METHODS

Study Area

RMBO conducts monitoring in all or parts of four BCRs: BCR 10 – Northern Rockies, BCR 16 – Southern Rockies/Colorado Plateau, BCR 17 – Badlands and Prairies, and BCR 18 – Shortgrass Prairie (Figure 1). These BCRs cover a broad array of habitats and elevation gradients and have a correspondingly diverse suite of priority birds. The MBCNF project lies entirely within BCR 16.

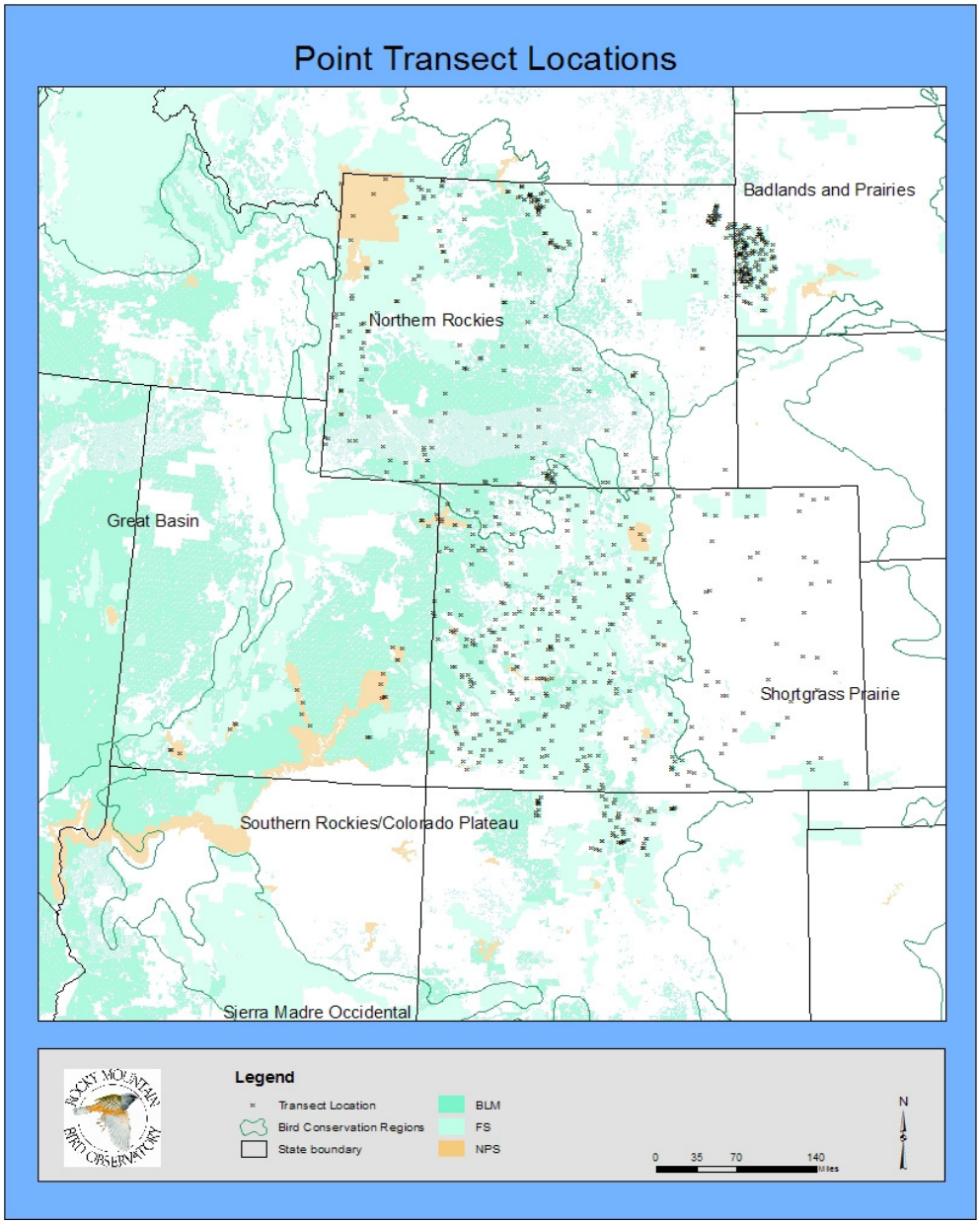

Figure 1. RMBO point-transect locations within state boundaries, BCR boundaries and land ownership.

Below is a breakdown of the habitats we surveyed in 2005 in the Carson National Forest. For more detailed descriptions of these habitats or habitats within other monitoring programs, please visit our website at www.rmbo.org where reports from other projects are available for download.

