Monitoring the Birds of the Black Hills: Year 3

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Annual Report
February 2004

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Submitted to:

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Recommended citation:

Panjabi, A. 2004. Monitoring the birds of the Black Hills: Year 3. Annual Report submitted to Black Hills National Forest. Rocky Mountain Bird Observatory, Brighton, Colorado. 58 pp.

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Executive Summary

Birds are excellent indicators of biological integrity and environmental change. Thus, monitoring bird populations not only provides data needed to effectively manage birds but also provides a means to monitor the effects of human activities on the ecosystem and to gauge the sustainability of those activities. Because bird communities in a given landscape reflect an integration of a broad array of ecosystem conditions, monitoring entire bird communities at the habitat level offers a cost-effective means for monitoring overall biological integrity at a variety of scales.

In 2003, Rocky Mountain Bird Observatory (RMBO), in conjunction with its funding partner, the Black Hills National Forest (BHNF), implemented Year 3 of *Monitoring the Birds of the Black Hills* (MBBH), as delineated by Panjabi et al. (2001). RMBO has designed this program to provide statistically rigorous long-term trend data for populations of most diurnal, regularly breeding bird species in the Black Hills, including some U.S. Forest Service Region 2 Sensitive Species and BHNF Management Indicator Species (MIS). In the short term, this program provides information needed to effectively manage and conserve bird populations in the Black Hills, including the spatial distribution, abundance, and habitat relations of each species. This cooperative project supports the BHNF's efforts to comply with requirements set forth in the National Forest Management Act and other statutes and regulations.

RMBO reduced the extent of survey effort in 2003 to match funding levels. RMBO staff conducted 152 point transect surveys (2,158 point counts) in five habitats (≥ 30 transects/habitat) within the Black Hills (burn area, montane riparian, ponderosa pine-northern hills, ponderosa pine-southern hills, and white spruce). RMBO did not survey five habitats covered in 2002 (aspen, foothill riparian, late-successional ponderosa pine, mixed-grass prairie and pine-juniper woodland). Other changes to the sampling scheme in 2003 included three new sites added in white spruce and two sites dropped from the montane riparian category.

RMBO staff recorded a total of 105 breeding bird species on point transects in the five habitats, many of which were observed on only a few occasions. The habitat-stratified point transects provided excellent results (CV of ≤ 50% in at least one habitat) on 52 bird species, including three BHNF MIS and three Region 2 Sensitive Species, and fair results (CV of 51-100% in at least one habitat) on two additional species. These 54 species should be effectively monitored under the current program in at least one of the five habitats surveyed, although in some cases significant portions of their population may occur in other habitats. Four more species, including one additional BHNF MIS, should be adequately monitored across two or more habitat types. The total number of species monitored by MBBH under the current level of implementation represents approximately 44% of the total number of breeding species in the Black Hills (Panjabi 2003a), a 15% decrease in coverage since last year.

The ongoing surveys in the Jasper burn area continue to reveal interesting patterns of population response by a wide range of bird species to this dramatic change in habitat. While populations of most woodpecker species appear to have stabilized, they still remain higher in the burn areas than in other habitats. And although populations of some forest birds have declined in the burns, others are maintaining populations, and some have even increased.

Introduction

Much like the canary in the coalmine, birds are being used as indicators of biological integrity and ecosystem health the world over (Morrison 1986, Croonquist and Brooks 1991, Bureau of Land Management 1998, Hutto 1998, O'Connell et al. 2000, Rich 2002, U.S. EPA 2002, Birdlife International 2003). Because birds comprise a diverse group of niche specialists, occupy a broad range of habitats, are sensitive to both physical and chemical impacts on the environment, and often reflect the abundance and diversity of other organisms with which they coexist, they can be useful barometers of environmental change and for measuring the sustainability of human activities on ecosystems.

Bird communities reflect an integration of a broad array of ecosystem conditions, including productivity, vegetation structure and composition, water quality, and landscape integrity (Adamus et al. 2001). The response by bird communities to changes in the environment can be examined at a variety of spatial scales, making them a powerful and practical tool for evaluating the broader effects of resource management, conservation and restoration activities, or other environmental changes. And because birds are generally abundant, conspicuous, and relatively easy to identify, they offer tremendous logistical and economic advantages over other taxonomic groups in aiding our ability to monitor their populations. Also, birds are popular with the public, and there is a strong and growing interest, both nationally and internationally, to manage and conserve bird populations, many of which are exhibiting long-term population declines (Sauer et al. 2003).

Aside from serving as indicators, birds are a tremendous economic resource in and of themselves. A recent federal economic report found that 46 million birdwatchers across America spent $32 billion in 2001 on bird watching and related activities (USFWS 2003). This spending generated $85 billion in overall economic output and $13 billion in federal and state income taxes, and supported more than 863,000 jobs. Birds also pollinate, disperse seeds, and consume pests of ecologically and economically important plants, thereby providing ecosystem services worth many billions of dollars. Declines in bird populations therefore could have profound negative implications for regional and local economies, both directly and indirectly.

In order for birds to be conserved on an international scale, all regions must assume responsibility to conserve the species and habitats for which they are stewards. The Black Hills host a unique avifauna and plays a critical role in conserving populations of many bird species. Well-designed count-based monitoring studies provide a scientific foundation for informed decision-making by providing the information needed to effectively manage and conserve birds.

In 2003, Rocky Mountain Bird Observatory (RMBO), in cooperation with its partner, the Black Hills National Forest (BHNF), implemented Year 3 of a habitat-

based bird monitoring program designed to provide rigorous population trend data on most diurnal, regularly occurring breeding bird species in the Black Hills (Panjabi et al. 2001). Modeled after *Monitoring Colorado's Birds* (Leukering et al. 2000), this program is entitled *Monitoring the Birds of the Black Hills (MBBH).* MBBH is consistent with goals emphasized in the Partners In Flight National Landbird Monitoring Strategy (Bart et al. 2001) and, in addition to monitoring bird populations, generates a wealth of information useful in managing birds (e.g., habitat associations, spatial distribution). This report details the findings from the third year of what is designed to be a long-term, cooperative effort to monitor bird populations in the Black Hills.

The Habitats

In January 2001, RMBO, in coordination with biologists from the U.S. Forest Service and other agencies, selected 10 habitats (aspen, burn areas, mixed-grass prairie, southern ponderosa pine, northern ponderosa pine, late-successional ponderosa pine, pine-juniper shrublands, riparian, wet meadows, and white spruce) in which to implement this bird monitoring effort (Panjabi et al. 2001). In 2002, wet meadows were dropped from the sampling scheme due to poor on-the-ground representation of this habitat, and riparian was split into two discrete habitats, montane riparian and foothill riparian, due to differences in the bird communities across this elevational gradient (Panjabi 2003a). In 2003, due to budgetary shortfalls, only 5 of the 10 habitats originally targeted for monitoring were sampled: burn areas (BU), montane riparian (MR), ponderosa pine, northern hills (PN), ponderosa pine, southern hills (PS), and white spruce (WS) (Figure 1).

Burn areas

Burn areas (BU) consist of previously forested landscapes that have been affected by wildfire. Currently, all BU sites but one are located in the Jasper burn area, which covers approximately 83,000 acres that burned in 2000. The other site is located in the nearby Elk Mountain burn area. The Jasper burn area is a mosaic of patches of charred, heat-killed, and live trees (mostly ponderosa pine, *Pinus ponderosa*) that ranged in seral stage from 'shrub-seedling' (2) to 'mature' (4; USDA Forest Service 1998) prior to being burned. In 2003, herbaceous and woody ground cover had resprouted throughout much of the Jasper burn area.

Ponderosa pine, northern hills

Ponderosa pine, northern hills (PN), or "pine-north," refers to the mesic forests dominated by ponderosa pine occurring north of the Mystic Ranger District. Although predominantly pine forest, this habitat designation incorporates the natural ecotonal variation in the landscape, such as small groves of aspen (*Populus tremuloides*) or bur oak (*Quercus macrocarpa*), drainages with birch (*Betula papyrifera*) and hazelnut (*Corylus cornuta*), riparian corridors, and other

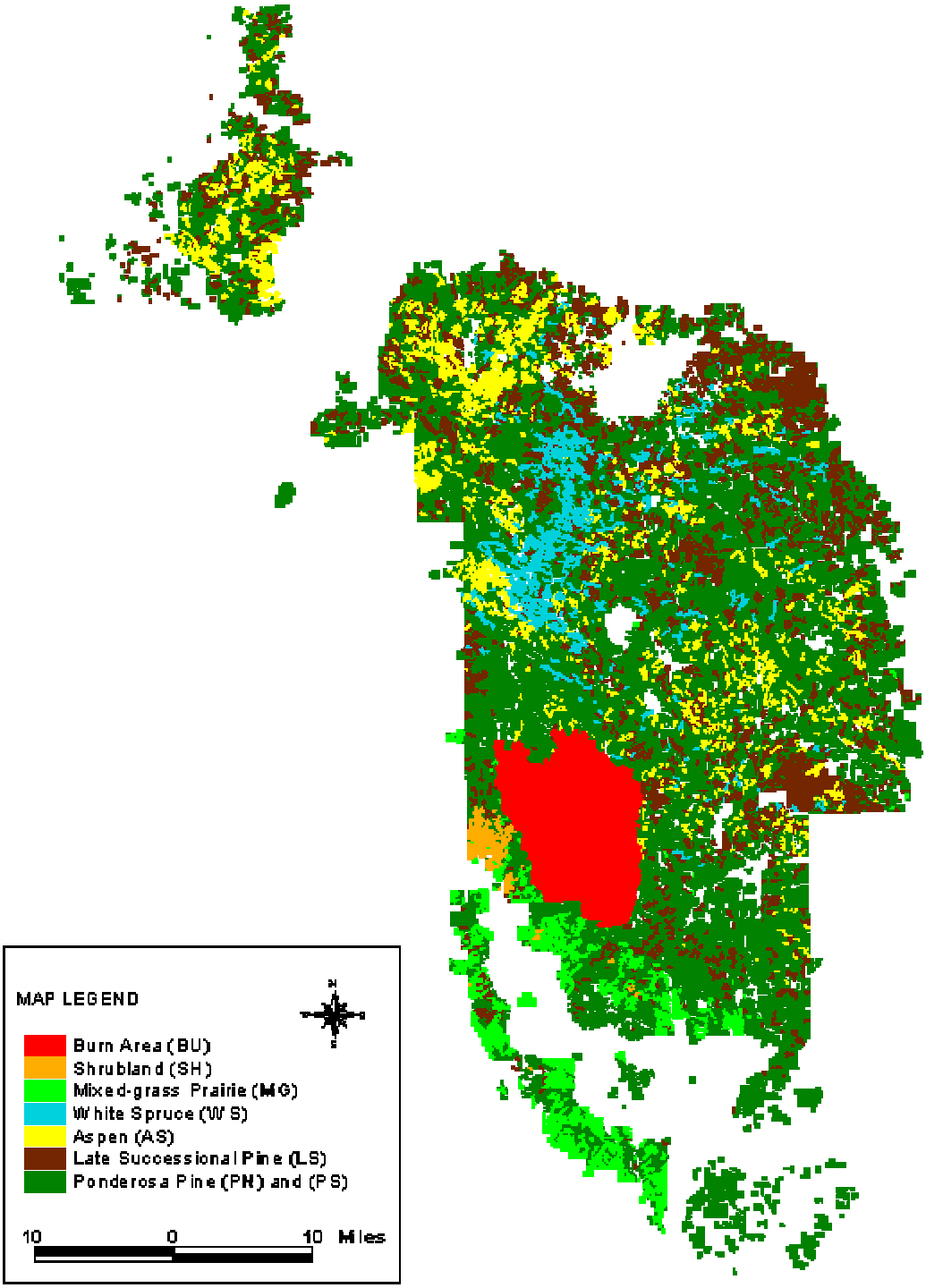


Figure 1. Distribution of habitats targeted for bird monitoring under *Monitoring the Birds of the Black Hills* (note: Foothills Riparian and Montane Riparian habitats not included).

habitat edges. Nonetheless, transects in this habitat primarily sample pine forest. We separated the northern ponderosa pine habitat from that in the south because of structural and physiognomic differences that contribute to differences in the bird communities in each area. The pine forests in the northern hills receive more rainfall than those in the south, and consequently support an extensive under- and mid-story of bur oak, aspen, paper birch, and other small deciduous trees. This widespread deciduous component contributes to a bird community that is substantially different from that in the south.

Ponderosa pine, southern hills

Ponderosa pine, southern hills (PS), or "pine-south," refers to the arid forests dominated by ponderosa pine occurring south of the Northern Hills Ranger District. Similar to pine-north, this habitat designation incorporates natural variations in the landscape, such as small groves of aspen or oak, drainages with birch and hazelnut, riparian corridors, and other habitat edges. Nonetheless, transects in this habitat primarily sample pine forest. Forests in the southern hills receive less rainfall than those in the north, and consequently have 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.

Montane riparian

Montane riparian (MR) refers to wooded habitats along valley bottoms at mid- to upper-elevations in the Black Hills. These habitats occur almost exclusively along flowing water. Some sites in this category lack an over-story component, while others contain well-developed under- and over-stories. Dominant over-story tree species typically include narrowleaf cottonwood, boxelder, ponderosa pine, bur oak, and/or white spruce. Associated tree species may include aspen, paper birch and ironwood (*Ostrya virginiana*). Willows (*Salix* spp.), alders (*Alnus* sp.) and other shrubs, including snowberry, chokecherry, stinking elderberry (*Sambucus racemosa*), currant (*Ribes* spp.), and/or hawthorn (*Crataegus chrysocarpa*), typically form a fairly continuous shrub layer. The presence of an extensive shrub layer and flowing water are the unifying characteristics among sites in this habitat type. Herbaceous vegetation, especially grasses, is also prevalent.

White spruce

White spruce (WS) refers to coniferous forests dominated by white spruce (*Picea gluaca*), 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 drainage bottoms 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

(Figure 1), although isolated pockets exist in moist, narrow canyons further south and along the eastern edge of the Black Hills.

Methods

Field Personnel

Five experienced biological technicians with excellent aural and visual bird-identification skills executed the field component of MBBH in 2003. All had worked on RMBO monitoring projects in previous years and thus brought with them considerable experience and familiarity with the protocol. Each completed a two-day training program at the beginning of the season to ensure full understanding of the field protocols and to practice distance estimation.

Site Selection

Survey sites were selected in 2001 and 2002 according to procedures described by Panjabi (2001, 2003a). Additional changes made to the sampling scheme in 2003 were three sites added in white spruce and two sites dropped from montane riparian (Table 1). The two montane riparian sites that were dropped were selected because they were the least representative of the 32 existing sites in this category, and only 30 sites are needed. The three sites added in white spruce allow us to reach our target of 30 sites in this habitat. In all of the habitats sampled in 2003, we have achieved or exceeded our goal of 30 independent, randomly-selected monitoring sites per habitat.

Table 1. Changes to the habitat-stratified sampling scheme of MBBH in 2003.

Habitats	Transects dropped in 2003	New transects added in 2003
Montane riparian	MR14, MR26	None
White spruce	None	WS03, WS97, WS98

National Park Service lands
In 2003, RMBO staff surveyed five point transects at sites on National Park Service lands in the Black Hills region. One site was in pine-north habitat in Devil's Tower National Monument, one in burn area in Jewel Cave National Monument, one in pine-south habitat in Mount Rushmore National Memorial, and one each in mixed-grass prairie and foothill riparian in Wind Cave National Park. Data from the sites in pine-north, pine-south, and burn area are included in the analyses and results in this report.

Point transect Protocol

RMBO staff conducted point transects (Buckland et al. 1993) in order to sample bird populations in each habitat selected for monitoring. Each transect was

surveyed by one observer following protocol established by Leukering (2000) and modified by Panjabi (2003b). Staff conducted all transect surveys in the morning, between ½-hour before sunrise and 11 AM; most surveys were completed before 10 AM. To maximize efficiency, observers located the selected stand on the ground prior to the morning of the survey. For new transects, observers used this pre-survey visit to establish an access point for each stand, and a random distance and bearing from the access point (between 0-400 m) at which the first point count station would be located. On the morning of the survey, the observer began the point transect at the first count station and then continued along the pre-selected bearing for all remaining points if possible. In many cases, the pre-selected bearing eventually would lead the transect out of the target habitat, or to some obstruction (e.g., cliff or private land), forcing the observer to change the bearing of the transect. When this happened, the observer back-tracked to the last completed point count and randomly turned the transect right or left, at an angle perpendicular to the original bearing, and then alternated right or left if additional turns were necessary. In some small or linear stands (e.g., riparian sites), the size and shape of the stand determined the location and course of the transect.

Observers conducted up to 15 five-minute point counts at stations located at 250-m intervals along each point transect, recording all bird detections on standardized forms. Fly-overs (birds flying over, but not using the immediate surrounding landscape) were recorded, but excluded from analyses of density. For each bird detected, observers recorded the species, sex, how it was detected (e.g., call, song, drumming, etc.), and distance from the observation point. Whenever possible, they measured distances using Bushnell® Yardage Pro 500™ laser rangefinders. When it was not possible to measure the distance to a bird, staff used rangefinders to gauge distance estimates by measuring to some closer object. Observers treated the 250-m intervals between count stations as parts of a line transect, and recorded individuals of a short list of low-density species (all grouse, raptors, woodpeckers, and a few species from other taxonomic groups) and measured the distance and bearing to each from where it was detected along the transect line. They also recorded bearings and distances to individuals of the same low-density species when they were detected at count stations. Birds initially detected on points were not recorded between points.

Observers recorded atmospheric data (i.e., temperature in degrees Fahrenheit, cloud cover, precipitation, and wind--Beaufort scale) and the time at the start and end of each transect. They measured distances between count stations using hand-held Garmin® E-trex™ Global Positioning System units. All GPS data were logged in Universal Transverse Mercator (UTM) North American Datum 1927. At each count station, observers recorded UTM coordinates, whether or not the station was within 100m of a road, the primary and secondary habitat types in the area, the seral stage and canopy closure of each habitat (Buttery and Gillam 1983, USDA Forest Service 1998), and the primary and secondary understory

types (and percent coverage of each) within a 50 m radius of the point. Observers recorded these data prior to beginning each bird count.

Data Analysis

I used program DISTANCE (Thomas et al. 1998-99) to generate density estimates (*D*) using only data collected at point count stations. The notation, concepts, and analysis methods of DISTANCE were developed by Buckland et al. (1993). In DISTANCE analysis, a unique detection function is fit to each distribution of distances associated with a species in a given habitat. Because the detection function is unique to each species in each habitat, DISTANCE analysis avoids some serious problems inherent in traditional analyses of point count data (e.g., unquantifiable differences in detectability among habitats, species, and years). DISTANCE analysis relies on three assumptions, all of which are reasonably well met by *MBBH*: 1) all birds at distance=0 are detected, 2) distances of birds close to the point are measured accurately, and 3) birds do not move in response to the observer's presence.

