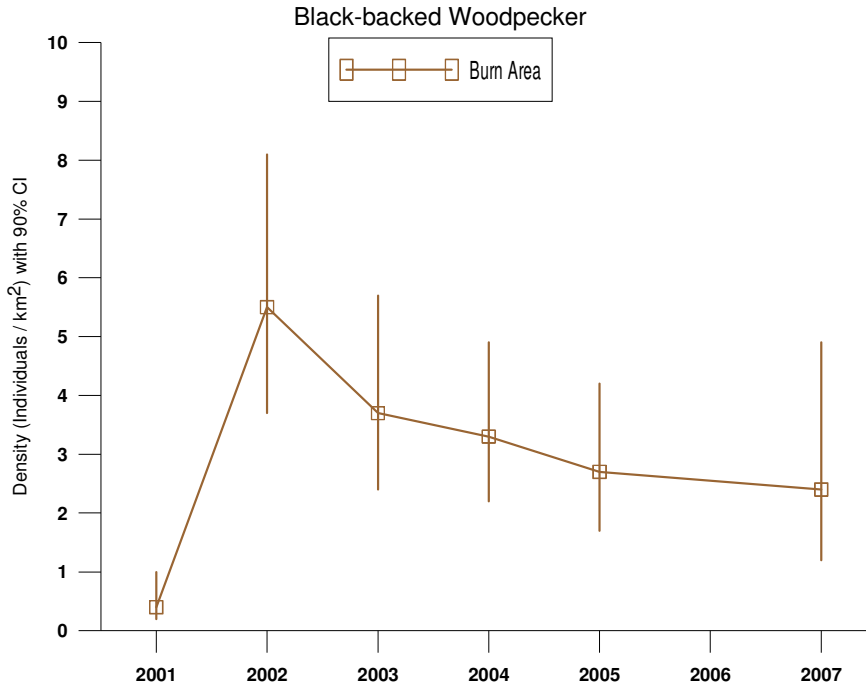


Figure 2. Density of Black-backed Woodpeckers in Burn Areas on the Black Hills National Forest, 2001-2007.

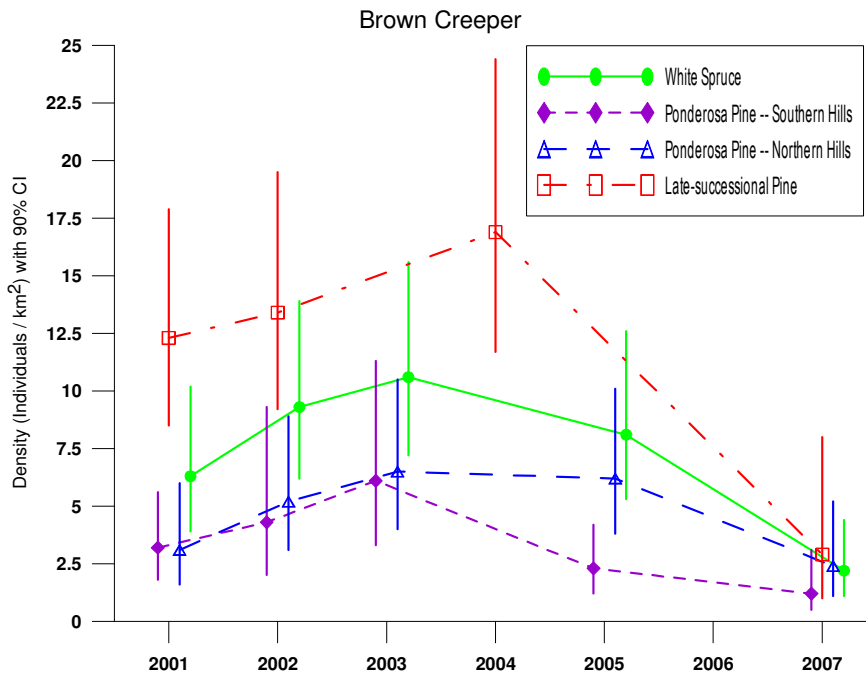


Figure 3. Density of Brown Creepers in four habitat types on the Black Hills National Forest, 2001-2007.

