MONITORING THE BIRDS OF KAIBAB NATIONAL FOREST: 2009 FIELD SEASON REPORT

ROCKY MOUNTAIN BIRD OBSERVATORY

March 2010

ROCKY MOUNTAIN BIRD OBSERVATORY

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

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

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

1. ***Science** provides the foundation for effective bird conservation.*
2. ***Education** is critical to the success of bird conservation.*
3. ***Stewardship** of birds and their habitats is a shared responsibility.*

RMBO accomplishes its mission by:

- ***Monitoring** long-term bird population trends to provide a scientific foundation for conservation action.*

- ***Researching** bird ecology and population response to anthropogenic and natural processes to evaluate and adjust management and conservation strategies using the best available science.*

- ***Educating** people of all ages through active, experiential programs that create an awareness and appreciation for birds.*

- ***Fostering** good stewardship on private and public lands through voluntary, cooperative partnerships that create win-win situations for wildlife and people.*

- ***Partnering** with state and federal natural resource agencies, private citizens, schools, universities, and other non-governmental organizations to build synergy and consensus for bird conservation.*

- ***Sharing** the latest information on bird populations, land management and conservation practices to create informed publics.*

- ***Delivering** bird conservation at biologically relevant scales by working across political and jurisdictional boundaries in western North America.*

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***Cover Photos**:* Juniper Titmouse by Tony Leukering. Pygmy Nuthatch by Glen Walbek. Used with Permission.

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EXECUTIVE SUMMARY

Birds are excellent indicators of environmental quality and change. In addition, they are one of the most highly visible and valued components of our native wildlife. Monitoring birds provides data needed not only to effectively manage bird populations, but also to understand the effects of human activities on the ecosystem and to gauge their sustainability. Because bird communities 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 biological integrity at a variety of scales.

In 2009, Rocky Mountain Bird Observatory, in conjunction with Kaibab National Forest, continued with the third year of *Monitoring the Birds of Kaibab National Forest*, a partnership effort using a protocol similar to other RMBO landbird monitoring programs as delineated by Hanni et. al. (2009). RMBO designed this program to provide statistically rigorous long-term trend data for populations of most diurnal, regularly breeding bird species in the Kaibab National Forest, including some United States Forest Service Region 3 Sensitive Species, Kaibab National Forest Management Indicator Species, and birds identified as species of greater conservation need by the Arizona Partners In Flight bird conservation plan. In the short term, this program provides information needed to effectively manage and conserve bird populations in Kaibab National Forest, including the spatial distribution, abundance, and relationship to important habitat characteristics of bird species. This cooperative project supports KNF's efforts to comply with requirements set forth in the National Forest Management Act and other statutes and regulations.

This year, we surveyed all 90 planned transects (1,077 point counts) in three habitats (Pinyon-Juniper, Mixed-Conifer, and Ponderosa Pine) within the KNF. We conducted an average of 13 point counts per transect and recorded 10,383 observations of 107 species of birds, 24 Abert's Squirrels and 50 Red Squirrels in Kaibab National Forest between 10 May and 7 July 2009. We calculated density estimates for 69 species in at least one habitat, including three Management Indicator Species: Hairy Woodpecker, Juniper Titmouse, and Pygmy Nuthatch.

We recommend that if the Kaibab National Forest decides to review its Management Indicator Species list that managers consider adding species that are of concern to agencies and partners within and outside the boundaries of the Forest (Appendix B): Gray Vireo, Pinyon Jay, Virginia's Warbler, Black-throated Gray Warbler, and Grace's Warbler. These species are recognized for their importance as habitat indicators and as regionally emblematic species.

ACKNOWLEDGEMENTS

The US Forest Service (USFS) funded this project, through a challenge cost-share agreement between Kaibab National Forest and Rocky Mountain Bird Observatory.

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INTRODUCTION

Reasons for Monitoring

Birds are excellent indicators of biological integrity and ecosystem health (Morrison 1986, Bureau of Land Management 1998, Hutto 1998, O'Connell et al. 2000, Rich 2002, U.S. EPA 2002, Birdlife International 2003). Birds comprise a diverse group of niche specialists, occupy a broad range of habitats, and are sensitive to both physical and chemical impacts on the environment. They often reflect the abundance and diversity of other organisms with which they coexist. They are useful barometers for environmental change and measuring the sustainability of human activities on ecosystems.