As a general rule, I generated density estimates only for species which had a minimum of 20 independent observations (not including fly-overs) from count stations within a single habitat. In a few cases, when the species was either of special interest, or when including the analysis was the most logical means of providing a comparison of density among habitats in which it occurred, I generated density estimates with fewer than 20 observations in order to present the results in this report. Although this is a small sample, program DISTANCE returns an honest assessment of density, as reflected by the confidence interval around each estimate, regardless of sample size. Density estimates returned by program DISTANCE therefore provide a more meaningful statistic for monitoring than do indices based solely on raw count data, especially where sample size is low. In all cases I strive to present as much information as possible on the greatest number of species for this report. However, the results for species with low sample sizes should be interpreted with caution.

Results

RMBO staff conducted a total of 2,158 point counts along 152 point transects in 5 different habitats (Figure 2) between 24 May and 10 July, 2003. At least thirty point transects were surveyed in each habitat; 1 additional transect was conducted in each Pine-north and Pine-south habitats on National Park Service lands within the Black Hills (Table 2).

RMBO staff observed a total of 21,558 birds of 107 species on point transects. Two species, Alder Flycatcher and White-crowned Sparrow, were likely transient migrants, while the rest were probably breeding in the area. Fifty-four probable breeding species were observed in sufficient numbers to estimate density in at

Table 2. Bird sampling periods and effort in each habitat.

Habitat	Dates sampled	# point transects	# point counts
Burn area	24 May – 6 June	30	447
Montane riparian	7 June – 3 July	30	403
Pine-north	29 May – 4 July	31	435
Pine-south	31 May – 29 June	31	451
White Spruce	15 June – 10 July	30	422
All habitats	24 May – 10 July	152	2158

least one habitat. Three additional breeding species, Broad-winged Hawk, Northern Saw-whet Owl and Common Poorwill, were observed outside the standardized survey periods. In total, RMBO staff have documented 165 species since 2001 that have either bred or summered in the Black Hills (Appendix A).

The total number of species detected in each habitat in 2003 ranged from 56 in white spruce to 84 in montane riparian (Table 3). While these totals communicate the magnitude of the spectrum of possible species across a range of sites within a habitat type, it should be understood that some species observed were largely peripheral to the habitat in which they were recorded. Thus, species richness measures reflect both the within- and between-habitat diversity of the sites surveyed in each habitat category.

Of the habitats surveyed in 2003, more birds were detected, and average species richness was greatest, in montane riparian (Table 3). I have provided estimates of avian species richness at both the count-level (i.e., sub-sample) and the transect (i.e., site) level, as the count-level data are not influenced by stand size (i.e., the number of sub-samples per site), and are therefore best for direct inter-habitat comparisons, while the site-level data, which are influenced by stand size, provide a more complete picture of the bird community within a given stand of habitat. Thus, both estimates are useful from a management perspective.

Table 3. Bird totals and species richness in habitats surveyed in the Black Hills, summer 2003.

Habitat	# birds detected	Avg. # birds/point	# species detected	Avg. species richness/point	Avg. species richness/transect
Burn area	4,345	9.7	63	7.1	25.2
Montane riparian	4,663	11.6	84	8.1	29.0
Pine-north	4,453	10.2	65	7.1	22.6
Pine-south	4,081	9.0	69	6.6	23.9
White spruce	4,016	9.5	56	6.6	21.3
All habitats	21,558	10.0	107	7.0	24.4

Burn area (BU)

RMBO staff surveyed 447 point counts along 30 transects in burn areas between 24 May and 6 June, 2003 (Table 2). They recorded a total of 4,345 birds in this habitat, and an average of 9.7 birds at each count station (Table 3).

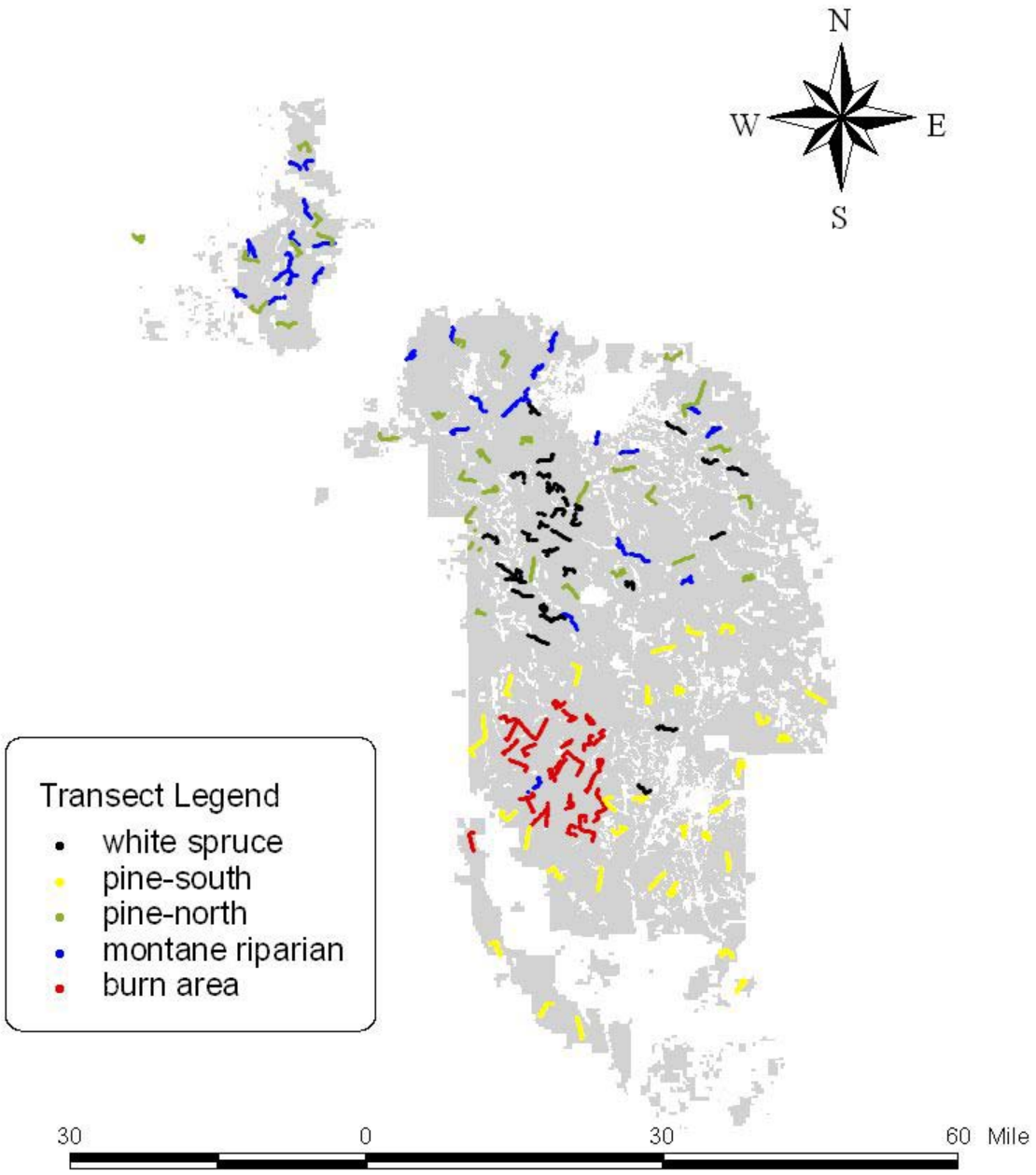


Figure 2. Distribution of habitat-stratified point transects in the Black Hills, 2003.

Observers detected 63 species in total and an average of 7.1 species per point count and 25.2 species per transect (i.e., per site) in burn areas.

The point transect data from burn areas yielded robust density estimates for 28 species (CV<50%) and moderately robust estimates for three additional species (CV=50-100%; Table 4). MBBH should effectively monitor these 31 species, which represent 49% of all species recorded from burn areas in 2003, in this habitat.

Chipping Sparrow, Dark-eyed Junco, American Robin, Western Tanager and Brown-headed Cowbird were the most abundant species in burn areas in 2003. Fourteen species (Red-headed Woodpecker, Hairy Woodpecker, Black-backed Woodpecker, Northern Flicker, Western Wood-Pewee, Eastern Bluebird, Mountain Bluebird, Western Tanager, Chipping Sparrow, Vesper Sparrow, Dark-eyed Junco, Western Meadowlark, Brown-headed Cowbird and American Goldfinch) --several of which are of high management or conservation interest-- had higher estimated densities in burn areas than in other habitats surveyed in 2003. Another species of conservation interest, Lewis's Woodpecker, was recorded exclusively in this habitat in 2003 (N=9).

Although the most apparent effects of the Jasper Fire on the forest ecosystem occurred immediately, the environment it created continues to evolve and populations of some bird species are still responding to the changing conditions. At least 6 species decreased in density between 2002 and 2003: Mourning Dove, Black-capped Chickadee, Red-breasted Nuthatch, Yellow-rumped Warbler, Red Crossbill and Pine Siskin. At least 5 species increased in density between 2002 and 2003: Western Wood-Pewee, Mountain Bluebird, Western Tanager, Chipping Sparrow and Dark-eyed Junco. Most other species appear to have remained relatively stable since 2002.

The initial population increases observed in some woodpecker populations during the first two years after the Jasper fire appear to have leveled off, and in one species the population already may be declining. Average densities of Red-headed Woodpeckers, Hairy Woodpeckers and Northern Flickers remained similar to those found in 2002, while the estimated average density of Black-backed Woodpeckers dropped by almost 50%. This decrease was not statistically significant.

Table 4. Estimated densities of breeding birds in 3-year post-burn areas in ponderosa pine forest in the Black Hills, summer 2003.

Species	D	LCL	UCL	CV	n
Mourning Dove	0.32	0.22	0.47	20%	46
White-throated Swift	0.13	0.05	0.35	53%	6
Red-headed Woodpecker	0.47	0.29	0.77	25%	46
Hairy Woodpecker	10.15	7.44	13.84	16%	153
Black-backed Woodpecker	3.59	2.26	5.69	24%	44

Species	D	LCL	UCL	CV	n
Northern Flicker	1.19	0.83	1.72	19%	84
Western Wood-Pewee	5.14	3.90	6.76	14%	150
Dusky Flycatcher	12.36	9.66	15.82	13%	154
Plumbeous Vireo	4.72	3.38	6.60	17%	76
Warbling Vireo	3.51	2.21	5.55	24%	56
Gray Jay	4.40	1.05	18.40	80%	27
American Crow	0.19	0.10	0.33	30%	54
Violet-green Swallow	1.94	0.89	4.21	41%	12
Black-capped Chickadee	4.65	3.02	7.18	22%	91
Red-breasted Nuthatch	2.28	1.63	3.21	17%	62
White-breasted Nuthatch	6.18	4.49	8.50	16%	84
House Wren	1.00	0.56	1.77	29%	24
Eastern Bluebird	2.66	1.81	3.92	20%	40
Mountain Bluebird	15.74	8.68	28.54	31%	60
Townsend's Solitaire	7.33	6.01	8.93	10%	202
American Robin	23.18	20.12	26.70	7%	452
Yellow-rumped Warbler	14.15	12.14	16.49	8%	309
Western Tanager	21.63	18.06	25.91	9%	305
Chipping Sparrow	82.98	62.36	110.43	15%	487
Vesper Sparrow	2.17	1.59	2.95	16%	88
Dark-eyed Junco	55.16	42.19	72.13	14%	296
Western Meadowlark	0.23	0.13	0.43	31%	21
Brown-headed Cowbird	17.00	14.11	20.49	10%	228
Red Crossbill	1.35	0.42	4.32	60%	10
Pine Siskin	1.92	1.12	3.30	28%	32
American Goldfinch	3.17	2.03	4.96	23%	43

D = density estimate in birds/km^2; LCL and UCL = lower and upper 95% confidence limits on D; CV = coefficient of variation of D; n = number of observations used to estimate D

Montane riparian (MR)

RMBO staff surveyed 403 point counts along 30 transects in montane riparian habitat between 7 June and 3 July, 2003 (Table 2). They recorded a total of 4,663 individual birds in this habitat, with an average of 11.6 birds per point count (Table 3). Observers detected 84 species in total and, on average, 8.1 species per point count and 29.0 species per transect in this habitat. On average, more individual birds of a greater number of species were recorded in montane riparian habitat than in any other single habitat type surveyed this year. However, individuals of some species were often recorded from adjacent habitats.

The point transect data from montane riparian habitat yielded robust density estimates (CV<50%) for 39 species and a moderately robust estimate for one additional species (CV=50-100%; Table 5). MBBH should effectively monitor these 40 species, which represent 48% of all species recorded from montane riparian in 2003, in this habitat.

Chipping Sparrow, MacGillivray's Warbler, Song Sparrow, American Redstart, and Dusky Flycatcher were the most abundant species in montane riparian this year. Eighteen species (Dusky Flycatcher, Red-eyed Vireo, American Crow, Violet-green Swallow, House Wren, Veery, American Robin, Gray Catbird, Cedar Waxwing, Yellow Warbler, American Redstart, MacGillivray's Warbler, Common Yellowthroat, Spotted Towhee, Song Sparrow, Black-headed Grosbeak, Red-winged Blackbird and Pine Siskin), more species than in any other habitat, had higher estimated densities in montane riparian relative to other habitats surveyed in 2003. If density is assumed to be positively correlated with habitat quality, then montane riparian habitats provide optimal habitat for more species than any other habitat surveyed in 2003. However, some of the aforementioned species may have had higher densities in habitats that were not surveyed this year.

Table 5. Estimated densities of breeding birds in montane riparian habitat in the Black Hills, summer 2003.

Species	D	LCL	UCL	CV	n
White-throated Swift	1.90	0.66	5.47	57%	13
Red-naped Sapsucker	5.68	3.30	9.77	28%	71
Hairy Woodpecker	0.70	0.34	1.44	37%	21
Northern Flicker	0.55	0.33	0.93	27%	23
Western Wood-Pewee	1.85	1.21	2.84	22%	50
Dusky Flycatcher	33.84	28.95	39.54	8%	242
Cordilleran Flycatcher	13.50	10.94	16.66	11%	136
Warbling Vireo	23.72	19.48	28.87	10%	290
Red-eyed Vireo	5.52	3.96	7.69	17%	80
Blue Jay	0.34	0.19	0.62	31%	15
American Crow	0.33	0.20	0.55	26%	27
Violet-green Swallow	8.35	5.18	13.46	25%	50
Black-capped Chickadee	10.78	7.68	15.12	17%	106
Red-breasted Nuthatch	4.51	3.32	6.12	16%	77
White-breasted Nuthatch	2.93	1.96	4.36	21%	36
House Wren	2.33	1.51	3.61	22%	35
Ruby-crowned Kinglet	8.90	7.17	11.06	11%	174
Townsend's Solitaire	2.06	1.59	2.68	13%	64
Veery	9.35	6.60	13.24	18%	89
Swainson's Thrush	6.56	5.13	8.37	13%	127
American Robin	32.99	27.84	39.10	9%	330
Gray Catbird	5.62	3.23	9.75	28%	25
Cedar Waxwing	8.83	4.05	19.22	41%	18
Yellow Warbler	7.75	4.71	12.76	26%	34
Yellow-rumped Warbler	10.72	8.36	13.76	13%	128
American Redstart	41.38	31.25	54.78	14%	203
Ovenbird	13.06	10.92	15.60	9%	279
MacGillivray's Warbler	57.91	40.87	82.04	18%	145
Common Yellowthroat	32.97	25.64	42.40	13%	182
Western Tanager	2.97	1.97	4.46	21%	72
Spotted Towhee	13.28	9.71	18.15	16%	102
Chipping Sparrow	58.70	27.08	127.24	41%	177
Song Sparrow	55.66	42.59	72.74	14%	176

Species	D	LCL	UCL	CV	n
Dark-eyed Junco	5.47	4.15	7.21	14%	82
Black-headed Grosbeak	10.29	7.68	13.78	15%	95
Red-winged Blackbird	3.62	1.92	6.83	33%	51
Brown-headed Cowbird	6.40	4.60	8.91	17%	93
Red Crossbill	4.83	3.10	7.51	23%	48
Pine Siskin	5.50	3.04	9.94	31%	29

D = density estimate in birds/km^2; LCL and UCL = lower and upper 95% confidence limits on D; CV = coefficient of variation of D; n = number of observations used to estimate D

Ponderosa pine, northern hills (PN)

RMBO staff conducted 435 counts along 31 transects in ponderosa pine forest in the northern Black Hills (pine-north) between 29 May and 4 July, 2003 (Table 2). They recorded a total of 4,453 birds in this habitat, with an average of 10.2 birds at each count station (Table 3). Observers detected a total of 65 species, and on average, 7.1 species per point count and 22.6 species per site in pine-north.

The point transect data from pine-north yielded robust density estimates (CV<50%) for 31 species, and moderately robust estimates for another 3 species (CV=50-100%; Table 6). MBBH should effectively monitor these 34 species, which represent 52% of all species recorded from pine-north habitat in 2003, in this habitat.

Chipping Sparrow, Warbling Vireo, Yellow-rumped Warbler, Dark-eyed Junco and Ovenbird were the most abundant species in this habitat this year. Six species (White-throated Swift, Red-naped Sapsucker, Warbling Vireo, Black-capped Chickadee, Red-breasted Nuthatch, and Ovenbird) had higher estimated densities in pine-north than in other habitats surveyed in 2003. However, some of these species may have had higher densities in other habitats not surveyed this year.

Because ponderosa pine forests in the northern Black Hills have a significant component of aspen, oak, and other broad-leaved trees, many bird species more often associated with broad-leaved habitats occur here in fairly high density. This fact is reflected by the higher average species richness per point count than in pine-south and by the relatively high densities of species such as Red-naped Sapsucker, Dusky Flycatcher, Warbling Vireo, Ovenbird, Black-headed Grosbeak, and other species that require broad-leaved vegetation. However, many of these species occur in greater densities in other habitats (e.g., aspen, montane riparian) in the Black Hills

Table 6. Estimated densities of breeding birds in ponderosa pine habitat (northern hills) in the Black Hills, summer 2003.