The Habitats

In May 2003, RMBO in coordination with biologists from the U.S.D.A. Forest Service selected 9 habitats (alpine tundra, aspen, grassland, mixed conifer, mid-elevation riparian, pinyon-juniper, ponderosa pine, sage shrubland, and spruce-fir) in which to place 60 point-count transects. These habitats were selected by USFS biologists on the basis of distinct avifaunal communities, as well as management questions associated with each on the CNF, with an emphasis placed on the massive pinyon pine die-off occurring from the severe drought conditions. Therefore, almost half of the transects were assigned to pinyon-juniper with the remaining transects evenly distributed between the other habitats. However, due to small and irregular patches of the other habitats besides ponderosa pine, only a few transects were able to be established in these habitats. In 2004, several new transects were established and many of the 2003 transects were relocated to more representative habitat. In 2005, additional changes were made to the existing transects.

Aspen

Aspen consists of forested stands dominated by quaking aspen (*Populus tremuloides)* and, typically, some conifers are present as aspen is seldom a climax vegetation type. In 2005, the most frequently recorded tree species, besides quaking aspen, were Douglas fir (*Pseudotsuga menziesii*), white fir (*Abies concolor*), and subalpine fir (*Abies lasiocarpa*). As a result of the presence of these tree species, there are often many detections of species generally associated with conifers on aspen transects. Aspen stands also have varying amounts of understory. The most commonly encountered plants in the understory, in addition to aspen and white fir saplings, were common juniper (*Juniperus communis*), big sagebrush (*Artemisia tridentata*), snowberry (*Symphoricarpos* sp.), and maple (*Acer* sp.).

Grassland

This habitat is composed of high-elevation open areas where various grass species dominate. In the CNF, grassland habitat is often above 10,000 feet elevation and not considered true “prairie”. Some shrubs are present and this season we recorded two species: big sagebrush and river birch (*Betula sp.*).

Mixed Conifer

This habitat designation describes mid-elevation, conifer-dominated stands made up of a diversity of tree species. In 2005 the most commonly recorded species were Douglas-fir, ponderosa pine (*Pinus ponderosa*), and aspen. Mixed conifer stands are found at elevations between those in which ponderosa pine and spruce-fir stands occur. The most frequently encountered shrubs in mixed

conifer in 2005 were narrowleaf cottonwood saplings (*Populus angustifolia*), river birch (*Betula* sp.), and willow (*Salix sp.*).

Pinyon-Juniper

Arid forested areas dominated by pinyon pine (*Pinus edulis*) and juniper (*Juniperus* sp.) compose this habitat. This year we recorded dead pinyon trees in a separate category to help determine the impact of the drought. Overall, living pinyon pines were still the most commonly recorded tree, followed by juniper, and then dead pinyon. The most common shrubs in pinyon-juniper habitat were big sagebrush, juniper saplings, and Gambel's oak (*Querces Gambel'sii*).

Ponderosa Pine

This habitat is composed of arid conifer stands dominated by ponderosa pine which are lower in elevation than mixed conifer stands. In 2005, besides ponderosa pine the most common tree species were Douglas fir and juniper. The most frequently recorded plants in the understory in 2005 were Gambel's oak, and ponderosa pine and juniper saplings.

Sage Shrubland

Open landscapes dominated by big sagebrush make up this habitat. The stands of sage that we survey in the CNF are generally narrow "fingers" of pure sage and point-count stations are often near forests. The most common shrub-sized plants in 2005, besides big sagebrush, were pinyon pine saplings and dead pinyon pine.

Spruce-Fir

This habitat is composed of high-elevation coniferous trees, such as Englemann spruce (*Picea engelmanii*), blue spruce (*Picea pungens*), and Douglas fir. In 2005, the three most common tree species recorded in this habitat were Englemann spruce, aspen, and Douglas fir, respectively. The three most frequently recorded plants in the understory were Englemann spruce, aspen, and juniper saplings.

Field Personnel

Six experienced biological technicians with excellent aural and visual bird-identification skills comprised the RMBO staff who executed the field component of MBCNF in 2005. All technicians had at least two years of experience conducting bird monitoring for RMBO, bringing with them considerable experience with the protocol and knowledge of the local birds. Each technician also completed a four-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 initially selected in 2003. In 2004, the alpine-tundra transects established the previous year were renamed as grassland as the transect location was more representative of that habitat. Similarly, one of the aspen transects was renamed as mixed conifer, and two sage shrubland transects were renamed as pinyon-juniper. Also in 2004, we established several new transects: four in grassland, three in pinyon-juniper, two in ponderosa pine, two in sage shrubland, two in alpine tundra, one in aspen, one in spruce-fir and one in mixed conifer habitat. In 2005 we made a few additional changes to the existing transects. We dropped the montane riparian habitats since we detected no birds of special interest that weren't already being detected in sufficient numbers in one or more of the other habitats. Also, one aspen transect conducted in 2003 and 2004 was renamed as mixed conifer. Finally, we established three new ponderosa pine transects and one new mixed conifer transect.