Bird communities reflect an integration of a broad array of ecosystem conditions including productivity, vegetation composition, water quality, and landscape integrity (Adamus et al. 2001). The response of 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, restoration activities, or other environmental changes. Birds are generally abundant, conspicuous, and relatively easy to identify; monitoring their populations can be more efficient than monitoring other taxonomic groups.

Population monitoring forms the backbone of avian conservation. Without current monitoring data, conservation efforts may be misguided and inefficient. For these and other reasons, legislation such as the National Environmental Policy Act (1969), Endangered Species Act (1973), and the Forest Management Act (1976), as well as various state laws, Forest plans, preserve management plans, and other long-range plans require population monitoring (Sauer 1993, Manley et al. 1993).

Given the declines of many bird species that breed in North America (NABCI 2007), there is an urgent need for monitoring programs that serve as an "early-warning" system to identify declining species and the causes of declines so that natural resource managers can proactively prevent further losses. RMBO's monitoring programs are comparable, repeatable, data rich, long-term, multi-scale, and accessible so that managers can make informed decisions to effectively conserve birds and their habitats.

Program History

In 2005, Kaibab National Forest (KNF) initiated a pilot monitoring program for landbirds (Noble 2005) using a habitat-stratified sampling design and distance sampling (Buckland et al. 2001). KNF expanded the effort in 2006, re-sampling the 2005 transects and adding new transects. They included squirrels in their survey effort. It soon became apparent that in order to meet the Forest's monitoring objectives, an effort was necessary beyond that which the KNF could sustain on its own. In 2008, RMBO began working with KNF to efficiently meet their monitoring objectives. KNF is the funding partner and assisted with logistical coordination while RMBO collected, analyzed, and summarized the survey data. KNF designed this program to provide population status and trend data for most diurnal, regularly-occurring breeding landbirds of the Forest.

Monitoring Objectives

RMBO's bird monitoring programs provide population trend or status data on regularly-occurring breeding species within the study areas. We expect to collect data to provide "early-warning" information for all species that can be monitored through a habitat-based approach.

The specific objectives of RMBO's monitoring program are:

- To provide better information on distribution and abundance for most breeding landbirds, especially priority species;
- To provide basic habitat association data for most bird species;
- To provide long-term trend or status data on most regularly occurring breeding species in the region, while being able to detect population rises and declines of 3% per year or greater to determine if a species' population decreases by 50% or more within a 30-year period;
- To maintain a high-quality database that is accessible to all of our collaborators, as well as the public, in the form of raw and summarized data; and
- To generate decision support tools such as population density models that help guide conservation efforts and provide a better measure of our conservation success.

The objectives of MBKNF also include tracking potential management impacts on birds and squirrels. We monitor Management Indicator Species (MIS), a concept adopted by the USFS. MIS is defined as any species, groups of species, or species habitat elements selected to track the effects of resource management on population recovery, maintenance of population viability, or ecosystem diversity. MIS serve as a barometer for species viability at the Forest level and also serve as a surrogate for addressing other species' ecological needs. The intended use is to be an indicator of habitat quality, track effects of management on the habitat, and predict future conditions.

In addition, results from MBKNF are designed to inform managers of impacts to other avian species, including those highlighted by Partners in Flight and the US Fish and Wildlife Service. Finally, there are many other species not mentioned in the preceding categories that are good indicators for habitat conditions on the KNF. Therefore, rather than targeting only MIS we simultaneously surveyed for all landbirds. This could provide information about which species would serve as ideal management indicators for the KNF in the future.

METHODS

Study Area

In 2007, biologists from KNF selected three vegetation cover types (Mixed-Conifer, Pinyon-Juniper, and Ponderosa Pine) in which to place 90 survey transects (Figure 1). KNF selected these habitats because they represent 83% of the land cover on the Forest (10 other vegetation types constitute the balance of the landscape), the most active management occurs in these cover types, and portions of Mixed conifer habitat is designated as "critical" by the recovery plan for the Mexican spotted owl.