Species	D	LCL	UCL	CV	n
Mourning Dove	0.30	0.13	0.69	43%	15

Species	D	LCL	UCL	CV	n
White-throated Swift	2.13	0.29	15.84	112%	6
Red-naped Sapsucker	9.65	6.51	14.29	20%	77
Hairy Woodpecker	3.36	1.83	6.17	31%	38
Northern Flicker	0.34	0.18	0.64	33%	20
Western Wood-Pewee	3.33	2.47	4.50	15%	105
Dusky Flycatcher	16.13	12.54	20.76	13%	147
Cordilleran Flycatcher	4.21	2.78	6.37	21%	41
Plumbeous Vireo	2.21	1.18	4.14	32%	21
Warbling Vireo	37.31	32.51	42.82	7%	385
Red-eyed Vireo	1.62	0.95	2.78	28%	19
Gray Jay	9.30	2.55	33.97	69%	19
Blue Jay	0.26	0.08	0.83	60%	11
American Crow	0.30	0.13	0.67	42%	28
Violet-green Swallow	1.88	0.47	7.44	74%	8
Black-capped Chickadee	13.68	9.71	19.28	18%	141
Red-breasted Nuthatch	18.14	14.67	22.42	11%	202
White-breasted Nuthatch	6.95	4.89	9.88	18%	66
Brown Creeper	3.06	1.73	5.41	29%	33
Ruby-crowned Kinglet	3.92	2.97	5.18	14%	87
Townsend's Solitaire	7.92	6.42	9.76	11%	218
Swainson's Thrush	2.73	1.97	3.77	17%	65
American Robin	20.56	17.56	24.08	8%	298
Cedar Waxwing	3.21	1.28	8.02	48%	6
Yellow-rumped Warbler	33.68	29.51	38.43	7%	434
American Redstart	7.58	4.59	12.54	26%	37
Ovenbird	25.59	21.42	30.58	9%	331
MacGillivray's Warbler	14.03	6.64	29.65	39%	38
Western Tanager	11.40	9.01	14.43	12%	182
Chipping Sparrow	72.45	30.74	170.74	46%	255
Dark-eyed Junco	27.50	23.61	32.03	8%	319
Black-headed Grosbeak	0.95	0.56	1.59	27%	18
Brown-headed Cowbird	8.97	6.97	11.53	13%	127
Red Crossbill	11.21	8.62	14.58	13%	157
Pine Siskin	3.90	1.87	8.13	38%	27

D = density estimate in birds/km^2; LCL and UCL = lower and upper 95% confidence limits on D; CV = coefficient of variation of D; n = number of observations used to estimate D

Ponderosa pine, southern hills (PS)

RMBO staff conducted 451 point counts along 31 transects in ponderosa pine forest in the southern Black Hills (pine-south) between 31 May and 29 June, 2003 (Table 2). They recorded 4,081 birds in total in this habitat and an average of 9.0 birds at each count station. This average number of birds per count was the lowest recorded in any habitat surveyed this year (Table 3). Observers detected 69 species in total in pine-south and an average of 6.6 species per point count and 23.9 species per site in this habitat.

The point transect data from pine-south yielded robust density estimates (CV<50%) for 28 species and moderately robust estimates for another 5 species (CV=50-100%; Table 7). MBBH should effectively monitor these 33 species, which represent 48% of all species recorded from pine-south habitat in 2003, in this habitat.

Chipping Sparrow, Warbling Vireo, Yellow-rumped Warbler, Dark-eyed Junco and Ovenbird were the most abundant species in this habitat this year. Seven species (Mourning Dove, Plumbeous Vireo, Gray Jay, White-breasted Nuthatch, Rock Wren, Townsend's Solitaire and Yellow-rumped Warbler) had higher estimated densities in pine-south than in other habitats surveyed in 2003. However, some of these species may have had higher densities in habitats not surveyed this year.

Table 7. Estimated densities of breeding birds in ponderosa pine forest (southern hills) in the Black Hills, summer 2003.

Species	D	LCL	UCL	CV	n
Mourning Dove	0.86	0.45	1.65	33%	39
White-throated Swift	1.42	0.42	4.79	64%	13
Hairy Woodpecker	3.57	2.32	5.49	22%	61
Northern Flicker	0.50	0.25	1.00	36%	14
Western Wood-Pewee	3.18	2.16	4.69	20%	73
Dusky Flycatcher	14.51	12.01	17.53	10%	157
Cordilleran Flycatcher	3.82	2.60	5.61	20%	42
Plumbeous Vireo	6.74	5.26	8.63	13%	127
Warbling Vireo	10.64	8.13	13.93	14%	131
Gray Jay	16.18	9.83	26.63	26%	64
American Crow	0.13	0.07	0.23	30%	40
Violet-green Swallow	4.72	1.83	12.22	50%	14
Black-capped Chickadee	6.25	5.00	7.82	11%	165
Red-breasted Nuthatch	12.58	9.88	16.03	12%	222
White-breasted Nuthatch	9.68	7.85	11.94	11%	109
Brown Creeper	4.22	2.36	7.56	30%	29
Rock Wren	0.35	0.18	0.66	33%	13
Ruby-crowned Kinglet	4.14	2.12	8.08	35%	22
Mountain Bluebird	1.87	0.69	5.08	52%	21
Townsend's Solitaire	10.68	7.76	14.70	16%	204
Swainson's Thrush	0.63	0.09	4.16	105%	11
American Robin	18.38	14.82	22.79	11%	302
Cedar Waxwing	1.76	0.58	5.39	61%	8
Yellow-rumped Warbler	47.59	41.26	54.88	7%	521
Ovenbird	7.15	5.65	9.05	12%	187
Western Tanager	17.72	14.87	21.11	9%	264
Spotted Towhee	1.69	0.97	2.96	29%	31
Chipping Sparrow	60.94	47.59	78.04	13%	258
Vesper Sparrow	0.86	0.48	1.55	30%	23
Lark Sparrow	8.27	1.91	35.75	79%	14
Dark-eyed Junco	36.74	27.16	49.70	15%	241
Brown-headed Cowbird	7.83	6.02	10.18	13%	120

Species	D	LCL	UCL	CV	n
Red Crossbill	11.69	8.58	15.94	16%	141
Pine Siskin	1.40	0.70	2.81	36%	15

D = density estimate in birds/km^2; LCL and UCL = lower and upper 95% confidence limits on D; CV = coefficient of variation of D; n = number of observations used to estimate D

White spruce (WS)

RMBO staff conducted 422 point counts along 30 transects in white spruce stands between 15 June and 10 July, 2003 (Table 2). They recorded a total of 4,016 birds in this habitat, with an average of 9.5 birds detected at each count station (Table 3). Observers detected 56 species in total and, on average, detected 6.6 species per point count and 21.3 species per site.

The point transect data from white spruce habitat yielded robust density estimates (CV<50%) for 27 species, and moderately robust estimates for another 2 species (CV=50-100%; Table 8). MBBH should effectively monitor these 29 species, which represent 52% of all species recorded from white spruce habitat in 2003, in this habitat.

Chipping Sparrow, Golden-crowned Kinglet, Yellow-rumped Warbler, Ruby-crowned Kinglet and American Robin were among the most abundant species in this habitat this year. Seven species (American Three-toed Woodpecker, Cordilleran Flycatcher, Brown Creeper, Golden-crowned Kinglet, Ruby-crowned Kinglet, Swainson's Thrush and Red Crossbill) had higher estimated densities in white spruce habitat than in other habitats surveyed in 2003. Two of these, American Three-toed Woodpecker and Golden-crowned Kinglet are entirely restricted to this habitat type in the Black Hills.

Table 8. Estimated densities of breeding birds in white spruce stands in the Black Hills, 2003.

Species	D	LCL	UCL	CV	n
White-throated Swift	0.13	0.05	0.32	50%	6
Red-naped Sapsucker	2.88	1.80	4.63	24%	38
Hairy Woodpecker	2.37	1.68	3.34	18%	43
American Three-toed Woodpecker	3.64	1.78	7.43	37%	35
Northern Flicker	0.89	0.58	1.37	22%	40
Dusky Flycatcher	1.58	0.81	3.08	34%	16
Cordilleran Flycatcher	15.55	11.91	20.30	14%	101
Warbling Vireo	8.77	6.55	11.74	15%	92
Gray Jay	4.64	3.21	6.71	19%	62
American Crow	0.16	0.08	0.32	34%	14
Black-capped Chickadee	8.96	7.21	11.15	11%	159
Red-breasted Nuthatch	15.01	12.79	17.63	8%	254
White-breasted Nuthatch	0.97	0.53	1.77	31%	16
Brown Creeper	7.28	5.22	10.16	17%	63
Golden-crowned Kinglet	58.59	44.48	77.17	14%	188

Species	D	LCL	UCL	CV	n
Ruby-crowned Kinglet	37.12	31.05	44.37	9%	419
Townsend's Solitaire	3.29	2.37	4.56	17%	83
Swainson's Thrush	18.02	15.32	21.19	8%	296
American Robin	31.32	25.82	38.00	10%	264
Yellow-rumped Warbler	44.67	35.41	56.36	12%	408
Ovenbird	1.14	0.67	1.93	27%	23
Common Yellowthroat	3.08	1.65	5.76	33%	18
Western Tanager	0.90	0.34	2.36	50%	18
Chipping Sparrow	81.57	64.01	103.95	12%	237
Song Sparrow	5.81	3.63	9.31	24%	46
Dark-eyed Junco	23.68	19.87	28.21	9%	275
Brown-headed Cowbird	1.58	0.81	3.08	35%	19
Red Crossbill	22.75	19.16	27.02	9%	315
Pine Siskin	3.35	2.01	5.57	26%	35

D = density estimate in birds/km^2; LCL and UCL = lower and upper 95% confidence limits on D; CV = coefficient of variation of D; n= number of observations used to estimate D

SPECIES ACCOUNTS

In this section I present one-page accounts for each bird species detected in 2003 that is of management interest, as designated by either the U.S. Forest Service, the U.S. Fish and Wildlife Service, the South Dakota Dept. of Game, Fish, and Parks, or Partners In Flight. Each of these organizations has a stake in maintaining healthy populations of birds in the Black Hills. For the U.S. Forest Service, I include designations for BHNF Management Indicator Species (MIS) and Region 2 Sensitive Species (R2SS). For the U.S. Fish and Wildlife Service I include designations for Birds of Conservation Concern for Bird Conservation Region 17 (BCR17; USFWS 2002). For the South Dakota Department of Game, Fish, and Parks, I include designations for State Threatened or Endangered Species, and for Partners In Flight I include designations from the Partners In Flight Continental Watch List (Rich et al. in prep), Bird Conservation Region 17, (PIF Species Assessment Database 2001), and the Wyoming Partners In Flight Bird Conservation Plan (2003; this designation included only for level I and II priority species that were recorded in the Wyoming portion of the Black Hills). Some of the information presented in this section has already been reported previously, but it is organized here in such a way so as to facilitate easy referencing of comprehensive information on important species.

The geographic distribution maps in the following accounts depict the locations and relative abundance of species of management interest that were detected on point transects in 2003. The relative abundance scale used in the maps is based on the average number of birds observed per point count along each transect where the species was detected. Therefore, the location of the dots do not necessarily indicate the precise location of the point at which the species was observed, but rather the mid-point of the transect on which the species was observed. It is important to keep in mind that the maps only reflect the abundance and distribution of the species across the sites we surveyed, and therefore should be construed to suggest anything about the areas that were not surveyed. Also, note that the abundance scale has been changed slightly from earlier reports to provide greater resolution at the lower end of the abundance scale. The scale is constant among maps, allowing for easy comparisons among species.

In a few cases, I provide comparisons with the only available historical accounts of the avifauna of the Black Hills (Grinnell 1875; Cary 1901; Pettingill and Whitney 1965) to provide a historical perspective in which to interpret the current findings.

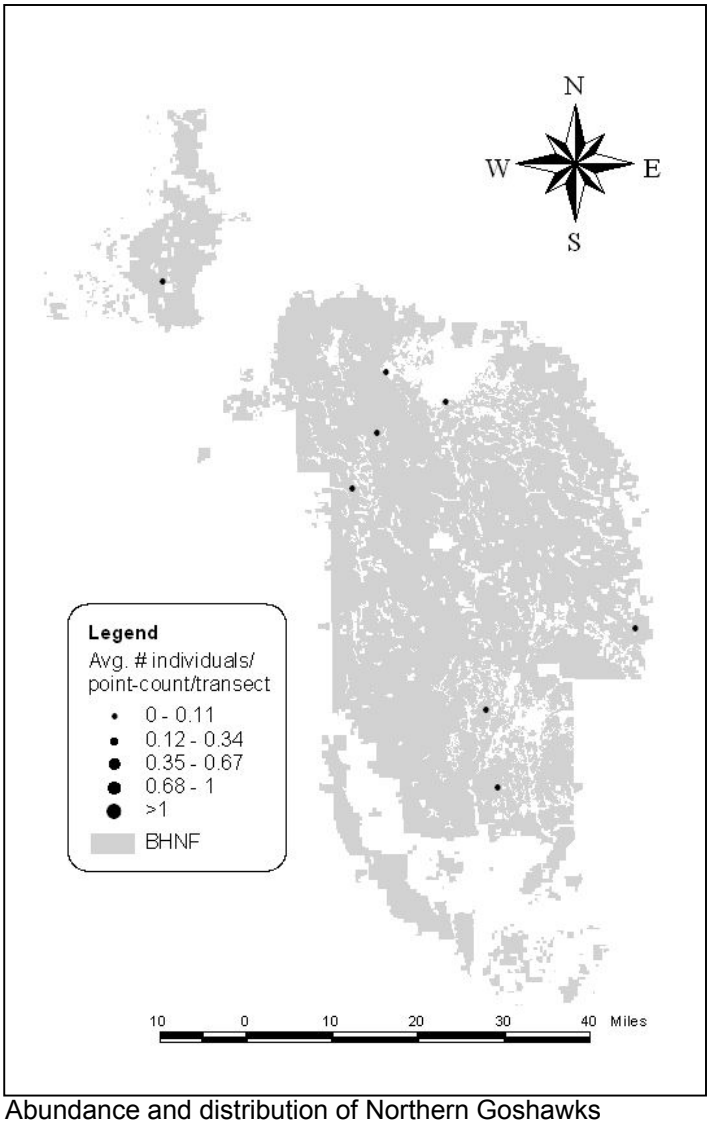
Northern Goshawk

(Region 2 Sensitive Species)
(BHNF Management Indicator Species)
(WY-PIF Level I Priority)

Northern Goshawk occurs widely in the Black Hills but it is uncommon throughout. Eight Northern Goshawks were recorded in 2003: three in montane riparian, two in pine-south, and three in white spruce. Too few were observed to estimate density either within or across habitats.

Although uncommon, Northern Goshawk has consistently been the most frequently observed species of the three *Accipiter* hawks that breed in the Black Hills, and is probably more abundant than either the Cooper's Hawk or Sharp-shinned Hawk.

Data from the full spectrum of habitat-based point transects across the Black Hills may provide a means to loosely track the status of Northern Goshawk over time. Effective monitoring, however, will likely require more intensive and focused efforts, probably involving call-response surveys. Given interest, such a program could be implemented cost-effectively as part of MBBH, with observers using playback to detect goshawks and other forest raptors at count stations after point transect surveys.



Abundance and distribution of Northern Goshawks observed on point transects in the Black Hills, 2003.

Observations of Northern Goshawk in the Black Hills, 2003.

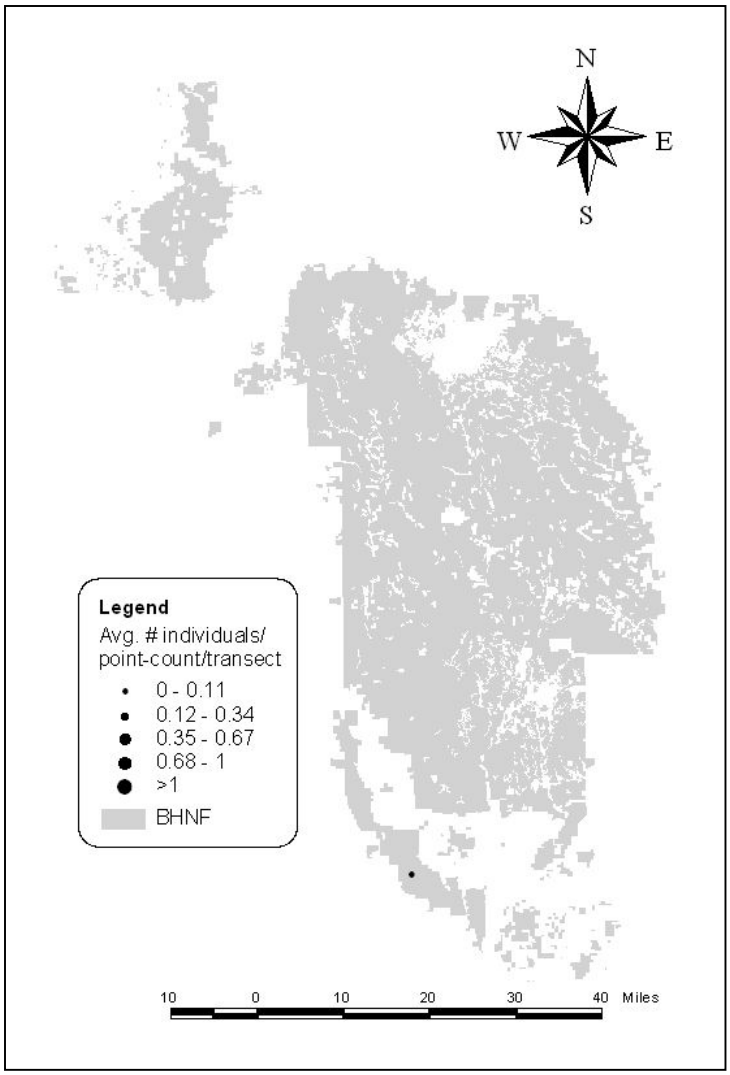
Habitat	D	LCL	UCL	CV(%)	N
MR	ID	--	--	--	3
PS	ID	--	--	--	2
WS	ID	--	--	--	3

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data

Golden Eagle
(USFWS Bird of Conservation Concern)

Golden Eagle occurs locally in the Black Hills, especially in areas with remote, high cliffs suitable for nesting. In 2003, a single individual was recorded in pine-south habitat in the Elk Mountains, although additional individuals were observed outside of the standardized surveys.

Because of the scarcity and localized nature of the species, Golden Eagle will not be effectively monitored through habitat-based point transects. However, their high detectability and conspicuous nests make then well suited to be monitored through a different technique. I recommend that focused efforts be implemented to locate all nests in the Black Hills, and monitor each one in the spring to determine its status and outcome. Such an effort could be incorporated into MBBH in a cost-effective manner, especially if combined with similar efforts for other cliff-nesting species (e.g., Prairie Falcon).



Abundance and distribution of Golden Eagles observed on point transects in the Black Hills, 2003

Observations of Golden Eagle in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV(%)	N
PS	ID	--	--	--	1

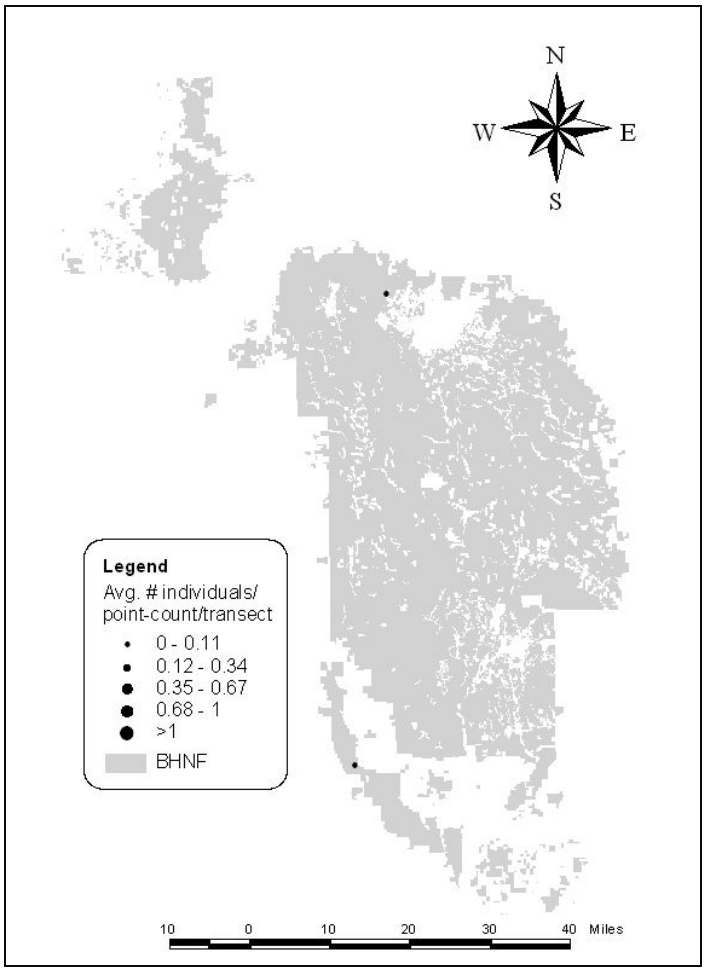
D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data

Prairie Falcon

(USFWS Bird of Conservation Concern)
(PIF High Overall Priority BCR17)

Prairie Falcon occurs locally in the Black Hills, primarily where high cliffs provide suitable nesting sites in proximity to open areas for hunting. Two individuals were observed in 2003, one in pine-south in the Elk Mountains and one in montane riparian in Spearfish Canyon.