Point Transect Protocol

RMBO staff conducted point transects (Buckland et al. 1993) 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 (2005). RMBO technicians 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 compass bearing from the access point (0-400 m and 0-360 degrees, respectively) 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 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 count station 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 transect, recording all detections of birds and red squirrels (*Tamiasciurus hudsonicus*) 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 nearby 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 other rare or uncommon species) 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. Individual birds initially detected on points that were again detected while moving between points were not included in the line-transect data. However, individuals detected between points, but then again during the subsequent point count, were removed from the line-transect data, and included only on the point count.

In 2004, we incorporated a change in the bird-data collection protocol relative to previous years in that we treat all non-independent detections of individual birds as part of a 'cluster' together with the first independently observed bird, rather than as separate independent observations of those individuals. This means that if the detection of an individual bird is dependent upon the previous detection of another individual, the resulting observation is recorded as one independent detection with a cluster size of *C*, where *C* is the original individual detected plus the sum of any additional individuals whose detection was dependent upon the first individual revealing its presence. For example, a bird sings, and is thus detected independently. The observer then looks over to that bird, and as a result, detects a second individual. The resulting observation is recorded as one detection of a cluster of two birds. This practice ensures that we adhere more strictly to the assumption inherent in random sampling that all observations are independent of each other.

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™ or other similar 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, and vegetation data, including the structural stage and canopy closure of the forest, mean canopy height, the types and relative proportions of overstory trees, the sub-canopy volume and tree species composition, and the % coverage and types of shrubs within a 50-m radius of the point. Observers recorded these data prior to beginning each bird count.

Data Analysis

We 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 MBCNF: 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.

Density estimates were generated only for species for which there was a minimum of 25 independently detected observations as recorded from count stations in a given habitat (not including fly-overs or between-point observations, and prior to truncation or removal of outliers). Because we considered only independent detections in our analyses of density, the number of *observations* (n) reported for each species may be lower than the number of *individuals* (N) observed. This is especially true for species that tend to associate in groups (e.g., swifts, swallows, crossbills, etc.). Both numbers are useful, especially for low-density species, and thus both are reported in the "Species Accounts" section for species with at least 25 detections. Note however, that in the habitat accounts in the "Results" section, the number of observations reported (n) reflects only the number of independent detections *used to estimate density* (i.e., after any truncation or removal of outliers), and may be less than the total number of independent detections or the total number of individuals observed.

RESULTS

RMBO staff conducted a total of 830 point counts along 56 point transects in seven habitats (Figure 1) between 14 May and 11 July 2005 (Table 1).

Table 1. Bird sampling periods and effort in each habitat in the Carson National Forest, summer 2005.

Habitat	Dates sampled	No. of Point Transects	No. of Point Counts
Aspen	19 June – 20 June	2	30
Grassland	13 June – 14 June	2	30
Mixed Conifer	4 June – 7 July	5	75
Pinyon-Juniper	14 May – 10 June	26	385
Ponderosa Pine	7 June – 23 June	12	180
Sage Shrubland	15 May – 24 June	5	71
Spruce-Fir	24 June – 11 July	4	59
All Habitats	**14 May – 11 July**	**56**	**830**

A total of 7,518 birds of 114 species were recorded on point-count transects in 2005. Forty-four breeding species were observed in sufficient numbers to estimate density in at least one habitat. In total, we have documented 137 species since 2003 that have either bred or summered in the Carson National Forest (CNF) (Appendix B). It should be noted that the number of birds in Appendix B includes between point detections of low-density species and flyovers of species that are not believed to be utilizing the habitat in which they

were detected. We recorded these detections while surveying but they are not used for estimating densities.

The total number of species detected on point counts in each habitat in 2005 ranged from 21 in grassland to 86 in pinyon-juniper (Table 2). 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 included in each total 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 2005, average species richness per point was greatest in mixed conifer habitat; however, average species richness per transect was greatest in ponderosa pine (Table 2). Herein, we provided estimates of avian species richness at both the point-level (i.e., sub-sample) and the transect (i.e., site) level. The point-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.