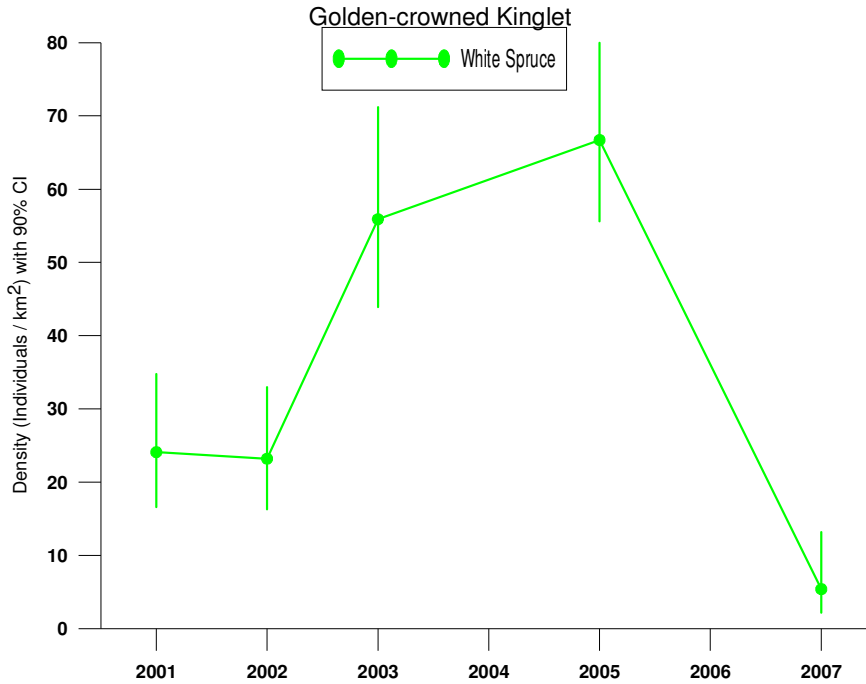


Figure 4. Density of Golden-crowned Kinglets in White Spruce habitat on the Black Hills National Forest, 2001-2007.

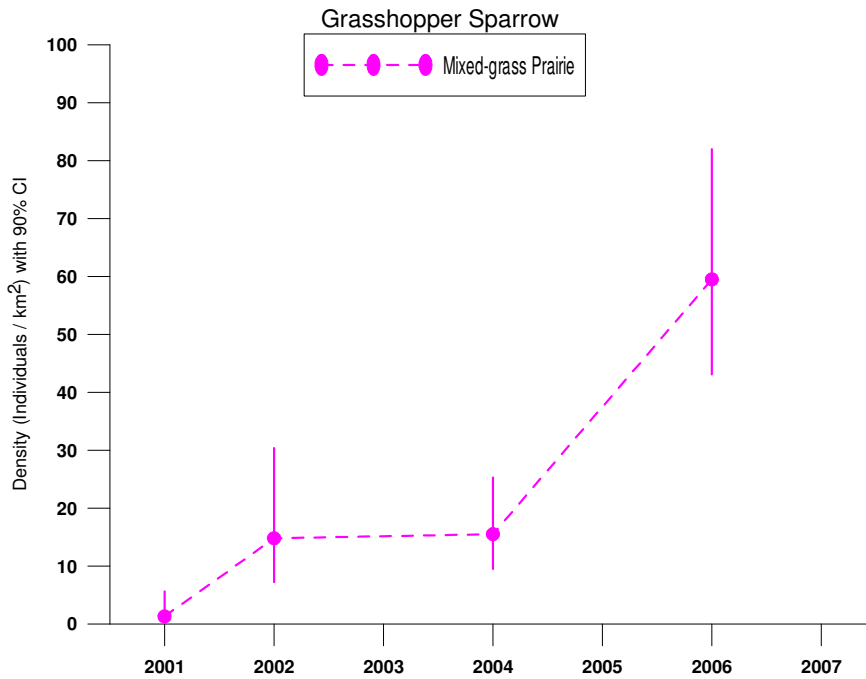


Figure 5. Density of Grasshopper Sparrows in Mixed-grass Prairie habitat on the Black Hills National Forest, 2001-2007.