Due to the low-density and localized distribution of Prairie Falcons in the Black Hills, habitat-stratified point transects may only provide a means to loosely track the status of this species, and will be inadequate for monitoring. Effective monitoring will likely best be accomplished through locating and monitoring all known nests of this species in the Black Hills. Such an effort could be incorporated into MBBH in a cost-effective manner, especially if combined with similar efforts for other cliff-nesting species (e.g., Golden Eagle).



Abundance and distribution of Prairie Falcons observed on point transects in the Black Hills, 2003.

Observations of Prairie Falcon in the Black Hills, 2003.

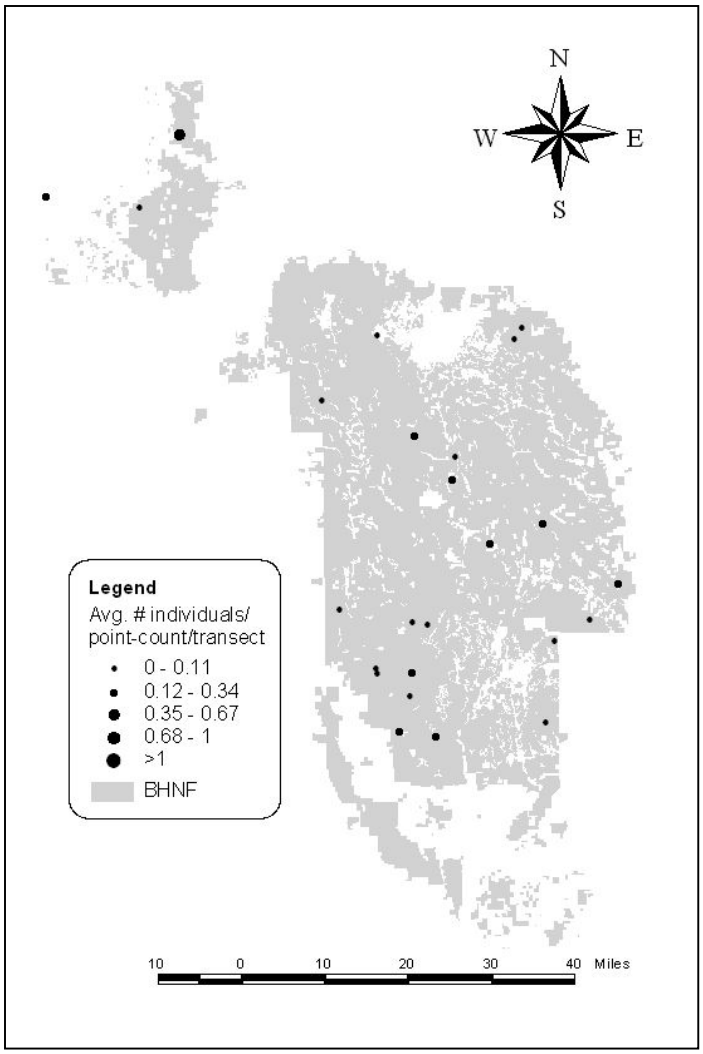
Habitat	D	LCL	UCL	CV(%)	N
MR	ID	--	--	--	1
PS	ID	--	--	--	1

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data

Wild Turkey
(BHNF Management Indicator Species)

Wild Turkey occurs throughout the Black Hills, but because vocalization activity declines sharply by the end of May, the species often goes undetected on our late-spring/early summer surveys. Nonetheless, the observations of turkeys from point transects appear to be sufficient, and should be consistent enough, to provide a reliable index to monitor the population across habitats. However, these data should not be relied upon for density estimates or to determine habitat relationships as observation rates in each habitat are probably more influenced by the seasonal timing of surveys in the habitat rather than the density of individuals per se.

Additional effort earlier in the spring would likely yield better information on Wild Turkey, although because it is a game species, presumably this species is already being monitored through other programs. However, Wild Turkeys should be effectively monitored under *MBBH* through point transects *across all habitat types*.



Abundance and distribution of Wild Turkeys observed on point transects in the Black Hills, 2003

Observations of Wild Turkey in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV(%)	N
BU	ID	--	--	--	7
MR	ID	--	--	--	10
PN	ID	--	--	--	7
PS	ID	--	--	--	19
WS	ID	--	--	--	2

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data

White-throated Swift

(PIF Continental Watch List)
(PIF High Regional Priority BCR17)
(WY-PIF Level II Priority)

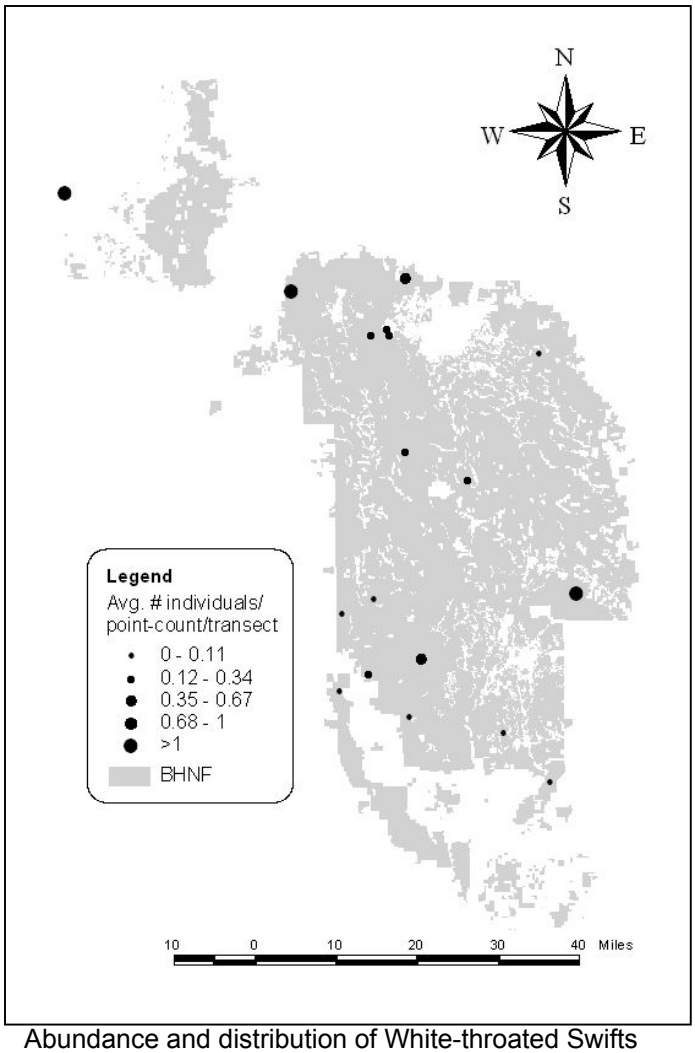
White-throated Swift is locally common in the Black Hills, particularly at lower elevations, where high cliffs provide suitable nesting sites. Of the habitats surveyed in 2003, White-throated Swifts occurred in highest density in montane riparian, pine-north and pine-south, although data from previous years suggest higher densities occur in foothill riparian and pine-juniper shrubland habitats (Panjabi 2001, 2002), where cliffs are more widely available.

Because White-throated Swifts are typically observed in flocks, they were analyzed as clusters. Although high numbers of individuals were observed, independently observed clusters in the five habitats surveyed in 2003 were too few to allow for statistically rigorous monitoring. Effective monitoring of White-throated Swifts will best be accomplished through point transects in foothill riparian and pine-juniper shrubland or through complimentary techniques that specifically target cliff-nesting birds.

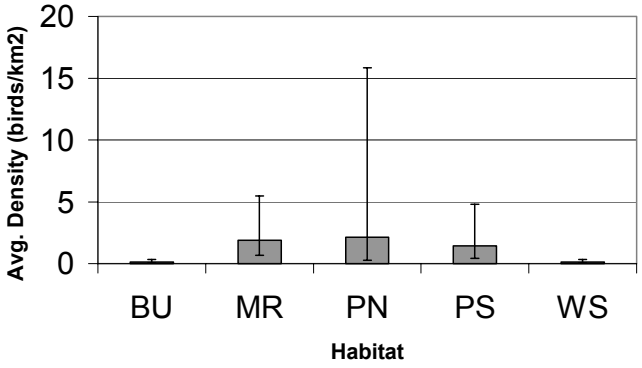
Habitat-specific density estimates for White-throated Swift in the Black Hills, 2003.

	0.13	0.05	0.35	53	6
MR	1.90	0.66	5.47	57	13
PN	2.13	0.29	15.84	112	6
PS	1.42	0.42	4.79	64	13
WS	0.13	0.05	0.32	50	6

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data



Abundance and distribution of White-throated Swifts observed on point transects in the Black Hills, 2003.



Relative density of White-throated Swifts among habitats surveyed in the Black Hills, 2003.

Lewis's Woodpecker

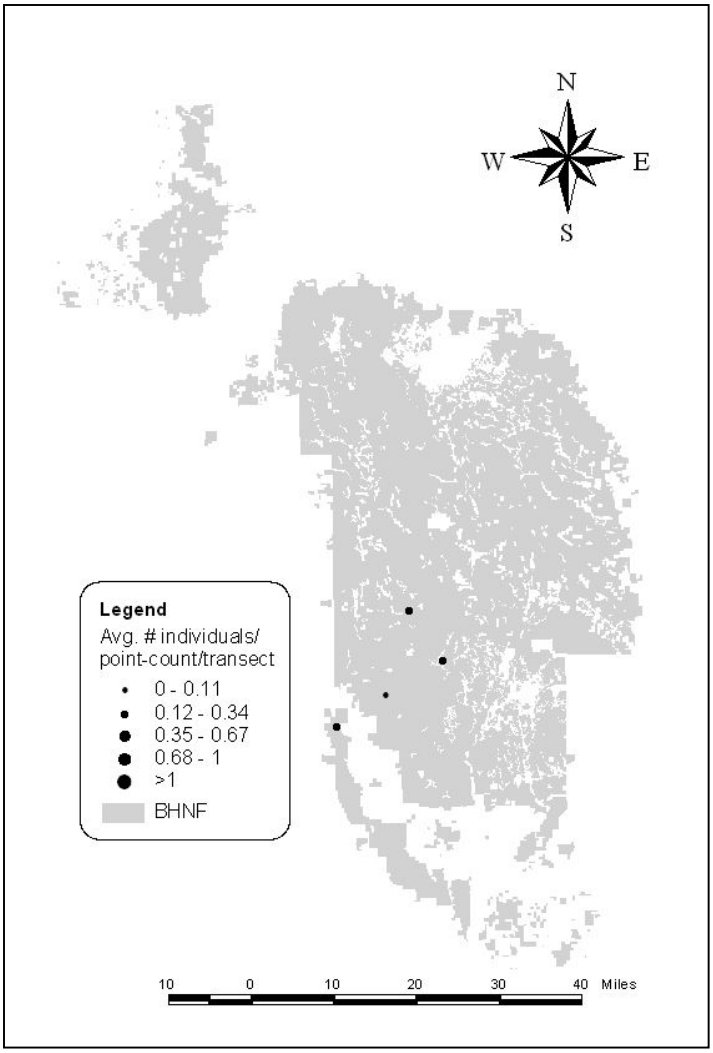
(Region 2 Sensitive Species)
(PIF Continental Watch List)
(PIF High Overall Priority BCR17)
(WY-PIF Level II Priority)
(USFWS Bird of Conservation Concern)

Lewis's Woodpecker reaches the most northeasterly extent of its global distribution in the Black Hills, where it is generally rare. In 2003, RMBO staff observed nine Lewis's Woodpeckers, all in burn areas. This is the largest number of Lewis's Woodpeckers observed in the Black Hills since the start of *MBBH*.

Previous accounts of the Lewis's Woodpecker's historical abundance in the Black Hills are somewhat conflicting. Some authors contend it has never been common (Grinnell 1875, Pettingill and Whitney 1965), but at least one author (Cary 1901) stated that it was "common" and "partial to burnt timber on the sides of canyons". Pettingill and Whitney (1965) also stated that it prefers "burned-over areas" and "edges of pine forests and streamside cottonwoods with considerable dead growth". The species has probably always been localized due to its narrow habitat requirements.

It appears that the Jasper Fire and other recent fires have created opportunities for new habitat for the Lewis's Woodpecker as these burns slowly become more suitable with age.

Because still so few Lewis's Woodpeckers are being recorded on point transects, it seems this method will be inadequate to monitor this species at present. However, point transects in burn areas, especially older burns, could eventually prove useful for monitoring this species in the future if populations increase in these areas.



Abundance and distribution of Lewis's Woodpeckers observed on point transects in the Black Hills, 2003.

Observations of Lewis's Woodpecker in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV(%)	N
BU	ID	--	--	--	9

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data

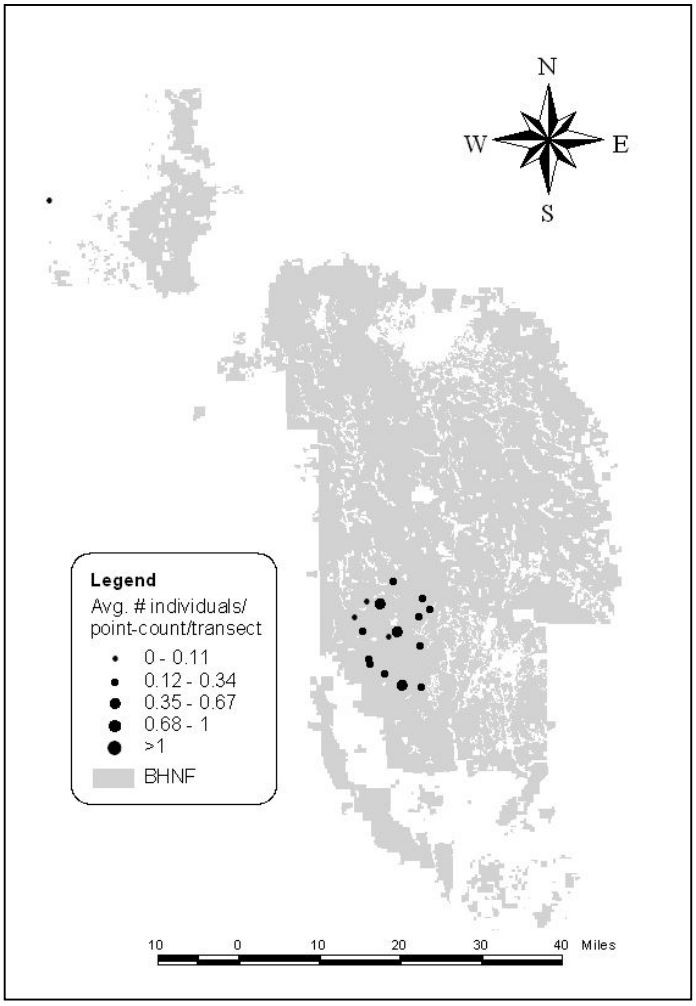
Red-headed Woodpecker

(PIF Continental Watch List)
(PIF High Regional Priority BCR17)

Red-headed Woodpecker occurs locally in the Black Hills, where it is generally uncommon. At present, it occurs in low density in burn areas, with approximately 1 bird for every 2 km^2 of habitat, or 1 pair for every 4 km^2. Nearly all individuals recorded in 2003 were observed in the Jasper burn area. Red-headed Woodpecker was recorded at only one other site in the Black Hills, a pine-north site in Devil's Tower National Monument that was also partially burned. Data from previous years also indicate a strong association with burned sites (Panjabi 2003a). Thus, the distribution of Red-headed Woodpecker in the Black Hills is largely tied to the availability of burned pine forests.

It is important to note that while the species appears to be fairly widespread in the Jasper burn, this population almost certainly did not exist prior to the Jasper fire. Although no pre-burn data exist from this area, the species has not been recorded on transects in the adjacent southern pine forests away from burns. Also, since the first year following the Jasper Fire, the distribution of the species within the burn area has increased annually. It is likely that Red-headed Woodpeckers are also occupying other recent burn areas in the Black Hills, although no data exist to document this.

Red-headed Woodpecker was formerly more common in the Black Hills. Grinnell (1875) described it as "especially abundant" in the Black Hills and Cary (1901) reported it to be "the most abundant woodpecker in the Hills". The global population of this species has declined by more than 50% across its range since 1966 (Sauer et al. 2003), and it appears to have declined in the Black Hills as well.



Abundance and distribution of Red-headed Woodpeckers observed on point transects in the Black Hills, 2003.

Red-headed Woodpecker should be effectively monitored under MBBH through point transects in BU. However, as the Jasper burn ages, it will likely be necessary to survey other more recent burn areas in order to continue monitoring the species' population. Additional point transects in new burns would also greatly increase our knowledge of this species' distribution and population size in the Black Hills.

Habitat-specific density estimates for Red-headed Woodpecker in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV%	n
BU	0.47	0.29	0.77	25	46
PN	ID	--	--	--	1

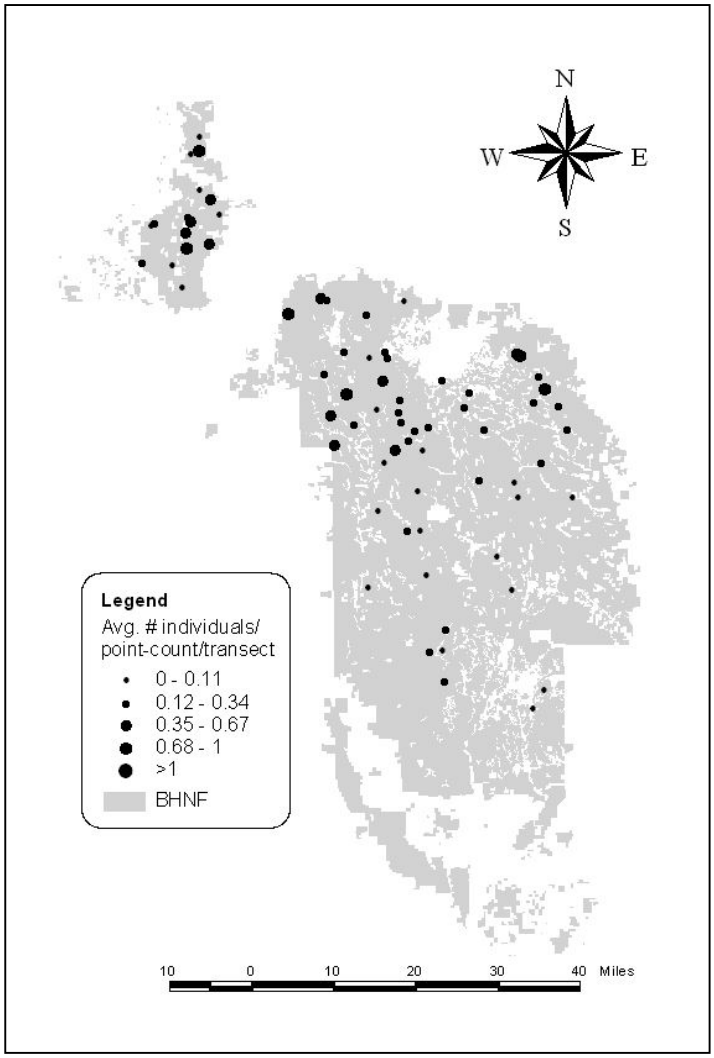
D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data

Red-naped Sapsucker

(USFWS Bird of Conservation Concern)
(PIF High Overall Priority BCR17)
(WY-PIF Level II Priority)

Red-naped Sapsucker occurs in much of the Black Hills, typically in low to moderate abundance, but it is most abundant and widespread in the north. The abundance and distribution of Red-naped Sapsucker are largely tied to the availability and abundance of broad-leaved, woody vegetation, especially aspens and willows.