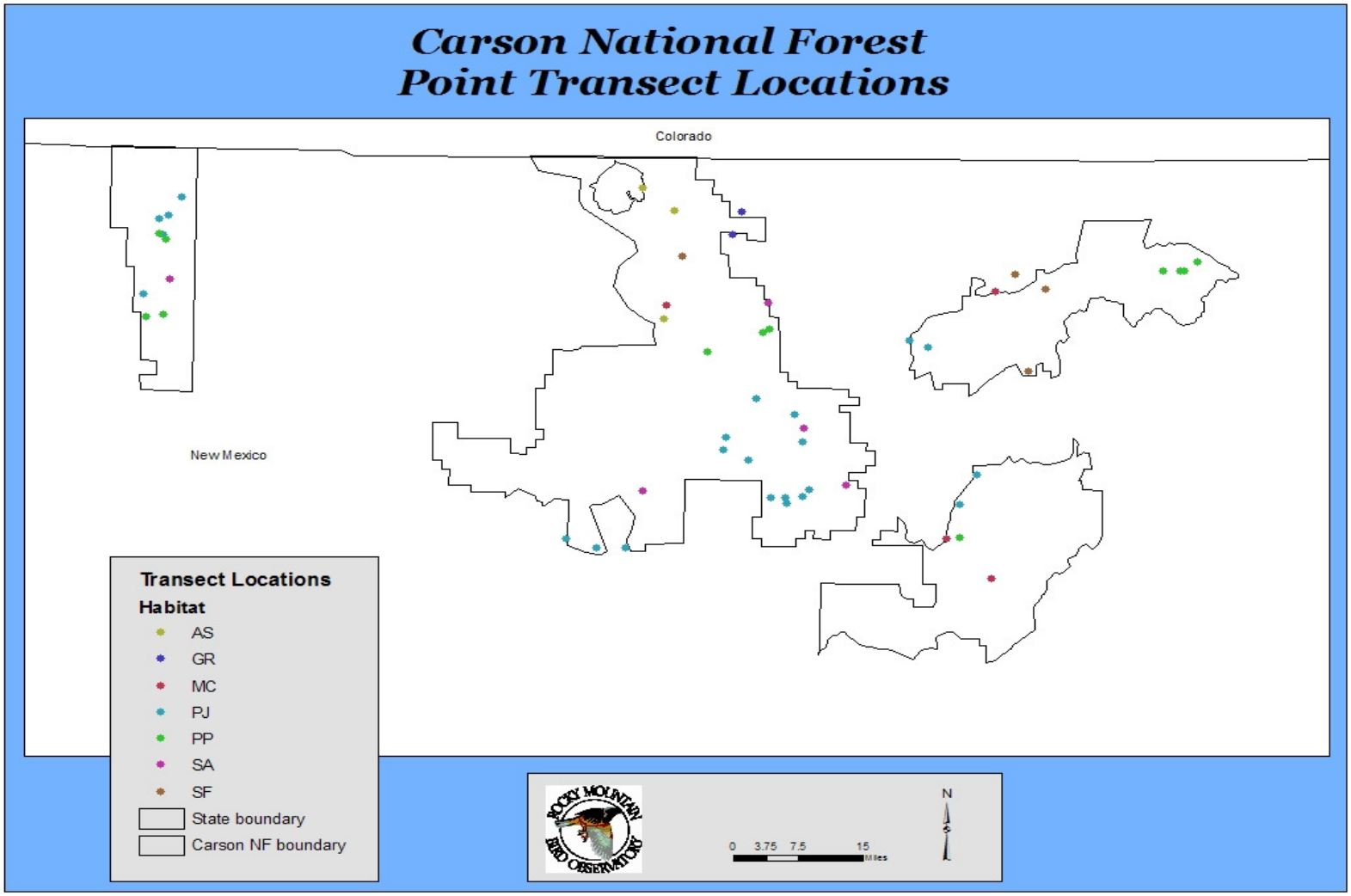

Figure 2. Distribution of habitats targeted for bird monitoring under *Monitoring Birds of the Carson National Forest*.

Table 2. Bird totals and species richness in habitats surveyed in the Carson National Forest, summer 2005.

Habitat	# birds detected	Avg. # birds/point	# species detected	Avg. species richness/point	Avg. species richness/transect
Aspen	285	9.5	40	6.9	28.5
Grassland	145	4.8	21	3.4	14.5
Mixed Conifer	852	11.4	50	8.4	29.4
Pinyon-Juniper	3353	8.7	86	6.7	27.2
Ponderosa Pine	1811	10.1	66	8.0	30.8
Sage Shrubland	480	6.8	54	5.3	24.8
Spruce-Fir	575	9.7	33	6.7	21.0
All habitats	7530	9.1	113	6.9	27.1

Aspen (AS)

This was the 3rd year aspen was surveyed in the CNF. We surveyed 30 point counts along 2 transects in aspen between 19 June and 20 June, 2005 (Table 1). A total of 285 birds were recorded in this habitat, with an average of 9.5 birds per count (Table 2). Observers detected 40 species in total and an average of 6.9 species per point count and 28.5 species per transect (i.e., per site) in aspen.