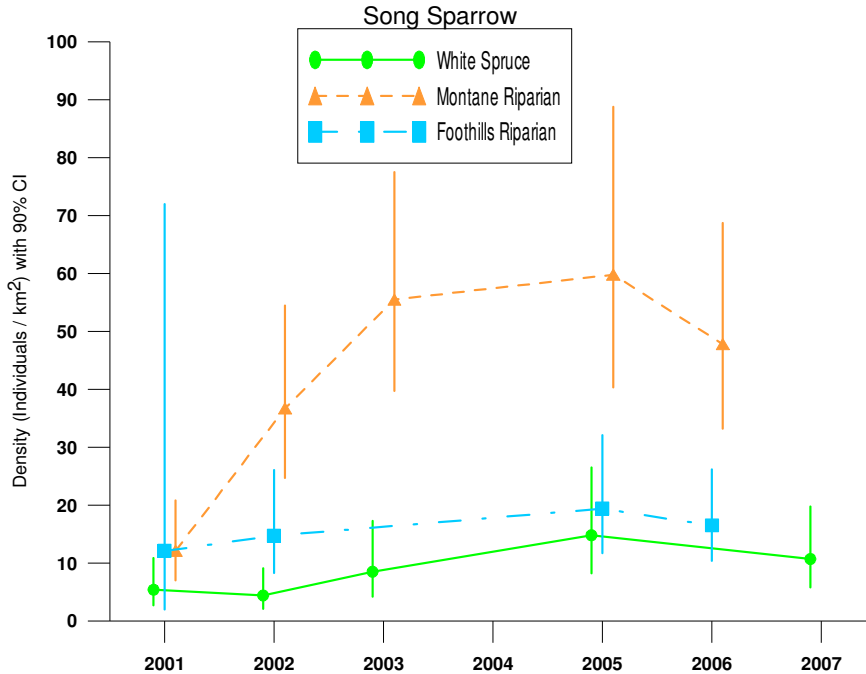


Figure 6. Density of Song Sparrows in three habitat types on the Black Hills National Forest, 2001-2007.

Power to Detect Trends

Power simulation results indicate that we would be able to detect a 3% average annual population decline within 30 years for 52 bird species and the Red Squirrel (Table 12). Eighteen of the bird species for which we would detect a 3% average annual decline are species with special management designations (see Giroir et al. 2007, Appendix A). These include four Management Indicator Species for the Black Hills National Forest, and an additional USFS Region 2 Sensitive Species. Because most species were sufficiently abundant in multiple habitat types we would be able to detect a 3% average annual population decline within 30 years for 330 species × habitat combinations. We would be able to detect this rate of decline for 14 to 32 species in each of the 10 habitat types sampled. Further more, sampling at the levels used in 2001-2007 would allow detection of a 3% average annual decline within 15 years for 16 species, within 20 years for 16 additional species, and within 25 years for 13 species. Note that a steeper population decline would be detected over a shorter timeframe.

Table 12. Number of years required to detect a 3% annual trend with 80% power by species and habitat type, based on power simulation. See text for details.

Species	Habitat Type ¹									
	AS	BU	FR	LS	MG	MR	PN	PS	SH	WS
Wild Turkey								30		
Turkey Vulture			30							
Mourning Dove		25	>40		>40	35		25	20	
White-throated Swift ^{e,f}			40			>40				30
Red-headed Woodpecker ^e		25								

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Species	Habitat Type ¹									
	AS	BU	FR	LS	MG	MR	PN	PS	SH	WS
Red-naped Sapsucker ^b	>40			>40		20	30			25
Hairy Woodpecker	25	20	30	20		25	25	20		25
American Three-toed Woodpecker ^{a,c,f}										25
Black-backed Woodpecker ^{a,c,d,e,f}		25								
Northern Flicker	25	15	30		30	25	25	25		30
Western Wood-Pewee	35	20	30	35	>40	30	30	30		
Dusky Flycatcher ^f	20	20	30	20	35	20	20	25	15	30
Cordilleran Flycatcher ^f	30		20	25		25	25	>40		25
Eastern Kingbird			>40							
Plumbeous Vireo ^f		20	25		40	35	30	20	20	
Warbling Vireo	15	25	25	20		15	15	20	35	20
Red-eyed Vireo			25	35		30	35			
Gray Jay	25	35		30			>40	25		35
Blue Jay			35			30				
Pinyon Jay ^e					35					
American Crow	20	20			20	30	25	25	25	25
Violet-green Swallow		>40	25			30		>40	25	
Black-capped Chickadee	15	20	>40	15	25	20	15	15	15	20
Red-breasted Nuthatch	20	20	25	15	25	15	15	15	25	15
White-breasted Nuthatch	30	>40	35	40	>40	25	20	20	20	40
Brown Creeper ^{d,f}				25			25	30		25
Rock Wren		35	35		30			30	30	
Canyon Wren			30							
House Wren		35	40			35				
Golden-crowned Kinglet ^{d,f}										20
Ruby-crowned Kinglet	25		35	25		25	25	35		20
Eastern Bluebird		25								
Mountain Bluebird ^e		20			25	40		35	30	
Townsend's Solitaire ^f	15	15	35	20	30	20	20	15	25	20
Veery						30				
Swainson's Thrush	25		40	25		25	20			15
American Robin	20	15	25	20	20	25	15	15	25	15
Gray Catbird						35				
Cedar Waxwing			>40			35				
Virginia's Warbler ^e									25	
Yellow Warbler			40			35				
Yellow-rumped Warbler	20	20	35	15	20	20	15	15	15	15
American Redstart	30		40	35		25	30			
Ovenbird	15		25	20	30	20	20	20	20	30
MacGillivray's Warbler ^f	35		40	35		25	30			
Common Yellowthroat	30		35			20				40
Yellow-breasted Chat			>40							
Western Tanager	20	20	20	20	25	25	20	20	15	35
Spotted Towhee	35		25		35	30		30	15	
Chipping Sparrow	35	15	25	40	35	40	15	15	15	15
Vesper Sparrow ^{e,f}		20			>40			30	30	
Lark Sparrow ^f			>40		>40			>40		
Grasshopper Sparrow ^{a,b,d,e,f}					>40					