Of the habitats surveyed in 2003, Red-naped Sapsucker occurred in highest density in PN, although surveys in 2002 indicate density is higher in aspen forest. This species should be effectively monitored under MBBH by point transects in a range of habitats.

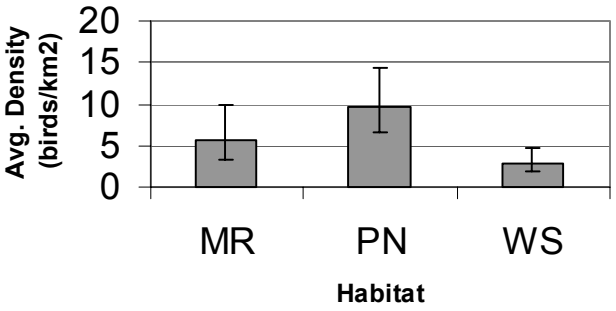


Abundance and distribution of Red-naped Sapsuckers observed on point transects in the Black Hills, 2003.

Habitat-specific density estimates for Red-naped Sapsucker in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV (%)	n
MR	ID	--	--	--	9
MR	5.68	3.30	9.77	28	71
PN	9.65	6.51	14.29	20	77
PS	ID	--	--	--	6
WS	2.88	1.80	4.63	24	38

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data



Relative density of Red-naped Sapsuckers among habitats in the Black Hills, 2003.

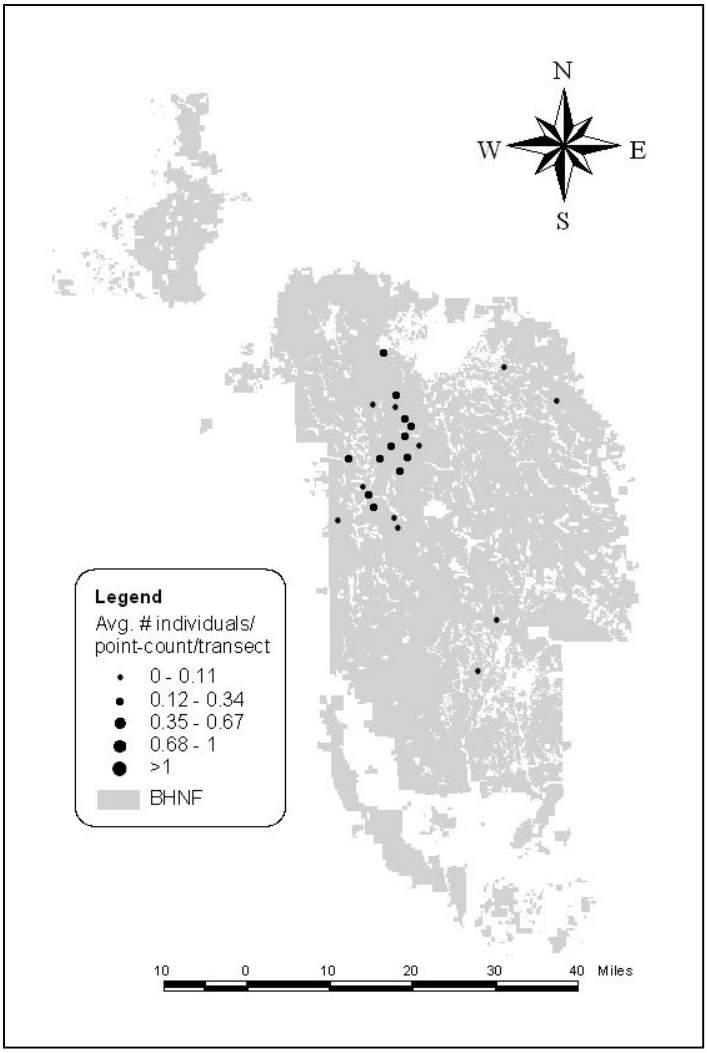
American Three-toed Woodpecker

(Region 2 Sensitive Species)
(BHNF Management Indicator Species)
(WY-PIF Level II Priority)

In the Black Hills, American Three-toed Woodpecker occurs almost exclusively in mature stands of white spruce, where it is generally found in low abundance. Although one individual was recorded on a PN transect it was observed in an area where white spruce was present.

Interestingly, this species has not invaded the Jasper burn or other recently burned areas in the Black Hills. Thus, it appears that its preference for spruce forests extends even to burned areas.

Three-toed Woodpecker should be effectively monitored under MBBH through point transects in WS.



Abundance and distribution of Three-toed Woodpecker observed on point transects in the Black Hills, 2003.

Habitat-specific density estimates for Three-toed Woodpecker in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV (%)	N
PN	ID	--	--	--	1
WS	3.64	1.78	7.43	37	35

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data

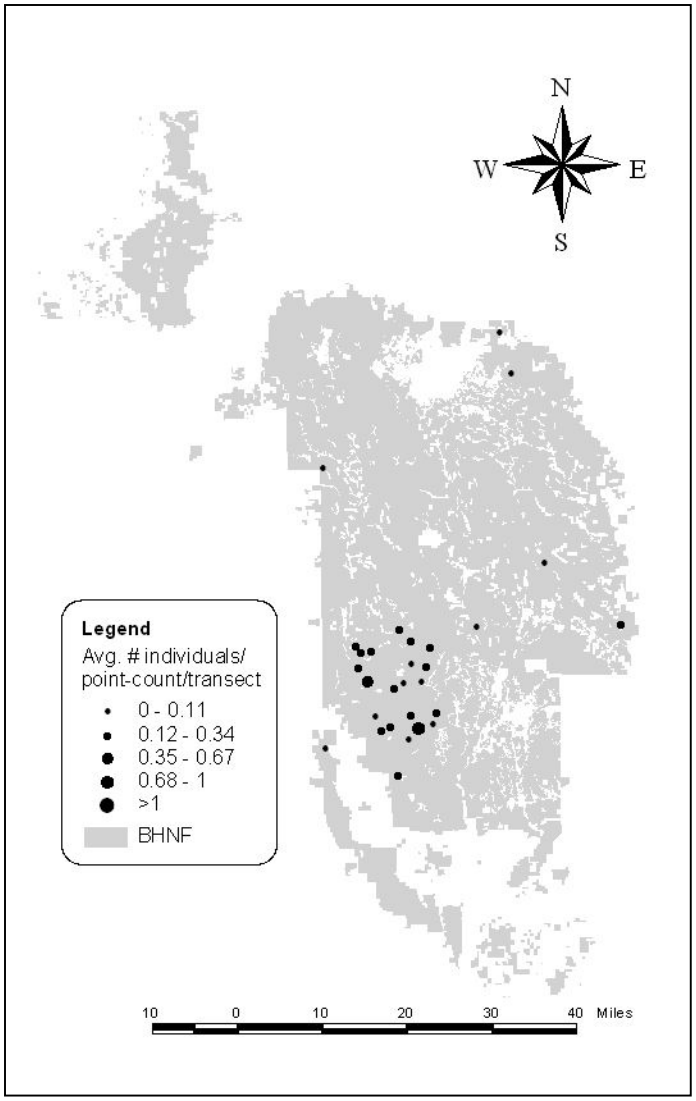
Black-backed Woodpecker

(Region 2 Sensitive Species)
(BHNF Management Indicator Species)
(PIF High Regional Priority BCR17)
(WY-PIF Level II Priority)

Black-backed Woodpeckers occur widely in the Black Hills, but they are rare outside of burns. Black-backed Woodpecker numbers increased significantly in the Jasper burn during the first two years following the fire (Panjabi 2001, 2002), but it appears the population has begun to level off, if not already decline. Estimated average density of Black-backed Woodpeckers in the Jasper burn dropped to 3.59 birds/km^2 in 2003, from an average high of 6.91 birds/km^2 in 2002, although this change was not significant at the α=.05 level.

In some parts of the Jasper burn, local densities of Black-backs remain high. The estimated density of Black-backed Woodpeckers in Jewel Cave National Monument was more than 4 times the average across the burn as a whole. Black-backed Woodpeckers in the Jasper burn have been found to prefer to nest in large diameter trees and in areas with a higher density of snags (Vierling and Saab 2002). Pre-burn stand conditions recorded in Jewel Cave were on average more reflective of mature forest (seral stage 4) than sites on BHNF lands in the Jasper Burn, although pre-burn canopy closure (i.e., snag density) was not higher in Jewel Cave (Panjabi unpublished data).

Black-backed Woodpeckers should be effectively monitored under MBBH by point transects in BU, however as conditions change in the Jasper burn it will be necessary to focus effort on other burn areas in order to monitor this species in the Black Hills. One option is to switch to rotational sampling in this habitat, so that newer burn areas are continually rotated through the sampling scheme. Alternatively, more sites could be added to the program as needed to reflect the full spectrum of burn habitat available on the Forest. Such an approach would also provide data on species that prefer later successional stages of post-burn habitats, such as Lewis's Woodpecker.



Abundance and distribution of Black-backed Woodpecker observed on point transects in the Black Hills, 2003.

Habitat-specific density estimates for Black-backed Woodpecker in the Black Hills, 2003.

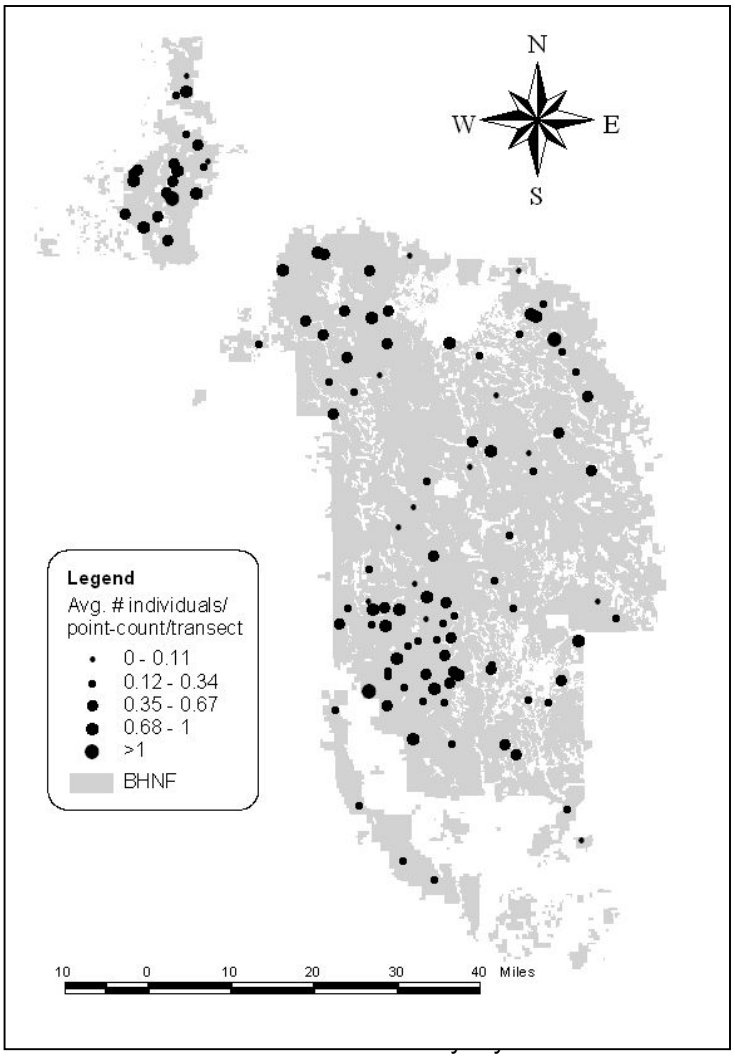
Habitat	D	LCL	UCL	CV (%)	N
BU	3.59	2.26	5.69	24	44
PN	ID	--	--	--	3
PS	ID	--	--	--	10

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data

Dusky Flycatcher
(WY-PIF Level II Priority)

Dusky Flycatchers occur widely throughout the Black Hills, but they are more abundant in some habitats than in others. Their distribution appears largely to be tied with the presence of broad-leaved, deciduous vegetation.

Dusky Flycatcher occurs in moderate density in several habitats. Of the habitats surveyed in 2003, density was greatest in montane riparian. Interestingly, the density of Dusky Flycatchers is not significantly different in the Jasper burn area relative to ponderosa pine habitats. The density of this species in the Jasper burn area has increased significantly since the first year post-fire. This species should be effectively monitored through point-transects in a wide range of habitats under *MBBH*.

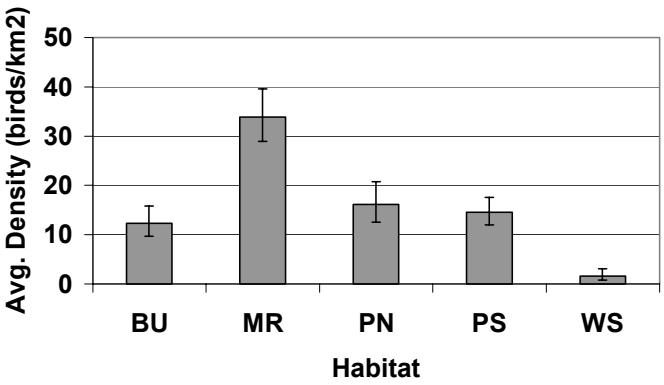


observed on point transects in the Black Hills, 2003.

Habitat-specific density estimates for Dusky Flycatcher in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV (%)	N
BU	12.36	9.66	15.82	13	154
MR	33.84	28.95	39.54	08	242
PN	16.13	12.54	20.76	13	147
PS	14.51	12.01	17.53	10	157
WS	1.58	0.81	3.08	34	16

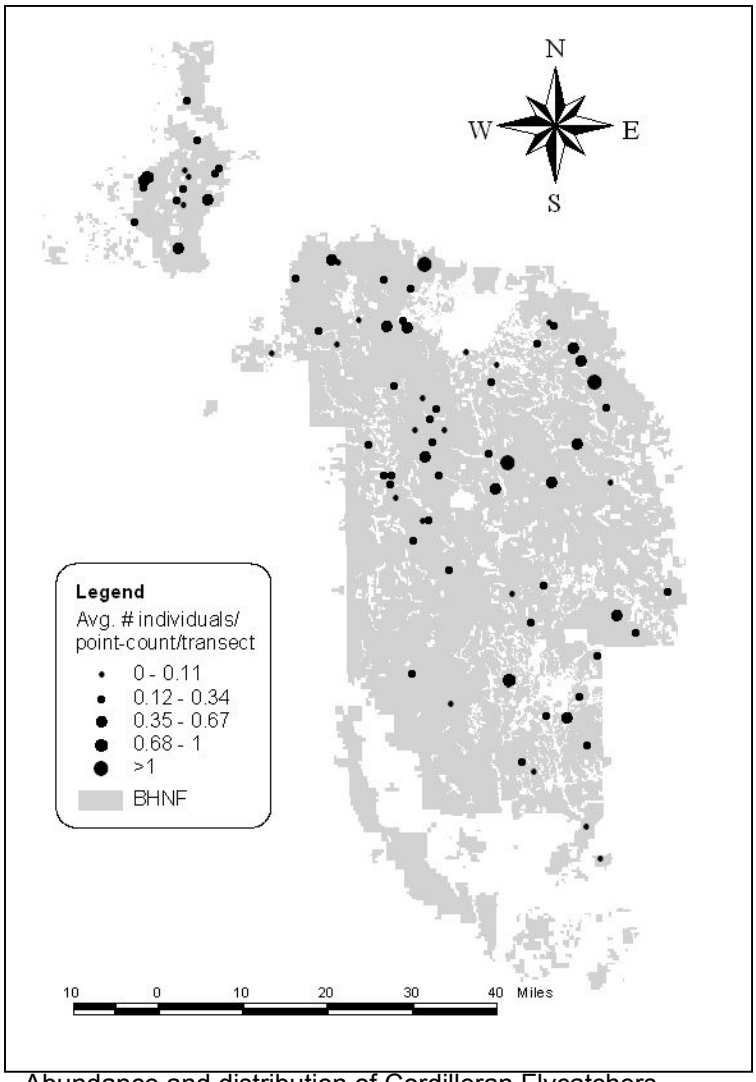
D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data



Cordilleran Flycatcher
(WY-PIF Level II Priority)

Cordilleran Flycatchers occur widely in the Black Hills, but their distribution is tied closely to the availability of suitable nest sites, primarily cliffs, rock outcrops, and other ledges. Of the habitats surveyed in 2003, estimated density was highest in montane riparian and white spruce, reflecting the greater availability of nest sites in or adjacent to these habitats. However, previous surveys have shown that density of this species is greater still in foothill riparian habitats (Panjabi 2003a).

Cordilleran Flycatchers should be effectively monitored under *MBBH* through point-transects in a range of habitats.

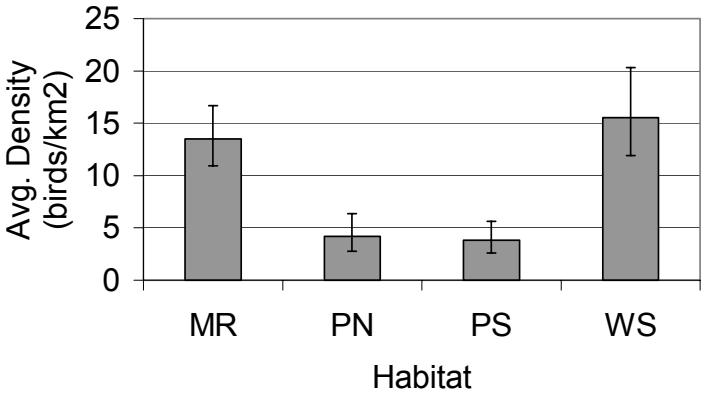


Abundance and distribution of Cordilleran Flycatchers observed on point transects in the Black Hills, 2003.