The point transect data from aspen yielded a robust density estimate for one species – Warbling Vireo (CV<50%) (Table 3). MBCNF should effectively monitor this species, which represents 3% of all species recorded from aspen in 2005. We also detected 33 Dark-eyed Juncos in aspen, but this represented only 22 independent detections which does not meet the minimum threshold of 23, therefore, we are unable to provide a density estimate for this species.

Several species listed as priorities for management concern by NM-PIF were detected on aspen transects (in order by number of individuals detected, highest to lowest): Dark-eyed Junco, Mountain Bluebird, Western Wood-Pewee, Violet-green Swallow, Green-tailed Towhee, Clark's Nutcracker, Red-breasted Nuthatch, Dusky Flycatcher, Broad-tailed Hummingbird, Townsend's Solitaire, Williamson's Sapsucker, Virginia Warbler, Red-naped Sapsucker, Hammond's Flycatcher, Common Nighthawk, and Cordilleran Flycatcher. NM-PIF does not provide a list of priority species specifically for aspen habitat, so these species are those listed in all forested habitats.

Conducting more transects in aspen in the CNF will enable us to provide density estimates for more species. One factor that might influence our ability to do this is the absence of large aspen stands in which to place transects in the CNF. If more financial resources could be dedicated to this effort, then we would be able to establish more aspen transects.

Table 3. Estimated densities of breeding birds in aspen in the Carson National Forest, summer 2005.

Species	D	LCL	UCL	CV	n	N
Warbling Vireo	389.50	129.62	1170.40	31.6%	24	26

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; N = number of individuals detected.

Grassland (GR)

This was the 3rd year that we have surveyed grassland habitat in the CNF. We surveyed 30 point counts along 2 transects in this habitat between 13 June and 14 June 2005 (Table 1). A total of 145 individual birds were recorded, with an average of 4.8 birds per point count (Table 2). Observers detected 21 species in total and, on average, 3.4 species per point count and 14.5 species per transect in this habitat (Table 2).

The point transect data from grassland habitat yielded robust density estimates (CV<50%) for Vesper Sparrow and Western Meadowlark (Table 4). These two species are listed as Representative Species for Plains and Mesa Grassland habitat by the NM-PIF. MBCNF should effectively monitor these two species, which represent 10% of all species recorded from grassland in 2005.

Table 4. Estimated densities of breeding birds in grassland habitat in the Carson National Forest, summer 2005.

Species	D	LCL	UCL	CV	n	N
Vesper Sparrow	14.60	10.04	21.23	18.6%	33	33
Western Meadowlark	10.49	1.93	56.88	25.0%	39	39

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; N = number of individuals detected.

Mixed Conifer (MC)

This was the 3rd year that we have surveyed mixed conifer habitat in the CNF. We conducted 75 point counts along 5 transects in this habitat between 4 June and 7 July 2005 (Table 1). A total of 852 individual birds were recorded, with an average of 11.4 birds per point count (Table 2). Observers detected 50 species in total and, on average, 8.4 species per point count and 29.4 species per transect in this habitat (Table 2).

The point-transect data from mixed conifer habitat yielded sufficient number of detections to estimate density for eleven species. Unfortunately, the observer that collected data in this habitat in 2005 did not record distances correctly so density estimates were not able to be calculated from these data.

Twelve species which are listed as priorities for management concern for mixed conifer Forest by NM-PIF were detected on mixed conifer transects (in order by number of individuals detected, highest to lowest): Dark-eyed Junco, Violet-green

Swallow, Broad-tailed Hummingbird, Cordilleran Flycatcher, Williamson's Sapsucker, Hammond's Flycatcher, Red-naped Sapsucker, Dusky Flycatcher, Townsend's Solitaire, Olive-sided Flycatcher, Clark's Nutcracker, and Blue Grouse.

Pinyon-Juniper (PJ)

This was the 3rd year that we have surveyed pinyon-juniper habitat in the CNF. We conducted 385 counts along 26 transects in pinyon-juniper in the CNF between 14 May and 10 June 2005 (Table 1). A total of 3,353 birds were recorded in this habitat, with an average of 8.7 birds at each count station (Table 2). Observers detected a total of 86 species, and on average, 8.0 species per point count and 27.2 species per site in pinyon-juniper (Table 2).

The point transect data from pinyon-juniper yielded robust density estimates (CV<50%) for 32 species and moderately robust estimates for another two species (CV=50-58%) for which we are able to provide densities (Table 5). MBCNF should effectively monitor these 34 species, which represent 40% of all species recorded from pinyon-juniper in 2005.