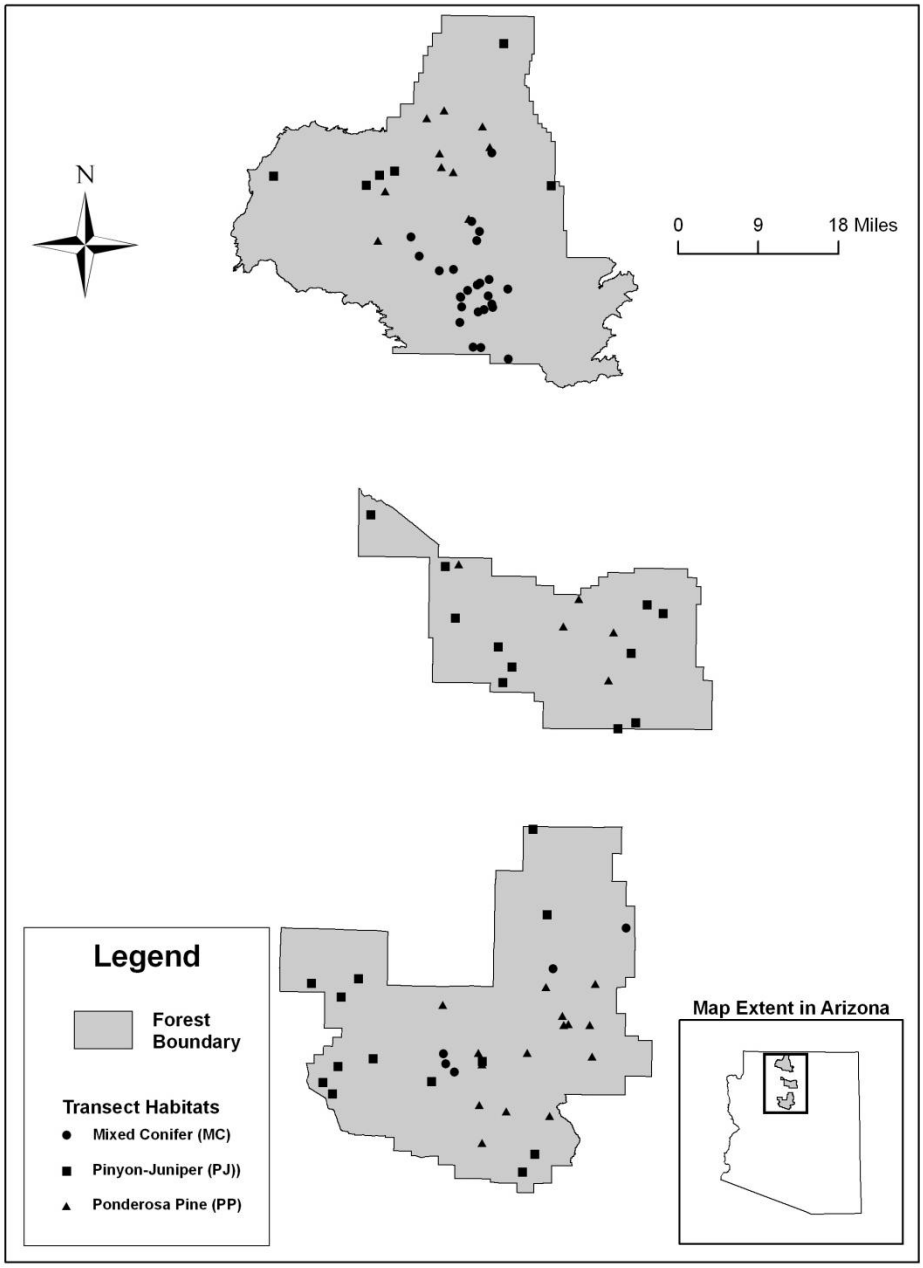

Figure 1. Kaibab National Forest transect locations, by habitat, 2009.

Mixed-Conifer (MC)

Mixed-Conifer is conifer-dominated forest made up of a diversity of tree species. On MC transects in the KNF, the most commonly recorded overstory species are white fir (*Abies concolor*), ponderosa pine (*Pinus ponderosa*), spruce (*Picea spp.*), Douglas fir (*Pseudotsuga menziesii*) and quaking aspen (*Populus tremuloides*). Saplings, predominantly of white fir, make up the understory.

Figure 2. Kaibab National Forest transect locations, by habitat, 2009.