Habitat-specific density estimates for Cordilleran Flycatcher in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV (%)	N
BU	ID	--	--	--	1
MR	13.50	10.94	16.66	11	136
PN	4.21	2.78	6.37	21	41
PS	3.82	2.60	5.61	20	42
WS	15.55	11.91	20.30	14	101

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data



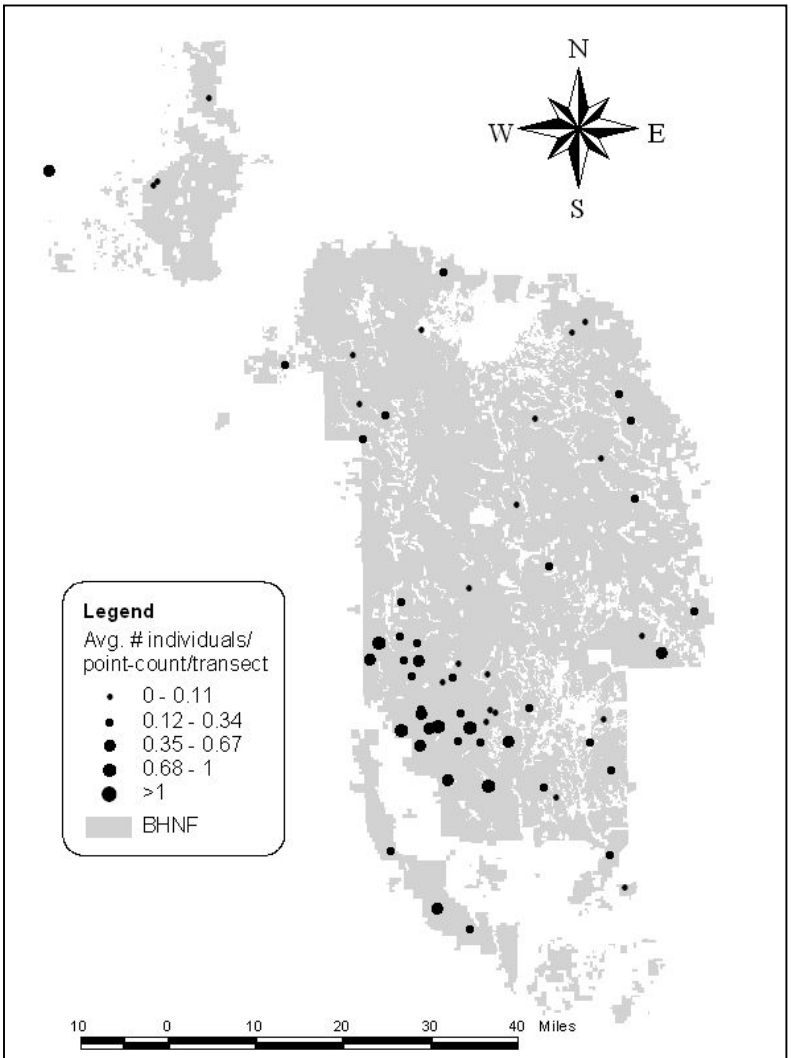
Relative density of Cordilleran Flycatchers among habitats in the Black Hills, 2003.

Plumbeous Vireo
(WY-PIF Level II Priority)

Plumbeous Vireos occur throughout the Black Hills in low to moderate abundance, but they achieve their greatest densities in the southwest. Elsewhere in the Black Hills they are perhaps most common along the northern and eastern perimeters of the Hills.

Plumbeous Vireos occupy a range of habitats, but in the Black Hills they are almost always associated with ponderosa pine. Although they are largely foliage-gleaners, Plumbeous Vireos appear to tolerate the impacts of wildfire. Three years after the Jasper Fire, they still occur in densities similar to that in the surrounding pine forests. Of the habitats surveyed in 2003, density may be somewhat greater in pine-south than in other habitats, although previous surveys suggest Plumbeous Vireos occur in higher densities in pine-juniper shrublands (Panjabi 2003a).

Plumbeous Vireos should be effectively monitored under MBHH through point-transects in a range of habitats, especially in pine-south and pine-juniper shrublands.

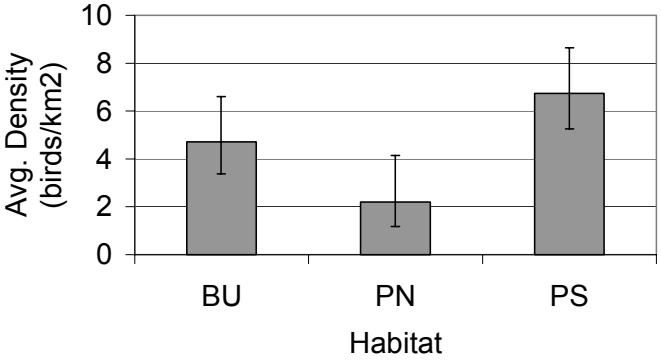


Abundance and distribution of Plumbeous Vireos observed on point transects in the Black Hills, 2003.

Habitat-specific density estimates for Plumbeous Vireo in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV (%)	N
BU	4.72	3.38	6.60	17	76
MR	ID	--	--	--	7
PN	2.21	1.18	4.14	32	21
PS	6.74	5.26	8.63	13	127
WS	ID	--	--	--	4

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data

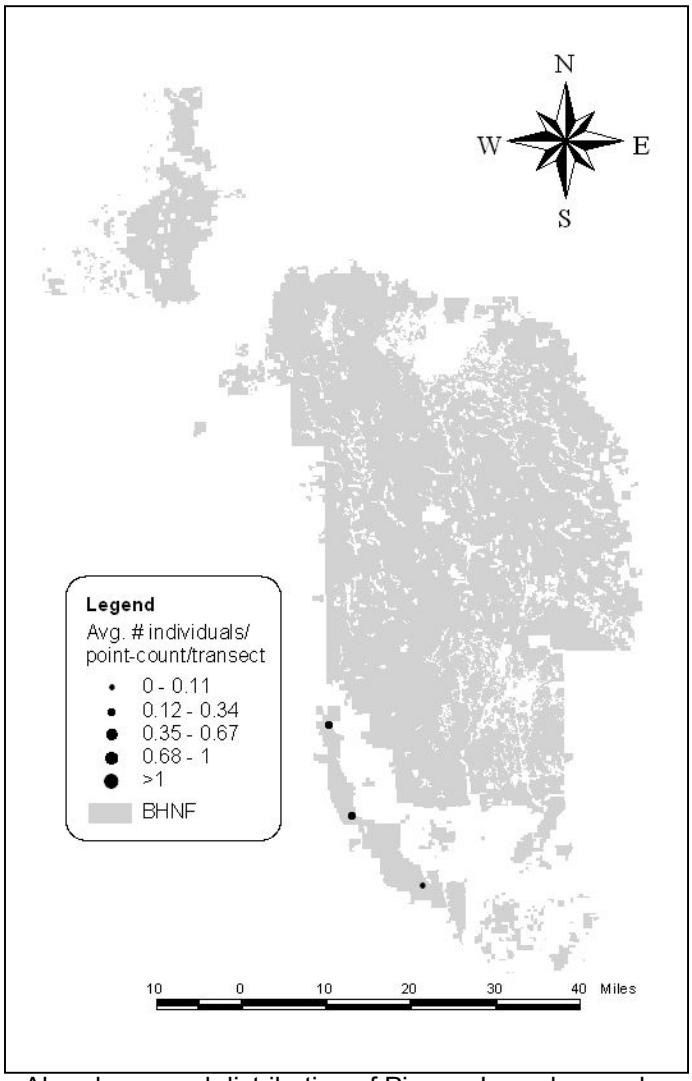


Relative density of Plumbeous Vireos among habitats in the Black Hills, 2003.

Pinyon Jay
(PIF Continental Watch List)

Pinyon Jays are primarily restricted to arid low-elevation habitats in the southwestern Black Hills, although they also occur seasonally in other areas. In 2003, Pinyon Jays were recorded in burn area and pine-south habitats, although previous surveys (Panjabi, 2001, 2003a) suggest this species may be more abundant in pine-juniper shrublands.

Because of their narrow distribution, small population, and propensity for flocking, the probability of encountering Pinyon Jays on point transect surveys is low. Pinyon Jays will probably not be adequately monitored under MBBH in any single habitat, but they may be adequately monitored across all habitats within its range, given continued effort in other habitats where this species is more frequently detected (e.g., pine-juniper shrubland).



Abundance and distribution of Pinyon Jays observed on point transects in the Black Hills, 2003.

Observations of Pinyon Jay in the Black Hills, 2003.

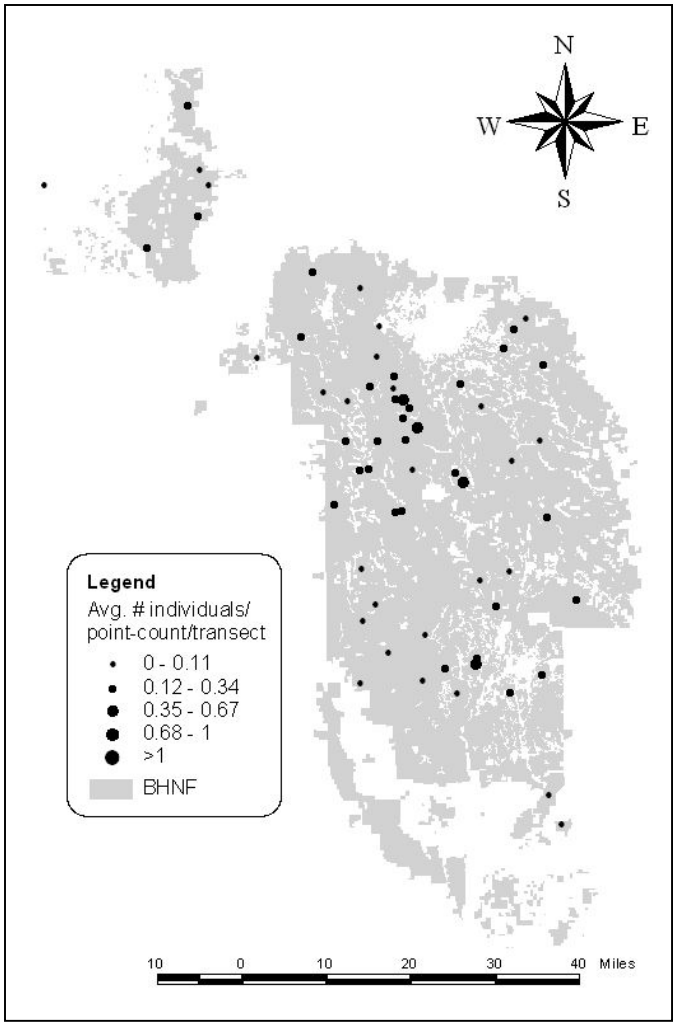
Habitat	D	LCL	UCL	CV(%)	N
BU	ID	--	--	--	3
PS	ID	--	--	--	4

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data

Brown Creeper

(BHNF Management Indicator Species)
(WY-PIF Level II Priority)

Brown Creepers occur in relatively low density in coniferous forests throughout the Black Hills. Of the habitats surveyed in 2003, Brown Creepers occurred in highest density in white spruce, although the differences among habitats were not statistically significant. Surveys in previous years suggest that Brown Creepers occur in similar or higher densities in late-successional pine stands relative to white spruce (Panjabi 2001, 2003a). Regardless of the type of coniferous forest, the distribution and abundance of Brown Creepers appears to be closely tied to the availability of mature and old-growth stand conditions, as evidenced by the fact that 90% of all Brown Creepers observed on point counts (*n*=136) in 2003 were recorded at sites where the surrounding habitat was classified as either seral stage 4 or 5 (Buttery and Gillam 1983, USDA 1998). Brown Creeper should be effectively monitored through point transects under *MBBH* in a range of habitats, especially white spruce and late-successional ponderosa pine.

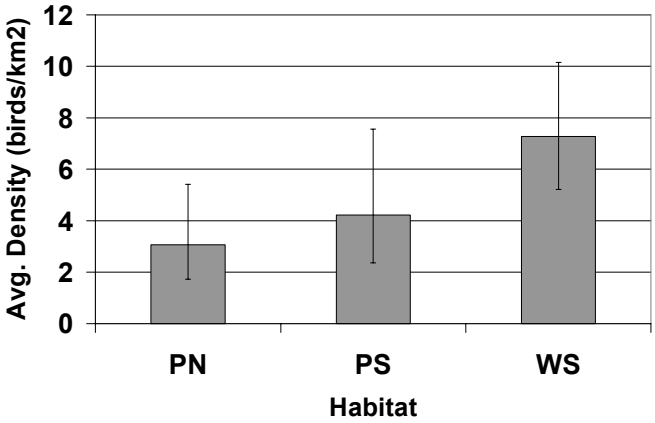


Abundance and distribution of Brown Creepers observed on point transects in the Black Hills, 2003.

Habitat-specific density estimates for Brown Creeper in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV(%)	N
BU	ID	--	--	--	4
MR	ID	--	--	--	7
PN	3.06	1.73	5.41	29	33
PS	4.22	2.36	7.56	30	29
WS	7.28	5.22	10.16	17	63

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data



Relative density of Brown Creepers among habitats in the Black Hills, 2003.

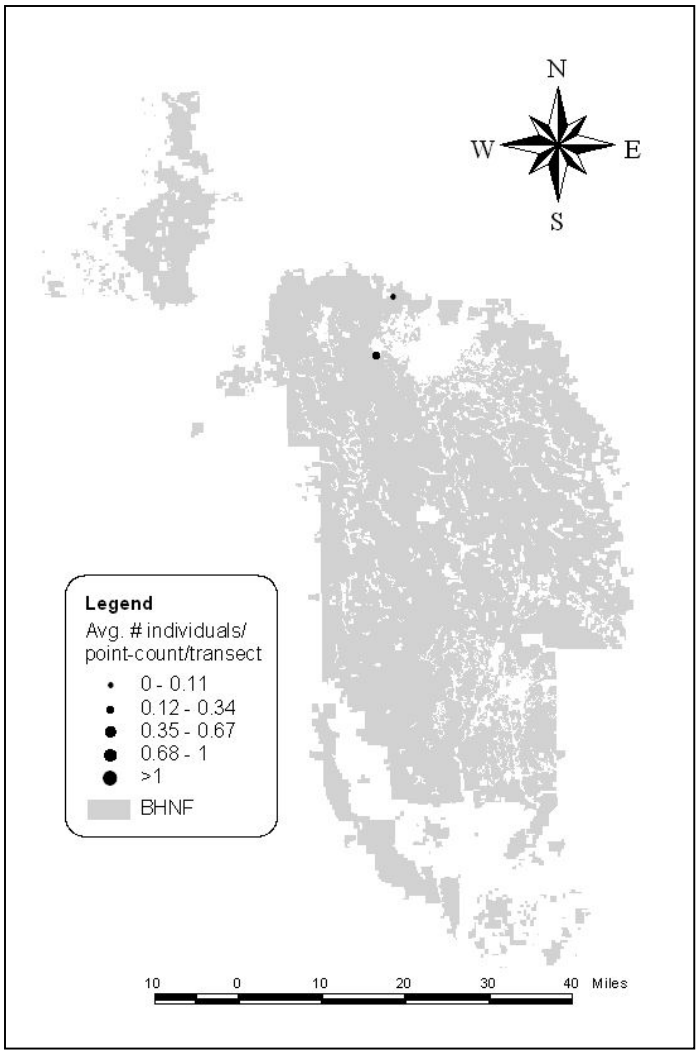
American Dipper

(Threatened Species, South Dakota Dept. of Game, Fish & Parks)

American Dipper occurs only along fast-flowing, rocky streams in the Black Hills, where it relies wholly on aquatic insects (particularly larvae) that are sensitive to water quality. The American Dipper is thus an excellent indicator of overall stream health (Tyler and Ormerod 1994).

American Dippers were recorded at two locations in 2003 on Spearfish Creek. Although they do occur elsewhere in small numbers, they are at present primarily restricted to this watershed. Previous reports of dippers on French Creek, Box Elder Creek, Elk Creek and Rapid Creek suggest the species has undergone a significant population decline and range reduction in the Black Hills (Backlund 2001). Without adequate conservation and management of dipper habitat, the species could become extirpated from the Black Hills.

This species will not be adequately monitored by point transects under MBBH. Additional efforts to census populations along streams, especially Spearfish Creek and its tributaries, Whitewood Creek, Bear Butte Creek, and Rapid Creek, will be needed to adequately monitor this species in the Black Hills.



Abundance and distribution of American Dippers observed on point transects in the Black Hills, 2003.

Observations of American Dipper in the Black Hills, 2003.

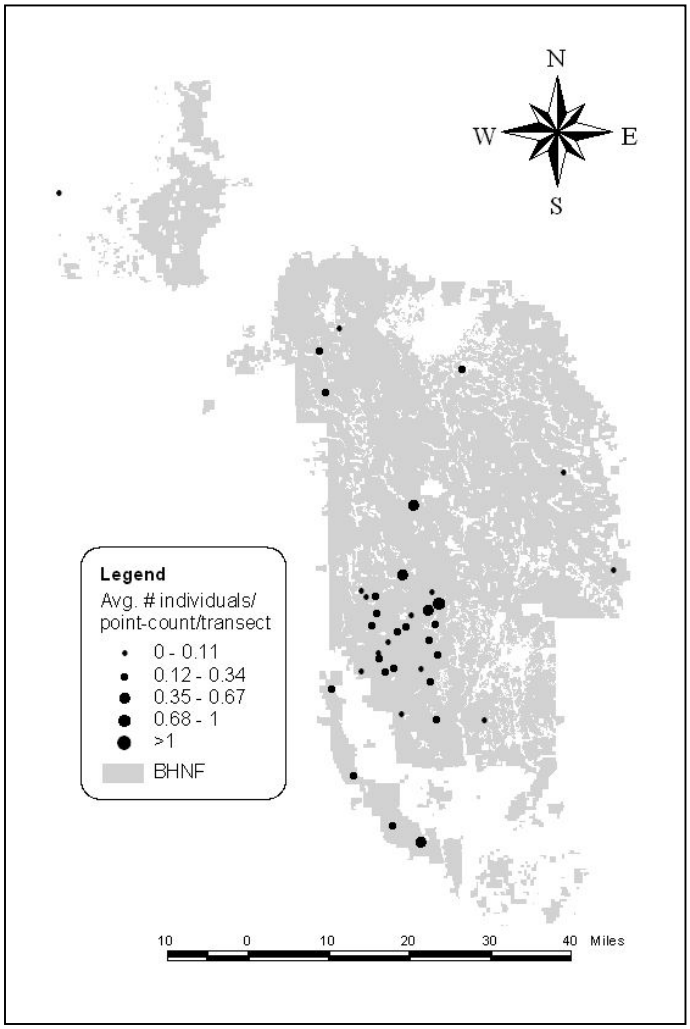
Habitat	D	LCL	UCL	CV(%)	N
MR	ID	--	--	--	1
WS	ID	--	--	--	3

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data

Mountain Bluebird
(PIF High Regional Priority BCR17)

Mountain Bluebirds occur locally throughout the Black Hills, where they occupy burn areas, grasslands and other forest openings. Of the habitats surveyed in 2003, average density was highest in burn areas, a pattern consistent with findings from previous years.

Mountain Bluebirds are secondary cavity nesters that rely largely on cavities excavated by woodpeckers for nest sites. Mountain Bluebirds should be effectively monitored under MBBH through point transects in a range of habitats, but most effectively in burn areas.