Chipping Sparrow, Broad-tailed Hummingbird, Black-throated Gray Warbler, Gray Flycatcher, and Bushtit were the most abundant species in this habitat this year. Thirteen species listed by the NM-PIF as priority for management concern for pinyon-juniper habitat were detected on transects this year (in order by highest number recorded to lowest): Black-throated Gray Warbler, Gray Flycatcher, Ash-throated Flycatcher, Juniper Titmouse, Virginia Warbler, Pinyon Jay, Lark Sparrow, Mountain Bluebird, Cassin's Kingbird, Western Bluebird, Say's Phoebe, Common Nighthawk, and Gray Vireo. We provide a density estimate for Juniper Titmouse which is also a MIS in the CNF, and we recorded one other MIS, Hairy Woodpecker, 21 times in pinyon-juniper habitat.

Table 5. Estimated densities of breeding birds in pinyon-juniper habitat in the Carson National Forest, summer 2005.

Species	D	LCL	UCL	CV	n	N
Mourning Dove	4.69	2.31	9.52	36.0%	41	41
Broad-tailed Hummingbird	117.98	74.88	185.89	23.2%	74	114
Gray Flycatcher	74.16	49.01	112.22	21.0%	257	257
Ash-throated Flycatcher	20.43	13.97	29.87	19.2%	199	206
Plumbeous Vireo	21.51	13.00	35.58	25.6%	148	148
Warbling Vireo	1.24	0.65	2.38	32.9%	33	33
Western Scrub-Jay	3.18	1.84	5.51	27.8%	47	52
Pinyon Jay	1.64	0.89	3.01	31.2%	51	55
Clark's Nutcracker	26.41	11.01	63.38	45.2%	61	62
Common Raven	3.06	1.34	6.99	43.4%	54	55
Violet-green Swallow	8.54	4.36	16.73	34.0%	68	68
Mountain Chickadee	17.90	9.08	35.30	35.0%	43	43
Juniper Titmouse	31.38	18.07	54.49	28.2%	119	124
Bushtit	55.78	27.74	112.16	36.3%	63	63

Table 5 cont. Estimated densities of breeding birds in pinyon-juniper habitat in the Carson National Forest, summer 2005.

Species	D	LCL	UCL	CV	n	N
White-breasted Nuthatch	4.58	2.01	10.42	42.6%	25	27
Rock Wren	1.87	0.76	4.64	47.0%	47	53
Bewick's Wren	24.31	9.55	61.89	49.9%	81	86
Blue-gray Gnatcatcher	23.15	14.27	37.56	24.4%	75	79
Mountain Bluebird	5.93	2.01	17.48	57.9%	25	26
American Robin	3.23	1.65	6.29	34.2%	42	43
Virginia's Warbler	27.90	13.09	59.47	39.1%	52	56
Yellow-rumped Warbler	3.13	1.43	6.86	40.3%	31	31
Black-throated Gray Warbler	77.06	52.56	112.97	19.4%	265	265
Western Tanager	4.13	2.13	8.01	33.2%	53	55
Green-tailed Towhee	4.13	1.86	9.18	40.4%	68	68
Spotted Towhee	25.06	16.49	38.07	21.1%	198	211
Chipping Sparrow	131.53	86.15	200.80	21.6%	265	271
Brewer's Sparrow	4.94	1.76	13.88	54.9%	30	30
Vesper Sparrow	1.02	0.39	2.68	49.8%	30	30
Lark Sparrow	2.13	0.84	5.44	48.6%	28	29
Black-headed Grosbeak	7.21	3.84	13.54	31.7%	91	91
Brown-headed Cowbird	4.59	2.62	8.04	28.3%	35	37
House Finch	2.39	0.97	5.84	46.7%	26	28
Pine Siskin	24.68	14.37	42.40	27.7%	65	76

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; N = number of individuals detected.

Ponderosa Pine (PP)

This was the 3rd year we surveyed ponderosa pine habitat in the CNF. We conducted 180 point counts along 12 transects in ponderosa pine forest in the CNF between 7 June and 23 June 2005 (Table 1). A total of 1,811 birds were recorded in this habitat, with an average of 10.1 birds at each count station (Table 2). Observers detected 66 species in total in ponderosa pine and an average of 8.0 species per point count and 30.8 species per site in this habitat (Table 2).

The point transect data from ponderosa pine yielded robust density estimates (CV<50%) for 20 species and moderately robust estimates for another four species (CV=50-62%; Table 6). MBCNF should effectively monitor these 24 species, which represent 36% of all species recorded from ponderosa pine in 2005.

Violet-green Swallow, Western Wood-Pewee, Broad-tailed Hummingbird, Yellow-rumped Warbler, and Chipping Sparrow were the most abundant species in this habitat this year. Eleven species listed by the NM-PIF as priority for management concern for ponderosa pine habitat were detected on transects this year (in order by highest number recorded to lowest): Western Wood-Pewee, Pygmy Nuthatch, Plumbeous Vireo, Virginia's Warbler, Western Bluebird, Broad-

tailed Hummingbird, Dark-eyed Junco, Dusky Flycatcher, Grace's Warbler, Williamson's Sapsucker, and Olive-sided Flycatcher.