Pinyon-Juniper (PJ; formerly referred to as Woodland/Grassland)

Originally Pinyon-Juniper was called Woodland/Grassland and it described the combination of pinyon-juniper woodland and savannah grasslands. We combined these habitats because we could not easily differentiate them. However, once we started surveys in this habitat, it became apparent that all the randomly selected transects for this vegetation type occurred in true pinyon-juniper woodland; hence we will refer to it as Pinyon-Juniper from this point forward. The most common vegetation within this cover type is pinyon pine (*Pinus edulis*) and juniper species (*Juniperus spp*.).

Ponderosa Pine (PP)

Ponderosa Pine is composed of conifer stands dominated by ponderosa pine that are typically lower in elevation than mixed-conifer stands. In addition to ponderosa pine, the most common tree species are juniper and pinyon pine. The most frequently encountered shrubs are common juniper (*Juniperus communis*) and Gambel oak (*Quercus gambelii*).

Site Selection

The KNF selected all survey sites for the MBKNF project and established the transect locations surveyed in 2005, 2006, and 2007. RMBO and the KNF established all new transect locations added in 2008, including the majority of those located on the North Kaibab Ranger District. We surveyed the same transects in 2009. Transect locations were randomly selected from stands stratified by habitat. Each transect consisted of 15 sample points with 250 meter spacing between points. We did not include wilderness areas in the sampling frame.

Sampling Method

To sample bird populations in habitats selected for monitoring, KNF and RMBO staff conducted point counts using methods that allow for estimating detection probability through the principles of Distance Sampling and following a protocol established by Leukering (2000) and modified by Hanni et. al. (2009). Distance sampling theory estimates detection probability as a function of the distances between the observer and the birds detected (Buckland et al. 2001). The detection probability is used to adjust the count of birds to account for birds that were present but undetected. Application of distance theory requires that three critical assumptions be met: 1) all birds at and near the sampling location (distance = 0) are detected; 2) distances of birds are measured accurately; and 3) birds do not move in response to the observer's presence.

Observers conducted point counts in the morning, between ½-hour before sunrise and 11 AM. For new sampling locations, observers established an access point, a randomly-selected bearing, and randomly-selected distance within 400 m of the access point to place the first point count location. On the morning of the survey, the observer began the point count at the first station and then continued along the randomly-selected bearing for all remaining points, if possible. In some cases, the random bearing led the observer out of the target habitat or to some obstruction (e.g. cliff or private land). When this happened, the observer returned to the last point and randomly turned the transect right or left 90 degrees and then alternated right or left if additional turns were necessary.

Observers conducted as many as 15 five-minute point counts per transect. For every bird detected, they recorded species, sex, distance from observer, time interval within the five-

minute count, and type of detection (call, song or visual sighting). Observers measured distances using laser rangefinders. When it was not possible to measure the distance to a bird, observers estimated distance by measuring to some nearby object. Observers treated the 250-m intervals between count stations as sections of a line transect and recorded certain bird and squirrel species that occur in low-densities (all MIS, grouse, raptors, woodpeckers, and a few other rare or uncommon species). They measured the distance and bearing to individuals of these low-density species from the transect line. Observers did not include low-density species in the line-transect data that they detected on a previous or subsequent point. Observers recorded detections of birds flying over but not actually using the habitat with a unique detection code to allow for exclusion in density analyses.

We considered all non-independent detections of birds as part of a 'cluster' rather than as separate independent observations (i.e. flocks or pairs of conspecific birds together in close proximity). Observers recorded clusters by recording the number of birds detected within the cluster along with a letter code to keep track of each distinct cluster.

At the start and end of transects, observers recorded time and atmospheric data (i.e., temperature in degrees Fahrenheit, cloud cover, precipitation, and wind speed). They recorded locations of count stations using hand-held Global Positioning System (GPS) units. Observers logged all GPS data in Universal Transverse Mercator (UTM) North American Datum 1927. Before beginning each point count, observers recorded vegetation data within a 50 m radius of the point, including dominant habitat type and structural stage, and the relative abundance, percent coverage, and mean height of trees and shrubs by species, and percent groundcover. . They recorded vegetation data quietly. This allowed the birds that may have been disturbed by our approach, time to return to their normal habits prior to beginning the point count.