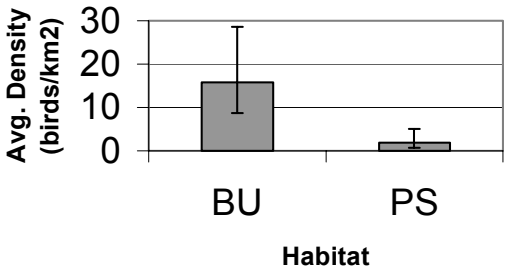


Abundance and distribution of Mountain Bluebirds observed on point transects in the Black Hills, 2003.

Habitat-specific density estimates for Mountain Bluebird in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV(%)	N
BU	15.74	8.68	28.54	31	60
MR	ID	--	--	--	15
PN	ID	--	--	--	4
PS	1.87	0.69	5.08	52	21

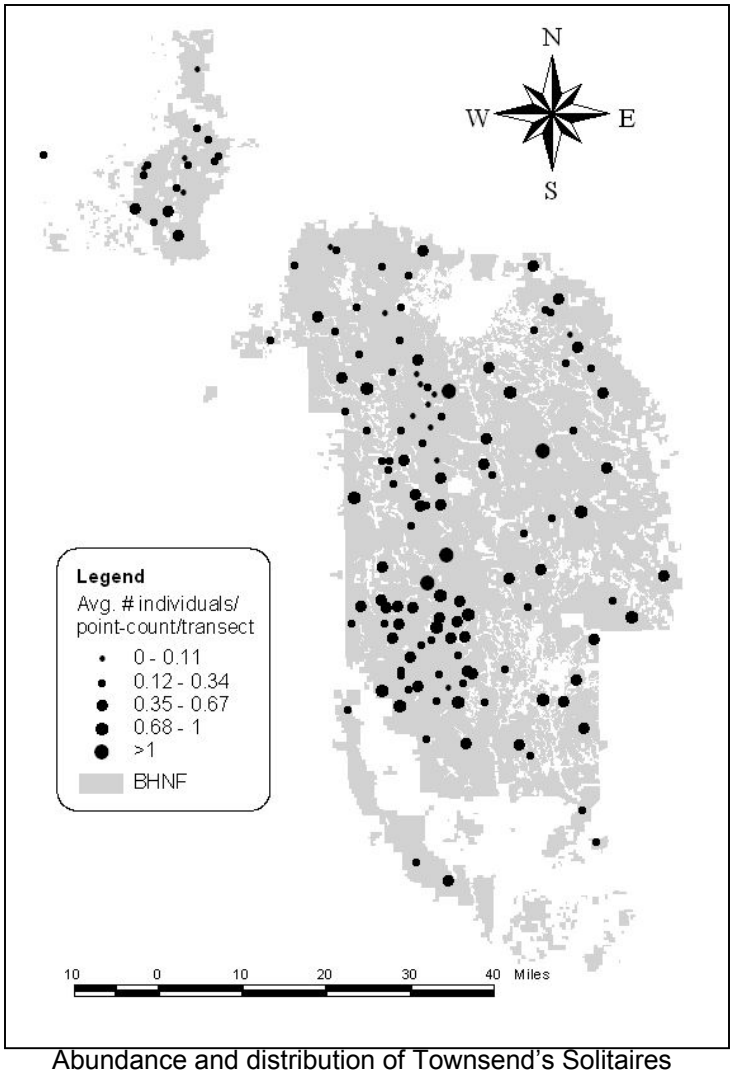
D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data



Relative density of Mountain Bluebirds among habitats in the Black Hills, 2003.

Townsend's Solitaire
(WY-PIF Level II Priority)

Townsend's Solitaire occurs throughout the Black Hills in low to moderate abundance. Density appears to be greatest in pine-south, pine-north, and in burn areas. This species should be effectively monitored under *MBBH* through point-transects in range of habitats.

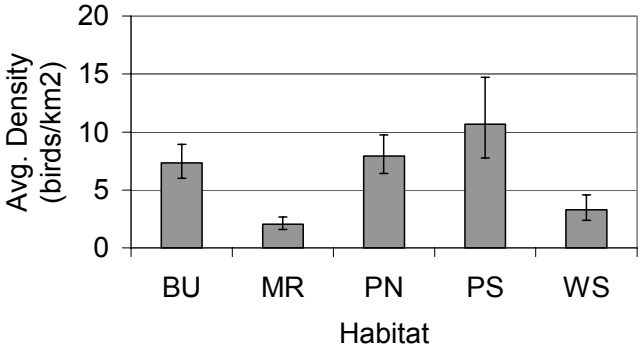


Abundance and distribution of Townsend's Solitaires observed on point transects in the Black Hills, 2003.

Habitat-specific density estimates for Townsend's Solitaire in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV(%)	N
BU	**7.33**	6.01	8.93	10	202
MR	**2.06**	1.59	2.68	13	64
PN	**7.92**	6.42	9.76	11	218
PS	**10.68**	7.76	14.70	16	204
WS	**3.29**	2.37	4.56	17	83

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data

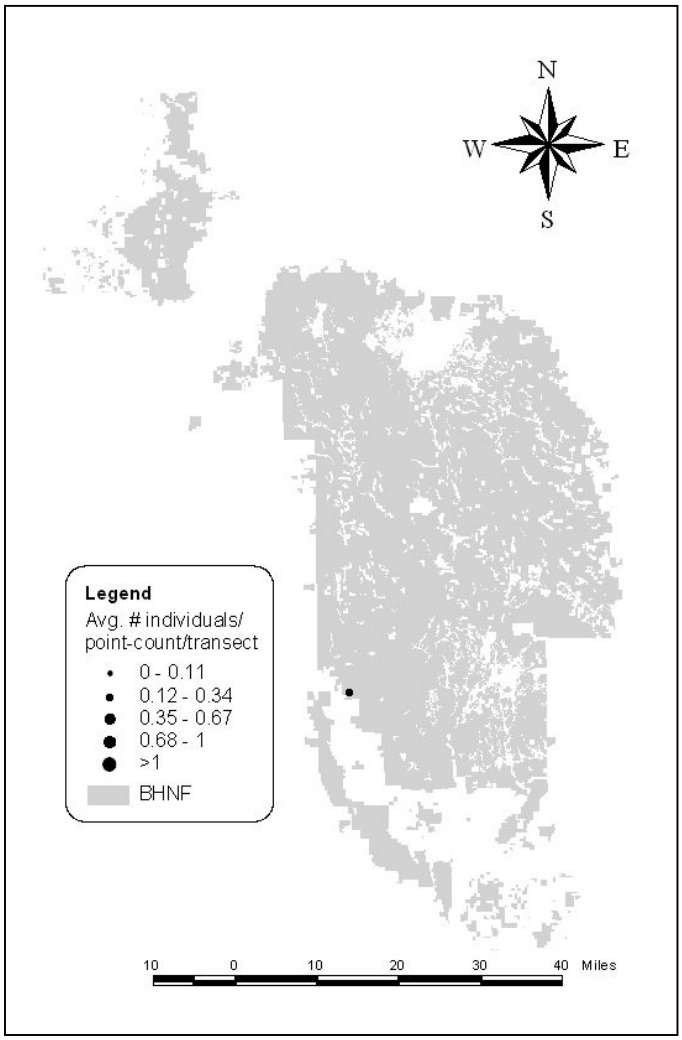


Relative density of Townsend's Solitaires among habitats in the Black Hills, 2003.

Virginia's Warbler
(PIF Continental Watch List)

Virginia's Warbler reaches the most northeasterly extent of its global breeding range in the Black Hills, where it is restricted to pine-juniper shrubland habitats in the southwest. In 2003, two individuals were recorded on counts along a pine-south transect, however the area around the count stations where these birds were recorded included pine-juniper shrubland habitat.

Virginia's Warblers were only recently discovered breeding in the Black Hills, and the full extent of the local population size and breeding range is still not fully known. Virginia's Warblers have only been recorded from a portion of the available habitat in the Black Hills, and it is not yet known whether their distribution closely matches that of the pine-juniper shrubland. Virginia's Warbler will not be adequately monitored in any of the habitats surveyed in 2003, but given continued effort in pine-juniper shrublands, it should be adequately monitored through point transects in that habitat.



Abundance and distribution of Virginia's Warblers observed on point transects in the Black Hills, 2003.

Observations of Virginia's Warbler in the Black Hills, 2003.

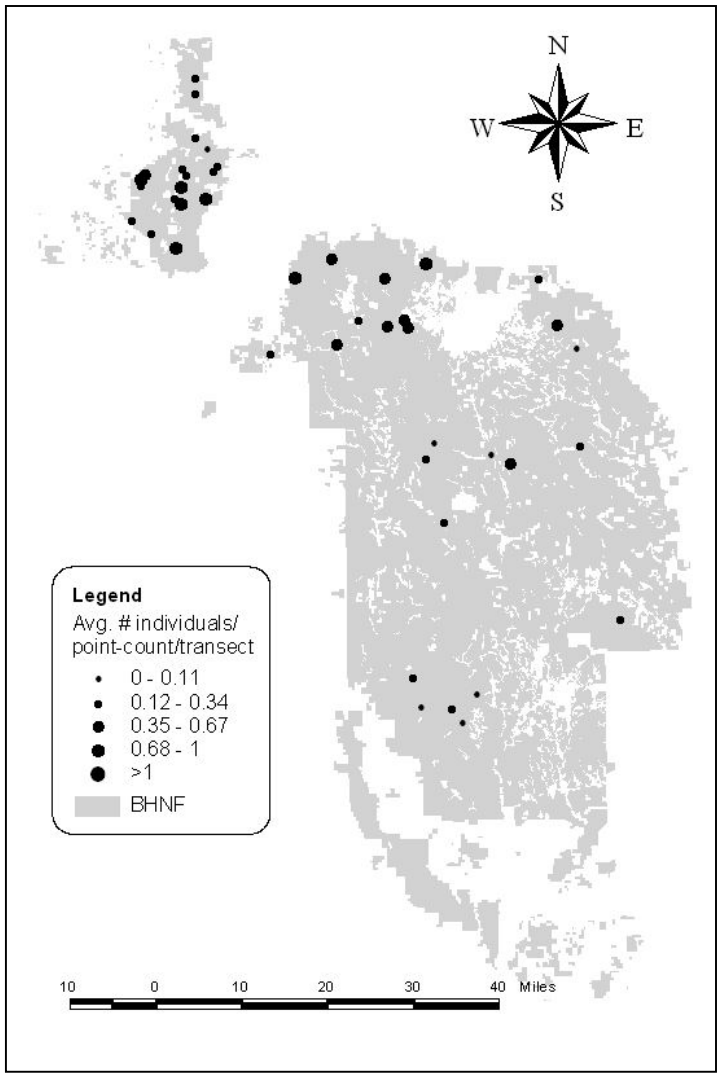
Habitat	D	LCL	UCL	CV(%)	N
PS	ID	--	--	--	2

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data

MacGillivray's Warbler
(WY-PIF Level II Priority)

MacGillivray's Warblers range throughout much of the Black Hills, but they occur very locally outside of the northern hills. They are most abundant in the northwestern Black Hills and Bear Lodge Mountains.

MacGillivray's Warblers are found primarily in montane riparian habitats, where they can occur in moderately high density. However, they also occupy clearings with extensive broad-leaved shrubby vegetation within both coniferous and broad-leaved (e.g., aspen) forests. MacGillivray's Warblers should be effectively monitored under *MBBH* through point-transects in a range of habitats, especially montane riparian.

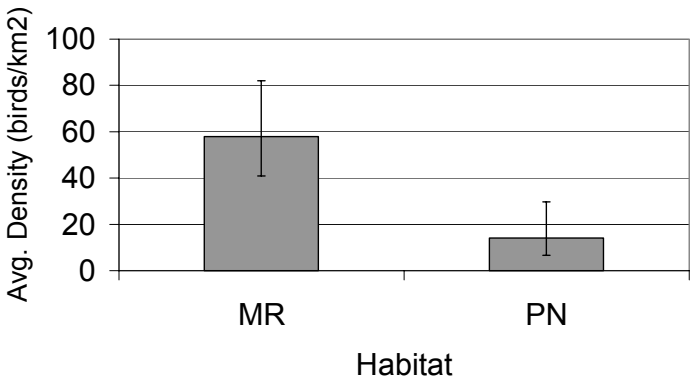


Abundance and distribution of MacGillivray's Warblers observed on point transects in the Black Hills, 2003.

Habitat-specific density estimates for Macgillivray's Warbler in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV(%)	N
BU	ID	--	--	--	4
MR	57.91	40.87	82.04	18	145
PN	14.03	6.64	29.65	39	38
PS	ID	--	--	--	3
WS	ID	--	--	--	11

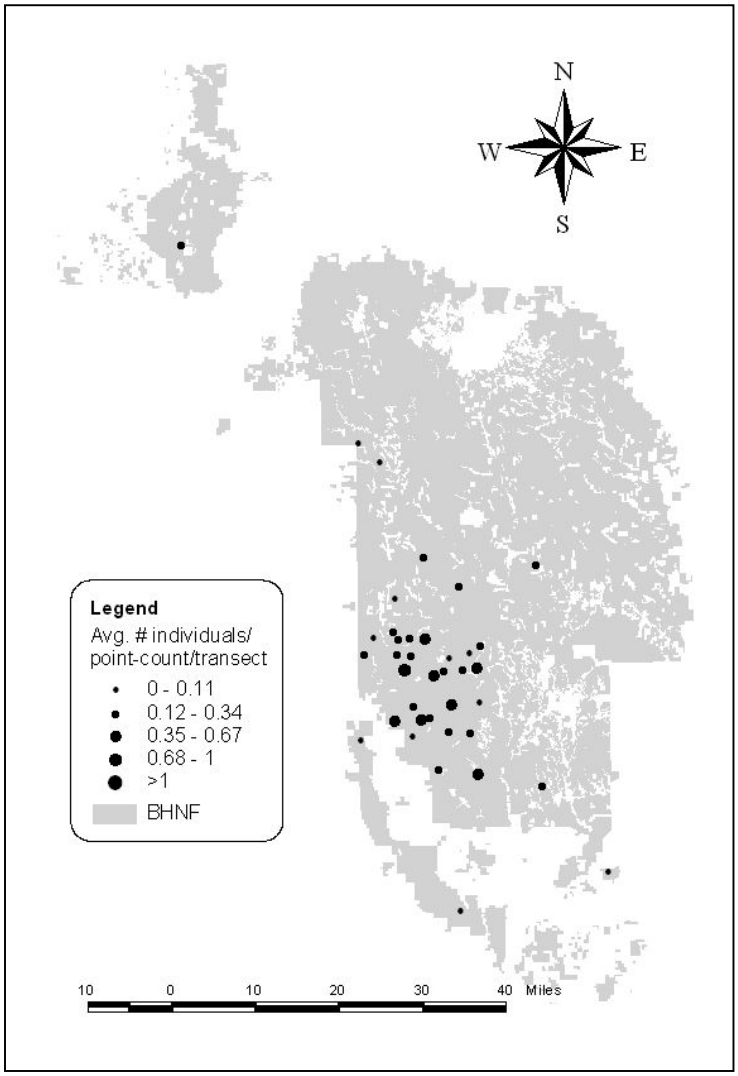
D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data



Relative density of MacGillivray's Warblers among habitats in the Black Hills, 2003.

Vesper Sparrow
(WY-PIF Level II Priority)

Vesper Sparrow occurs widely in the Black Hills, primarily in grassy, open habitats, especially in the southwest and in the large open prairies of the central Hills. Of the habitats surveyed in 2003, estimated density was greatest in burn areas. Although Vesper Sparrows do occur in greater density in grasslands within the Black Hills (Panjabi 2003a), the relatively high density in burn areas of this and other grasslands species, such as Western Meadowlark, suggests that wild fires play an important ecological role in creating and maintaining grasslands within the Black Hills. Lower densities of Vesper Sparrows species are found in most other habitats that contain grassy openings. Vesper Sparrows should be effectively monitored under *MBBH* through point-transects in burn areas and grasslands.

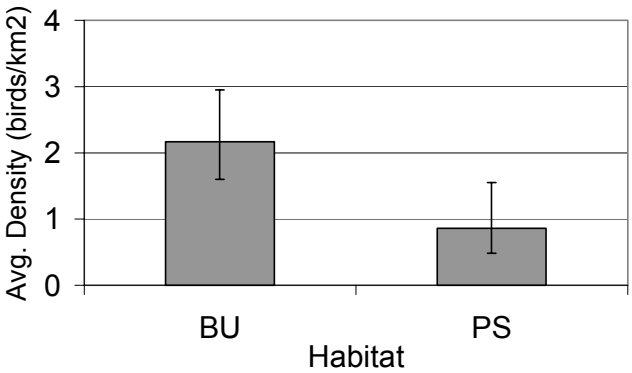


Abundance and distribution of Vesper Sparrows observed on point transects in the Black Hills, 2003.

Habitat-specific density estimates for Vesper Sparrow in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV(%)	N
BU	2.17	1.59	2.95	16	88
MR	ID	--	--	--	2
PN	ID	--	--	--	1
PS	0.86	0.48	1.55	30	23
WS	ID	--	--	--	4

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data



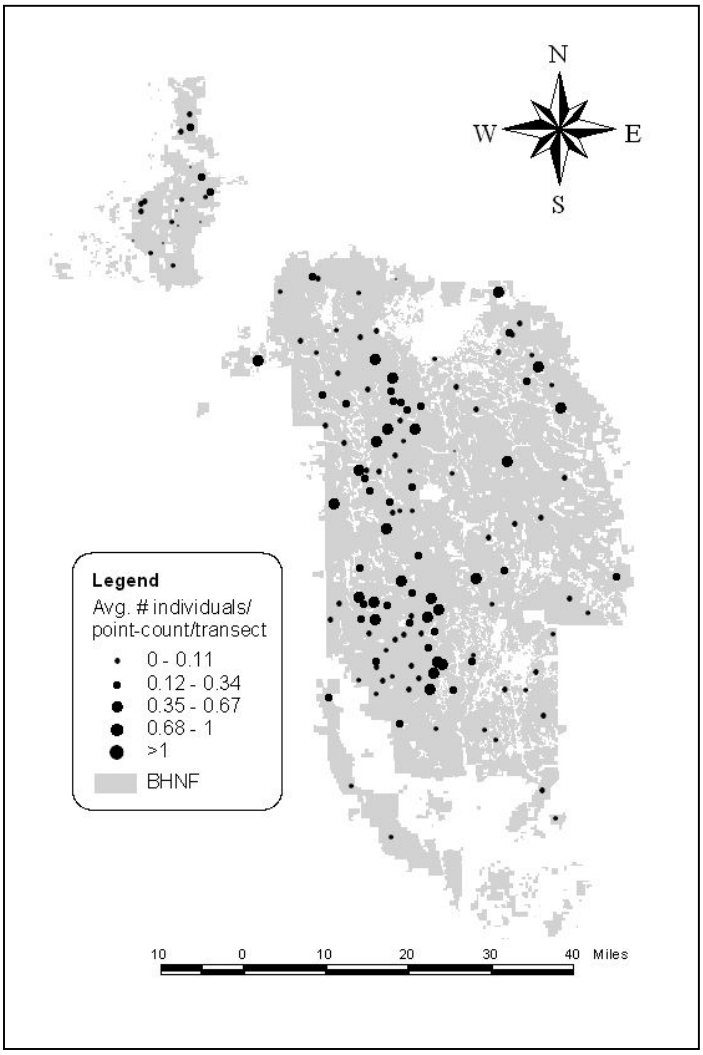
Relative density of Vesper Sparrows among habitats in the Black Hills, 2003.