Table 6. Estimated densities in ponderosa pine forest in the Carson National Forest, summer 2005.

Species	D	LCL	UCL	CV	n	N
Broad-tailed Hummingbird	145.29	76.76	275.00	31.8%	30	33
Western Wood-Pewee	169.71	126.91	226.95	14.2%	153	160
Dusky Flycatcher	8.22	3.85	17.57	37.0%	31	32
Ash-throated Flycatcher	11.99	4.68	30.71	47.7%	31	38
Plumbeous Vireo	40.04	24.33	65.89	24.5%	95	96
Warbling Vireo	9.46	2.89	30.94	58.8%	37	38
Steller's Jay	5.52	2.63	11.57	37.4%	29	29
Violet-green Swallow	228.89	166.85	313.99	15.5%	137	137
Mountain Chickadee	44.28	23.46	83.57	32.1%	69	71
White-breasted Nuthatch	28.81	19.91	41.70	18.3%	44	44
Pygmy Nuthatch	83.48	54.75	127.30	20.7%	64	76
Western Bluebird	49.58	27.72	88.67	28.5%	42	43
Hermit Thrush	3.25	1.21	8.72	50.6%	24	30
American Robin	49.13	28.33	85.23	26.7%	89	90
Virginia's Warbler	24.92	12.48	49.76	33.3%	77	77
Yellow-rumped Warbler	137.05	75.38	249.17	30.6%	83	84
Grace's Warbler	6.81	1.98	23.37	62.0%	24	24
Western Tanager	19.67	12.09	32.00	23.5%	57	62
Spotted Towhee	26.37	12.89	53.95	34.2%	80	80
Chipping Sparrow	88.23	49.39	157.61	29.6%	67	71
Dark-eyed Junco	60.66	31.21	117.91	32.9%	49	49
Black-headed Grosbeak	18.18	9.55	34.62	31.3%	41	42
Red Crossbill	9.36	3.26	26.91	53.6%	26	47
Pine Siskin	66.92	32.97	135.85	35.6%	25	34

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; N = number of individuals detected.

Sage Shrubland (SA)

This was the 3rd year we surveyed sage shrubland habitat in the CNF. We conducted 71 point counts along 5 transects in these stands between 15 May and 24 June 2005 (Table 1). A total of 480 birds were recorded, with an average of 6.8 birds detected at each count station (Table 2). Observers detected 54 species in total and, on average, detected 5.3 species per point count and 24.8 species per site (Table 2).

The point transect data from sage shrubland habitat yielded robust density estimates (CV<50%) for three species and moderately robust estimates for one species (CV=50-57%; Table 7). MBCNF should effectively monitor these four species, which represent 7% of all species recorded from sage shrubland in 2005.

Ten species which are listed as priorities for management concern for montane shrubland or Great Basin desert shrub (both habitats can be considered sage shrubland) by NM-PIF were detected on sage shrubland transects (in order by number of individuals detected, highest to lowest): Green-tailed Towhee, Brewer's Sparrow, Spotted Towhee, Blue-gray Gnatcatcher, Sage Sparrow, Ash-throated Flycatcher, Sage Thrasher, Rock Wren, Virginia's Warbler, and Black-throated Sparrow. Also, a MIS for the CNF, Brewer's Sparrow, was detected enough times in sage shrubland to provide a density estimate.

Table 7. Estimated densities of breeding birds in sage shrubland in the Carson National Forest, 2005.

Species	D	LCL	UCL	CV	n	N
Green-tailed Towhee	16.76	6.58	42.67	36.2%	50	50
Spotted Towhee	15.40	3.96	59.83	56.9%	27	27
Brewer's Sparrow	37.58	19.65	71.90	31.3%	42	45
Vesper Sparrow	48.82	20.03	118.99	43.7%	51	52

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; N = number of individuals detected.

Spruce-Fir (SF)

This was the 3rd year we surveyed spruce-fir habitat in the CNF. We conducted 59 point counts along 4 transects in this habitat between 24 June and 11 July 2005 (Table 1). A total of 575 individual birds were recorded, with an average of 9.7 birds per point count (Table 2). Observers detected 33 species in total and, on average, 6.7 species per point count and 21.0 species per transect in this habitat (Table 2).

The point-transect data from spruce-fir habitat yielded sufficient number of detections to estimate density for seven species. Unfortunately, the observer that collected data in this habitat in 2005 did not record distances correctly so density estimates were not able to be calculated from these data.

Seven species which are listed as priorities for management concern for spruce-fir forest by NM-PIF were detected on spruce-fir transects (in order by number of individuals detected, highest to lowest): Dark-eyed Junco, Broad-tailed Hummingbird, Clark's Nutcracker, Golden-crowned Kinglet, Townsend's Solitaire, Brown Creeper, and Red-naped Sapsucker.