Field Personnel

RMBO staff, consisting of four experienced biological technicians with good aural and visual bird-identification skills, conducted field work in 2009. Technicians completed a week-long training program at the beginning of the field season to ensure full understanding of the field protocols, to practice bird and plant identification, and to calibrate distance estimation in a variety of habitats.

Squirrel Sampling

In an effort to provide a basic metric for Abert's Squirrels (*Sciurus aberti*) and Red Squirrels (*Sciurus vulgaris*) of KNF, a methodology has been developed and implemented alongside MBKNF. We collected these data after we finished bird sampling. While observers walked back to their vehicles, they recorded sightings of squirrel sign along the survey transects. We only sampled for squirrel sign on MC and PP transects because PJ does not support many squirrels.

We considered each 250-m segment between point count stations to be a transect line. Technicians looked for squirrel sign out to 5-m on each side of the transect as they walked between points. We assigned squirrel sign observations to one of three categories:

Cones

Cores – the center of cones which have had their scales removed to gain access to the seeds inside. We only counted cones that appeared to be fresh.

Scales – the scales which squirrels peel from cones. We often found these further away from the trunk than cone cores.

Clippings

Branch cuttings – principally, but not exclusively, from Ponderosa Pine, these are clusters of needles with several inches of twig attached which squirrels cut from the tree. Squirrels cut twigs in a diagonal fashion which one can easily distinguish from branches that have been sheared off by wind or other forces. Cuttings that have needles that are different colors from each other have been cut at different times and we counted them as two feeding events.

Peeled twigs – after squirrels cut branches, they cut a section of twig (usually 3-5") off the end and eat the cambium, leaving a bright section of twig fairly uniform in size. We usually find these among branch cuttings. We count either as a clipping, but both will not count as two events as they are part of the same process. Only Abert's Squirrel feeds on ponderosa pine cambium this way.

Middens

Middens – piles of cone scales and cores, often near the base of a tree or downed log. Only red squirrels produce middens. Observers recorded whether squirrels recently used the midden.

We only count each grouping of each type of sign once per 20 m section. That is, once we observe one type of sign, we did not count any other encounters with that sign type until we travel another 20 m along the transect. This helped to separate feeding events and resulted in a conservative estimate of squirrel sign. The only exception was branch cuttings of different ages which we counted as multiple feeding events, as they occurred at different times. Observers recorded the presence or absence of oak in each section.

Data Analysis

Analysis of distance data is accomplished by fitting a detection function to the distribution of recorded distances. The distribution of distances can be a function of characteristics of the object being recorded (for birds e.g., their size, color, movement, volume or frequency of song), the sampling landscape (e.g., density of vegetation), and observer ability. Because detectability varies among species and sometimes among habitats, we analyzed the data separately for each species and habitat.

We used the analysis software Distance 6.0 (Thomas et al. 2010) to estimate detection probabilities using our point count data. We estimated densities of species for which we obtained at least 60 independent detections across years, within a sampled habitat. We excluded birds flying over but not using the immediate surrounding landscape and birds detected between points from analyses. We fit the following functions to the distribution of distances for each species: Half normal key function with cosine series expansion, Uniform function with cosine series expansion, Hazard rate key function with cosine series expansion, and Hazard rate key function with simple polynomial series expansion (Buckland et al. 2001). We used Akaike's Information Criterion (AIC) corrected for small sample size (AIC_c) and model selection theory to select the most parsimonious detection function for each species (Burnham and Anderson 2002). We estimated variance in program Distance using bootstrapping of transects within strata rather than using empirical estimates. Empirical methods tend to underestimate variance from small sample sizes.

The number of detections used in analyses (*n*) may be fewer than the number of birds observed because:

1. We record a cluster of birds as a single detection.
2. We exclude birds detected far from the observer.
3. We remove birds detected flying over but not using the habitat.
4. We remove low-density birds detected between points.

The difference between (*n*) and the total number of birds observed can be large for species that we often observe in groups (e.g., swifts, swallows, and crossbills), at great distance (e.g. raptors and corvids), and while flying over (e.g. Pine Siskin and Evening Grosbeak).