Dark-eyed Junco

The "white-winged" subspecies of the Dark-eyed Junco, known as the White-winged Junco, occurs widely in the Black Hills, where it is generally fairly common to abundant. Although not currently recognized as a priority for management or conservation, this subspecies is endemic to the Black Hills region, from northwest Nebraska to southeast Montana. Thus, the Black Hills comprise the epicenter of this subspecies' global population. Because of its highly adaptable nature and current land-use practices within its coniferous forest habitat, the white-winged subspecies of the Dark-eyed Junco is largely secure across its range.

The estimated densities of Dark-eyed Juncos increased significantly in the Jasper burn area and pine-south habitat from 2002 to 2003. However, the estimated density in the Jasper burn area surpassed that in all other habitats surveyed, suggesting that burn areas can provide optimal habitat for the species in the Black Hills.

Dark-eyed Juncos should be effectively monitored under MBBH in a range of habitat types.

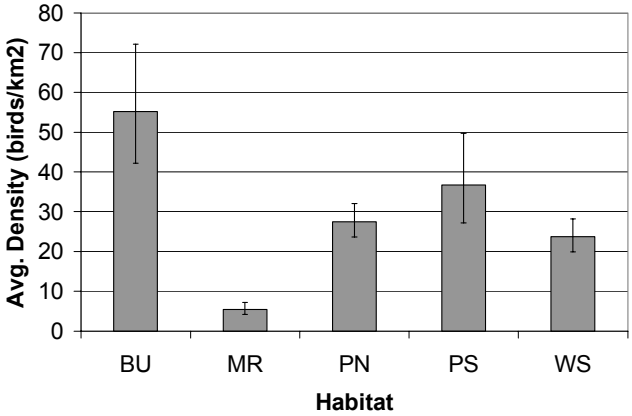


Abundance and distribution of Dark-eyed Juncos observed on point transects in the Black Hills, 2003.

Habitat-specific density estimates for Dark-eyed Junco in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV(%)	N
BU	55.16	42.19	72.13	14	296
MR	5.47	4.15	7.21	14	82
PN	27.50	23.61	32.03	08	319
PS	36.74	27.16	49.70	15	241
WS	23.68	19.87	28.21	09	275

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data

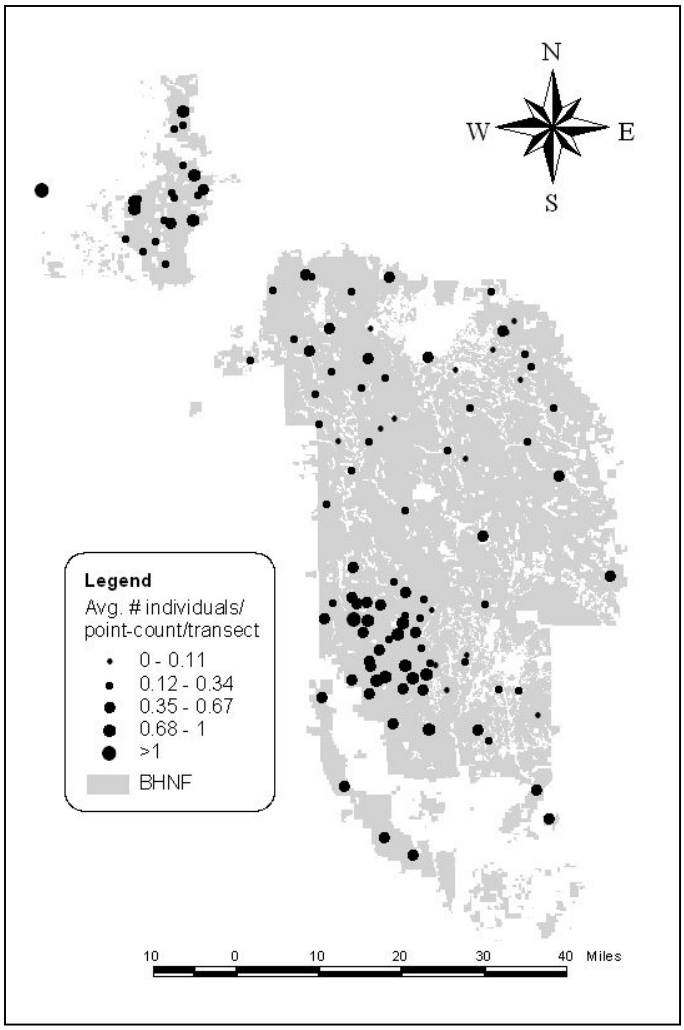


Relative density of Dark-eyed Juncos among habitats in the Black Hills, 2003.

Brown-headed Cowbird

Brown-headed Cowbirds occur throughout the Black Hills, but they are especially abundant in the Jasper Burn. Of the habitats surveyed in 2003, density of Brown-headed Cowbirds was greatest in burn areas. Interestingly, Brown-headed Cowbird density was lowest in white spruce, suggesting that birds in this habitat probably are subject to less pressure from nest parasitism and therefore may experience greater reproductive success.

Although Brown-headed Cowbirds are not a species with any special conservation status or other management designation, they are an important species to monitor as they directly impact populations of other passerine birds through brood parasitism. In 1965, Pettingill and Whitney described this species as a "rare summer resident at lower elevations." Since then it appears that Brown-headed Cowbirds have increased substantially in the Black Hills as they are no longer rare in most habitats. Brown-headed Cowbirds should be effectively monitored under *MBBH* through point transects in a wide range of habitats.

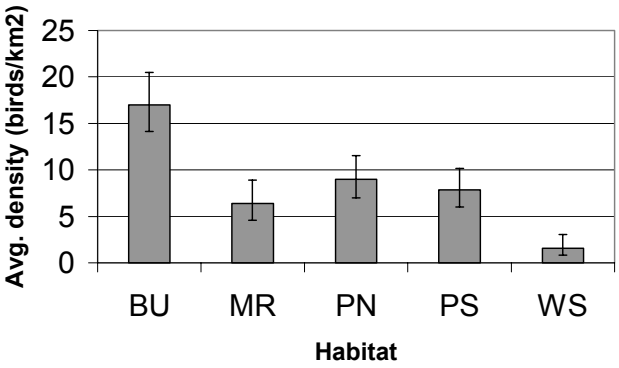


Abundance and distribution of Brown-headed Cowbirds observed on point transects in the Black Hills, 2003.

Habitat-specific density estimates for Brown-headed Cowbird in the Black Hills, 2003.

Habitat	D	LCL	UCL	CV(%)	N
BU	17.00	14.11	20.49	0.10	228
MR	6.40	4.60	8.91	0.17	93
PN	8.97	6.97	11.53	0.13	127
PS	7.83	6.02	10.18	0.13	120
WS	1.58	0.81	3.08	0.35	19

D=Density in birds/km2; LCL=lower 95% confidence limit on D; UCL=upper 95% confidence limit on D; coefficient of variation on D; N=number of observations; ID=insufficient data



Discussion and Recommendations

Use of burn areas by woodpeckers

Three years after the Jasper Fire burned almost 85,000 acres in the southern Black Hills, 63 bird species were recorded using the resultant burn area during the 2003 breeding season, six species less than were found in surrounding ponderosa pine forests. However, 14 of these species occurred in significantly higher densities in the burn area relative to the pine forest or any other habitat. While two of these, Western Meadowlark and Vesper Sparrow, probably are more abundant in grasslands not surveyed this year, the demonstrated use and preference of this post-fire environment by such a large and diverse group of birds suggests that many bird species in this region are adapted to, and benefit from, the ecological conditions created by stand-replacement fires.

Most notable in this group of birds are several species of woodpeckers. Red-headed Woodpecker, Black-backed Woodpecker, Hairy Woodpecker, and Northern Flicker all have shown significant positive population responses in the burned areas. Lewis's Woodpecker also appears to be increasing in the burn, and although there were too few observations of the species to rigorously interpret this change, this increase is probably real given that the species is so rare anywhere else in the Black Hills. Burn areas have been found to be population source habitats for Lewis's Woodpeckers (Saab and Vierling 2001), and the preferential use of burn areas by Lewis's Woodpeckers has been documented (Block and Brennan 1987, Linder and Anderson 1998). Also, Lewis's Woodpecker has been recorded nesting in the McVey burn in the Black Hills (South Dakota Ornithologists' Union 1991). Thus the Jasper and other recent fires have played a critical role in increasing available habitat for these woodpecker species, three of which, Red-headed, Black-backed, and Lewis's, are of high management and conservation concern, both regionally and nationally. This increase in available habitat has likely helped boost what were previously reduced populations in the Black Hills, and thus lessened the risk of local extirpation of these species. For these woodpeckers, stand-replacement fires, and perhaps other types of fires, may be essential for maintaining populations in the Black Hills over the long term.

The presence of bark beetles and wood-boring insects after stand-replacement fires provides a unique, short-term foraging niche for Black-backed Woodpeckers (Goggans et al. 1989, Murphy and Lehnhausen 1998, Powell 2000). Caton (1996) found that Black-backed Woodpeckers in western Montana occupy burns for one to six years following a fire, with peak densities occurring at three and four years. This peak corresponds to the timeframe that bark beetles and woodborers are also present in highest densities in burns (DeNitto et al. 2000).

Populations of most woodpeckers in the Jasper burn remained relatively stable between 2002 and 2003, but the estimated density of Black-backed Woodpeckers fell by almost 50%. Although this change was not statistically significant, it suggests that the Black-backed Woodpecker population in the Jasper burn peaked in 2002, two years after the fire, and now may be declining. It is possible that some Black-backed Woodpeckers have moved from the Jasper burn into other more recently created burn areas. However, given that the Jasper burn did not appear to be saturated with Black-backed Woodpeckers (peak density was approximately 7 birds/km^2 in 2002) and still should have been increasing in quality from a food availability perspective, it is not clear why such a movement would have occurred. Presumably, the more recent burns do not provide equally suitable habitat as the three year old Jasper burn, if all else is equal. However, it seems logical that the Jasper burn has decreased in terms of its suitability for nesting and foraging by Black-back Woodpeckers. Subsequent monitoring in the Jasper burn in 2004 should determine whether the Black-backed Woodpecker population has already peaked in this burn.

It is interesting to note that the density of Black-backed Woodpeckers in Jewel Cave National Monument, which is part of the Jasper burn area, was more than four times the average than that in the burn area as a whole in 2003 (Panjabi 2003c). Pre-burn stand conditions in Jewel Cave were on average more reflective of mature forest than BHNF lands in the Jasper burn (Panjabi, unpublished data), and no post-fire salvage logging occurred in Jewel Cave. Black-backed Woodpeckers are known to prefer post-fire stands with high snag density and large-diameter snags for nesting (Vierling and Saab 2002), and salvage logging has been shown to reduce the suitability of burn sites for Black-backed Woodpeckers (USDA 1995, USDA 1999). Whether or not salvage logging affected Black-backed Woodpecker abundance in the Jasper burn could be answered empirically using the existing RMBO bird monitoring data and BHNF silvicultural data to examine spatial patterns of Black-backed Woodpecker abundance in relation to salvage logged areas.

Contrary to those species that have benefited from the Jasper Fire, Red-naped Sapsuckers, Downy Woodpeckers, and American Three-toed Woodpeckers have not shown any significant positive response in the burn area, and they continue to remain more abundant in other habitats. American Three-toed Woodpeckers, which are known to exploit burns in other parts of their range (Bock et al. 1978, Taylor and Barmore 1980, Caton 1996, Hoffman 1997), have not been recorded in the Jasper burn area (a single observation reported in 2001 was later believed to be a black-backed), despite that local populations exist within 20 miles of the burn. Thus, it appears that Three-toed Woodpeckers inhabit white spruce forests exclusively in the Black Hills, and do not use ponderosa pine forests, burned or unburned, as we have yet to detect them away from white spruce stands since the start of MBBH. These findings are in contrast to Mohren and Anderson (2001) who reported Three-toed Woodpeckers from aspen and ponderosa pine stands in the Black Hills. Other authors also report a strong association between

Three-toed Woodpeckers and mature and old-growth spruce stands (Bock and Bock 1974, Imbeau et al. 1999), and areas with significant amount of rotten downed wood (Hoffman 1997). Leonard (2001) states that Three-toed Woodpeckers use spruce habitats and eat primarily bark beetles (Scolytidae), whereas black-backs use a wider variety of conifers and eat Cerambycidae beetles that reside deeper in the tree. Thus differences in foraging behavior between black-backs and three-toeds could explain why three-toeds do not exploit burns in ponderosa pine forest. It is reasonable to assume however, that American Three-toed Woodpeckers probably would exploit burns in the Black Hills if the burns occurred in spruce stands.

Because Three-toed Woodpeckers are essentially limited to white spruce habitats in the Black Hills, they may not be as vulnerable as some species to large-scale activities such as logging and fire suppression, which occur mainly in ponderosa pine forests. Because most spruce stands are not managed for timber, they tend to have more large-diameter trees, more dead and dying trees, and more abundant downfall. These conditions provide favorable habitat for three-toeds and other woodpeckers. This is reflected by the densities of Three-toed and Hairy Woodpeckers, and Northern Flickers in spruce stands which are higher than in other forest types (excepting burn areas). Thus, spruce stands may serve as de facto management areas for these woodpeckers. Such areas have been suggested as a means for sustaining populations of woodpeckers in otherwise intensively managed forests (Goggans et al. 1989). However, such areas located only in spruce habitats would not meet the needs of Black-backed, Red-headed, or Lewis's Woodpeckers.

Monitoring post-fire bird communities

Monitoring birds in the Jasper burn area has provided an interesting case study and for the first time has provided quantitative insight into the population dynamics of an entire bird community in a post-fire ponderosa pine forest in the Black Hills. Through this effort, we are learning which bird species respond positively or negatively to stand-replacement fires, in what densities post-fire specialists and non-specialists occupy burns, and how long burned areas provide suitable habitat for post-fire birds, particularly those of high management or conservation interest. While it will prove useful to continue monitoring birds in the Jasper burn for at least several more years, eventually this area will no longer provide the conditions needed by those species we aim to monitor in this habitat, particularly Black-backed and Lewis's Woodpeckers. Therefore, as populations of these target species shift with the availability of suitable habitat, so must the sampling effort. Thus, it will eventually be necessary to broaden the scope of the sampling scheme to include all areas of potential habitat, so that population trends are not biased toward any individual burn. For Black-backed and Red-headed Woodpeckers, this will probably mean monitoring burns during the first few years post-fire, whereas for Lewis's Woodpeckers it may mean monitoring somewhat older burns. The optimal time frame for sampling burns in order to

best target Black-backed and Lewis's Woodpeckers will probably best be determined after several more years of monitoring in the Jasper burn.

Over the long term, monitoring post-fire bird communities will require maintaining a floating sampling scheme that in essence targets a shifting habitat type across the Black Hills, as individual burns are suitable for certain species for only short periods of time. In doing so, it will probably be necessary to sample more than 30 sites in this habitat, or to split the burn areas category into two distinct habitat types, early-successional burn areas (1-6 years post fire) and mid-successional burn areas (4-10 years post fire), as the two target species in this habitat occupy these two different post-fire stages. Although this will require an increase in effort and cost, it still will provide the most cost-effective means for monitoring these species in the Black Hills.

Prospects for population monitoring

The habitat-stratified point transects produced excellent results with low coefficients of variation (≤ 50%) in at least one habitat on 52 bird species, and moderate results (CV of 51-100%) on two additional species. Thus we should be able to detect habitat-specific population trends for these species within our maximum target of 30 years. We obtained sufficient data on an additional 4 species to monitor their populations across habitat types. Together, these 58 species represent about 55% of *all species* observed in the five habitats surveyed this year. However these 58 species make up almost 99% of all *individual birds* we observed. The other 45% of species (~1% of birds observed) fall into one of the following categories below:

1) low-density, highly localized species (e.g., Golden Eagle)
2) low-density, widespread species (e.g., Northern Goshawk)
3) irregular species (e.g., Bobolink);
4) vagrant breeders (e.g., Northern Parula)
5) species that occur mainly outside the Black Hills in the low foothills or on the Great Plains (e.g., Brown Thrasher);
6) nocturnal species (e.g., Northern Saw-whet Owl);
7) wetland-obligate species (e.g., Sora); and
8) species that are readily detectable only prior to late May (e.g., Ruffed Grouse).

Species in the aforementioned groups could be monitored through additional effort using one or more of the following survey techniques:

1) additional point transects in existing habitats;
2) censusing small but localized populations;
3) censusing birds at nesting sites (e.g., colonies, eyries, etc);
4) species-specific call-response surveys;
5) nocturnal surveys;

6) wetland surveys; and
7) early-season (i.e., winter/spring) surveys.

Perhaps the most effective way to monitor the health of bird populations, especially small ones, is to monitor reproductive output at nests. While this method can be more labor intensive than count-based monitoring, depending on the species in question and the detail of information needed, monitoring reproductive output does not necessarily imply high costs.

For species with small populations, such as Golden Eagles and Prairie Falcons, monitoring could be achieved by locating all active nests and visiting each during the spring and summer as necessary to evaluate the outcome of each. Known nests would first be identified by consulting with local biologists, birders, and other experts, and then as part of the field effort, additional suitable habitat could be searched to locate previously unrecorded nests. Ultimately, the majority of active nests would be included in the monitoring scheme. Because relatively few nests exist for these species, this type of monitoring would probably require the equivalent effort of what is required for habitat-based monitoring (i.e., one additional person in the field during the spring and early summer).

For some low-density but widespread species, such as Northern Goshawk, a brief call-response survey could be conducted at the end of each point count to detect the presence of this or other similar species across the areas already covered by the habitat-stratified point transects. A high-powered, yet highly portable playback system would be required for each observer, but other than this expense, relatively few additional expenses would be incurred.

Because of the already extensive point transect effort undertaken each year, implementing additional field techniques to target other high-priority species can be done cost-effectively. Rocky Mountain Bird Observatory is open to discussing these options with the Black Hills National Forest in the future.

Acknowledgements

This project was funded by the U.S. Forest Service, through a cooperative agreement with Black Hills National Forest and Rocky Mountain Bird Observatory. Support for transects on National Park Service lands was provided by the National Park Service.

I thank Steve Hirtzel and Cara Staab, of the U.S. Forest Service, for their continued support for and involvement in the program as well as for logistical assistance provided during the field season. I also thank Dan Licht, of the National Park Service, for his continued support and for his interest to integrate National Park Service lands into the program. I am grateful to Bob Paulsen and Mark Keffeler, of the Nature Conservancy, for the generous use of their

comfortable facilities at the Whitney Preserve for the training session and throughout the field season. I am especially grateful to the 2003 field crew, Nicholas Block, Cameron Cox, Michael Freiberg, Michael Retter, and Jason Starfire, who spent many weeks in the field, sometimes under difficult conditions, conducting field surveys and seeking out birds. I sincerely appreciate the generosity of Michael Retter for providing the cover illustration for this report. Finally, I thank Scott Gillihan, Steve Hirtzel, Tony Leukering and Rich Levad for their helpful comments that substantially improved this report.

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