DISCUSSION AND RECOMMENDATIONS

Monitoring Pinyon-Juniper Habitat

The emphasis of this project is to monitor birds in pinyon-juniper habitat. In the southwest, millions of pinyon pines have died-off from severe drought conditions. In the Carson National Forest, similar die-offs have occurred to pinyon pines. Consequently, the CNF partnered with RMBO to monitor the status of bird species in this habitat over time.

The New Mexico Partners in Flight Plan identifies 20 priority bird species for pinyon-juniper habitat. In 2005 we collected sufficient data to monitor two of the highest priority species (Gray Flycatcher and Black-throated Gray Warbler), two priority species (Mountain Bluebird and Virginia's Warbler), and four high responsibility species (Ash-throated Flycatcher, Pinyon Jay, Juniper Titmouse and Lark Sparrow). We also collected sufficient data on one other high priority species, Western Bluebird, to monitor its status across the full spectrum of surveyed habitats on the CNF.

Brown-headed Cowbird parasitism rates may also effect the breeding success of many songbird species, especially Plumbeous Vireo, Blue-gray Gnatcatcher and Western Tanager. We detect all three of these species, as well as cowbirds, in sufficient number to monitor their status in pinyon-juniper habitat forest-wide.

In addition to surveying for birds in pinyon-juniper, we also began collecting data on the proportion of dead trees at each point-count station in 2005. We will track this over time and compare it to the trends we detect for each species. Declines in the numbers of corvid seed dispersers active in pinyon-juniper woodlands will probably be associated with the loss of mature pinyons. In 2005, Clark's Nutcrackers, Pinyon Jays, and Western Scrub-Jays were detected in suffient numbers in pinyon-juniper habitat to monitor their status in this habitat.

Pinyon-juniper woodlands occupy millions of acres across the southwestern United States and provide habitat for many bird species. Additionally, pinyon-juniper woodlands provide seasonal habitat for elk and mule deer, as well as many human uses including pinyon nuts, firewood, fence posts and livestock forage. The shift in plant composition, distribution and abundance that may occur to this habitat from the drought will impact a diverse dependent community. Few studies have monitored the impacts of such a change over the long-term on the full-spectrum of the avian community. Continued monitoring in this habitat will provide valuable information to both managers as well as the scientific community.

Prospects for Population Monitoring

The habitat-stratified point transects produced excellent results with low coefficients of variation (≤ 50%) on 44 bird species in at least one habitat surveyed in 2005. 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 14 species to monitor their populations across habitat types, although in some cases, these species may be better monitored with additional transects in a certain habitat. These 58 species represent about 51% of *all species* observed in the seven habitats surveyed in 2005, but they represent almost 97% of all *individual birds* observed. The other 49% of species (~3% of birds observed) fall into one of the following categories below:

1) Low-density, highly localized species;
2) Low-density, widespread species;
3) Irregular species;
4) Vagrant breeders;
5) Species that occur mainly outside the Carson National Forest in other habiats;
6) Nocturnal species;
7) Wetland-obligate species; and
8) Species that are readily detectable only prior to late May.

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) Complete census of small, localized populations;
3) Complete census of 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.

One 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 active nests and visiting a subset during the spring and summer as necessary to evaluate the outcome of each. Nests would first be located 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 and a random subset would be visited each year to check for occupancy and outcome.

For some low-density but widespread species, such as Northern Goshawk, a brief call-response survey could be used 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. RMBO will be implementing a pilot study in 2006 that will use a call-playback technique developed by the USFS for Northern Goshawk. This study will be conducted in several National Forests through out Colorado, Wyoming and the Black Hills.

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 Carson National Forest in the future.

Coordinated Bird Monitoring

Coordinated Bird Monitoring (CBM) is an ongoing effort that began with the Western Working Group of Partners in Flight in 1999, to integrate existing monitoring data to estimate trends in population size, describe changes in abundance, and monitor several fitness indicators. CBM focuses on management issues and, ideally, the integration will be useful at many spatial and administrative levels.

RMBO has been working with the Western Working Group of PIF over the last few years to implement CBM, especially in the Intermountain West. We are in the process of redesigning our web site to enable web-based queries of our data and the display of results by habitat, management unit, ecoregion, and other scales. Some of these data will be available via web crawlers to a larger network of monitoring programs so that data can be queried at a regional level in collaboration with CBM. Currently, several partners are involved in this effort, including the Avian Science Center at the University of Montana, Cornell Lab of Ornithology's Avian Knowledge Network, and the US Geological Survey. Within the next few years, we plan to merge results, broaden our scale of comparison, and provide our collaborators with an easily accessible and more dynamic dataset.

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