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Species	Habitat Type ¹									
	AS	BU	FR	LS	MG	MR	PN	PS	SH	WS
Song Sparrow ^d			35			20				30
Dark-eyed Junco ^c	15	15	>40	25	25	20	15	15	30	20
Black-headed Grosbeak	25		25			25	30			
Lazuli Bunting			40							
Bobolink ^f						>40				
Red-winged Blackbird			>40			35				
Western Meadowlark ^e		30	40		>40			35	30	
Common Grackle			>40							
Brown-headed Cowbird	30	15	20	25	25	25	25	20	20	25
Red Crossbill	25	25	>40	20	>40	25	25	25	25	15
Pine Siskin	30	30	30	30		25	20	25		25
American Goldfinch		25	40		30	40		35	25	
Red Squirrel	30	>40	40	25		40	30	30		20
Number of bird species for which 3% trend detected within 30 years	24	26	20	19	14	32	28	27	25	24

¹Habitat Types: AS = Aspen; BU = Burn area; FR = Foothills Riparian; LS = Late-successional Pine; MG = Mixed-grass prairie; MR = Montane Riparian; PN = Ponderosa Pine – Northern Hills; PS = Ponderosa Pine – Southern Hills; SH = Pine-Juniper Shrubland; WS = White Spruce.

Special management designations: ^aU.S. Forest Service Region 2, Sensitive Species; ^bU.S. Fish and Wildlife Service, Bird of Conservation Concern; ^cSouth Dakota Department of Game, Fish, and Parks, Species of Greatest Conservation Need; ^dBlack Hills National Forest, Management Indicator Species; ^ePIF=Partners In Flight, various designations; ^fWyoming Partners in Flight, Level II Priority (Monitoring).

DISCUSSION AND RECOMMENDATIONS

The sampling design used in 2001 – 2007 to monitor breeding landbirds on the Black Hills National Forest yielded density estimates for the majority of regularly occurring species (n = 65), including five Management Indicator Species and one additional Special Species. For the first time, we analyzed data across years for each species/habitat combination. This allowed us to estimate densities of species with fewer than 60 detections per year in a given habitat.

Based on empirical estimates of density, encounter rate, and detection probability, we would be able to detect a 3% average annual decline within the targeted 30 years for 52 bird species, including four Management Indicator Species and one additional Region 2 Sensitive Species. In MBBH annual reports (e.g., Giroir et al. 2007), we have stated that we would be able to effectively monitor species with robust density estimates (CV < 50%). This rule-of-thumb proved to be generally reliable with respect to our ability to detect a 3% average annual decline within 30 years.

The Grasshopper Sparrow was the only MIS for which we could obtain density estimates but not detect trend within 30 years. Grasshopper Sparrows, as well as other grassland-dependent species, exhibit high annual variation in population size at the local scale. High annual variation in population size results in a weaker ability to detect population trends across years. It may be necessary to add additional transects in Mixed-grass Prairie (MG) habitat in order to effectively monitor the Grasshopper Sparrow population. An increase in MG transects could be offset by decreasing the number of transects in Ponderosa Pine – Northern Hills (PN) and Ponderosa

Pine – Southern Hills (PS). For example, 20 MG transects could be added and 10 transects each in PN and PS could be eliminated. Of the 34 species for which we could detect 3% average annual population declines in either PN or PS, 21 species are common to both habitats. Twelve of the 13 remaining species are sufficiently monitored in other habitat types. The Wild Turkey is the only species that occurs in sufficient numbers solely in PS habitat. Future data analyses could employ a common detection function for PN and PS, further mitigating the effects of decreased sampling effort in each habitat type.

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