This year, we did not use the 2005-2006 data because of a strong bias of the KNF data in 2006. In 2006, surveyors recorded all detections of 100 m or greater as simply "100 m," resulting in over 30% of detection distances equaling exactly 100 m. Analyses of these data required that we truncated all data at < 100 m. 2009 was the first year that we had more detections available for analysis by using data with unlimited distance (2007-2009) than if we had limited useable detections to those below 100 m and included the 2005-2006 data. We will exclude 2005-2006 data from analyses in future years.

For squirrel sign analysis we used the number of independent observations divided by the area sampled to come up with a gross density for squirrel sign in MC and PP. This can only be used as a general index for squirrel activity on transects where sampling occurred.

RESULTS

RMBO staff conducted 1,077 point counts along 90 transects in three habitats between 10 May and 7 July, 2009 on the MBKNF project.

We recorded 10,383 birds of 107 species, 24 Abert's Squirrels and 50 Red Squirrels on MBKNF transects in 2009 (Appendix A). We provide density estimates for 23 species in MC, 24 species in PJ, and 25 species in PP from the 2007-2009 data. By excluding the 2005-2006 data in analysis, we were able to use observations of birds at distances greater than or equal to 100 m.

The number of species we detected this year in sampled habitats were 52 bird and 2 squirrel species in Mixed-Conifer, 83 bird species and Abert's Squirrels in Pinyon-Juniper, and 79 bird and 2 squirrel species in Ponderosa Pine. We detected some of these species peripheral to the habitat in which we recorded them.

Mixed Conifer

We conducted 306 point counts along 30 transects in 2009 for an average of 10 points per transect in MC. We recorded 3,268 birds of 52 species, six Abert's Squirrels, and 48 Red Squirrels. We were able to calculate densities for 23 species including Red Squirrel and one MIS, Hairy Woodpecker, from the 2007-2009 MC data. Technicians detected an average of 111 individuals and 23 species of birds and squirrels per transect in MC.

Table 1. Estimated densities of breeding birds in Mixed-Conifer habitat in Kaibab National Forest, 2007-2009*.

Common Name	Year	D	LCL	UCL	CV	n
Broad-tailed Hummingbird	2007	67.11	37.85	118.97	35	25
	2008	30.50	16.05	57.96	40	25
	2009	38.05	22.30	64.94	33	26
Williamson's Sapsucker	2007	20.35	5.32	77.93	97	42
	2008	10.00	3.23	31.01	77	50
	2009	16.73	5.44	51.43	77	65
Hairy Woodpecker	**2007**	**22.29**	**11.19**	**44.41**	**43**	**37**
	2008	**8.95**	**3.45**	**23.24**	**63**	**35**
	2009	**10.39**	**4.01**	**26.91**	**62**	**33**
Northern Flicker	2007	24.81	16.85	36.52	24	53
	2008	18.49	13.40	25.52	20	95
	2009	22.30	15.98	31.11	20	86
Western Wood-Pewee	2007	18.16	10.95	30.14	31	42
	2008	26.69	17.69	40.27	25	142
	2009	14.69	9.81	21.99	25	62
Warbling Vireo	2007	69.65	50.51	96.04	20	96
	2008	66.42	50.49	87.39	17	222
	2009	89.70	59.93	134.26	25	182
Steller's Jay	2007	6.63	3.70	11.89	36	23
	2008	7.74	5.16	11.62	25	66
	2009	5.85	3.67	9.32	29	38
Common Raven	2007	3.50	1.80	6.80	41	14
	2008	3.24	2.03	5.17	29	37
	2009	2.66	1.32	5.36	44	21
Violet-green Swallow	2007	68.21	45.30	102.70	25	58
	2008	65.42	42.90	99.76	26	119
	2009	60.77	38.61	95.66	28	70
Mountain Chickadee	2007	114.92	70.04	188.55	30	76
	2008	53.82	32.22	89.89	32	157
	2009	72.64	46.02	114.65	28	76
Red-breasted Nuthatch	2007	16.33	9.76	27.35	32	39
	2008	9.81	7.22	13.31	19	60
	2009	7.68	5.17	11.41	24	33
House Wren	2007	42.44	25.37	70.99	32	42
	2008	38.95	26.70	56.81	23	89
	2009	57.75	33.74	98.85	33	90
Ruby-crowned Kinglet	2007	45.13	30.92	65.86	23	55
	2008	66.49	45.36	97.48	24	183
	2009	102.23	70.91	147.40	22	176
Hermit Thrush	2007	42.61	31.25	58.10	19	158
	2008	42.39	32.07	56.02	17	374

Common Name	Year	D	LCL	UCL	CV	n
Hermit Thrush (cont.)	2009	36.45	27.85	47.70	16	253
American Robin	2007	8.57	3.38	21.73	61	15
	2008	16.09	7.32	35.39	50	66
	2009	13.93	7.10	27.34	42	45
Yellow-rumped Warbler	2007	214.71	146.54	314.59	23	130
	2008	322.21	234.98	441.83	19	445
	2009	309.79	212.70	451.20	23	280
Grace's Warbler	2007	16.42	6.98	38.65	55	11
	2008	32.30	13.17	79.21	58	48
	2009	21.42	11.15	41.15	41	27
Western Tanager	2007	70.06	49.24	99.66	21	130
	2008	66.50	52.94	83.54	14	296
	2009	47.97	36.54	62.97	17	167
Chipping Sparrow	2007	20.21	10.51	38.88	41	20
	2008	64.44	42.86	96.88	25	157
	2009	40.61	24.74	66.66	31	71
Dark-eyed Junco	2007	94.08	65.47	135.22	22	76
	2008	127.47	82.10	197.90	27	237
	2009	90.04	59.47	136.33	26	119
Black-headed Grosbeak	2007	9.91	4.21	23.30	55	15
	2008	6.98	2.67	18.22	63	25
	2009	13.44	5.62	32.14	56	35
Pine Siskin	2007	12.15	5.14	28.73	56	7
	2008	133.21	86.44	205.28	27	139
	2009	114.66	64.15	204.94	36	75
Red Squirrel	2007	57.10	24.45	133.36	55	23
	2008	47.75	28.25	80.70	32	49
	2009	28.54	15.24	53.46	39	23

*MIS are in bold**; D** = estimated density (birds/km^2); **LCL** and **UCL** = lower and upper 90% confidence limits on *D*; **%CV** = percent coefficient of variation of *D*; *n* = number of observations used to estimate *D*. We did not include density estimates for species with $n < 60$ across years.

Pinyon-Juniper

We conducted 390 point counts along 30 transects in 2009 for an average of 13 points per transect in PJ. We recorded 3,518 birds of 83 species and four Abert's Squirrels. We were able to calculate densities for 24 species including one MIS, Juniper Titmouse, from the 2007-2009 PJ data. Technicians detected an average of 117 individuals and 29 species of birds and squirrels per transect in PJ.

Table 2. Estimated densities of breeding birds in Pinyon-Juniper habitat in Kaibab National Forest, 2007-2009*.

Common Name	Year	D	LCL	UCL	CV	n
Mourning Dove	2007	5.04	2.72	9.36	39	30
	2008	3.70	2.22	6.16	32	28
	2009	12.42	7.33	21.02	33	94
Northern Flicker	2007	5.88	3.32	10.41	35	34
	2008	1.30	0.63	2.67	45	10
	2009	5.57	3.60	8.61	27	41
Gray Flycatcher	2007	32.53	22.94	46.13	21	73
	2008	28.45	20.69	39.13	20	84
	2009	56.27	40.35	78.48	20	161
Ash-throated Flycatcher	2007	30.11	20.20	44.87	25	134
	2008	30.42	21.73	42.59	21	180
	2009	37.80	26.76	53.39	21	221
Gray Vireo	2007	7.84	4.65	13.23	32	20
	2008	1.78	0.61	5.18	71	6
	2009	10.54	4.70	23.66	51	34
Plumbeous Vireo	2007	9.64	5.03	18.47	41	30
	2008	13.92	9.20	21.08	25	57
	2009	25.30	18.52	34.57	19	99
Steller's Jay	2007	5.13	2.82	9.30	37	32
	2008	2.02	1.05	3.87	41	16
	2009	2.12	1.23	3.65	33	16
Western Scrub-Jay	2007	7.06	4.04	12.33	35	23
	2008	6.56	3.71	11.62	36	28
	2009	14.85	8.23	26.79	37	55
Pinyon Jay	2007	4.17	1.89	9.22	51	39
	2008	3.59	2.08	6.19	34	41
	2009	13.27	6.80	25.92	42	85
Common Raven	2007	7.56	4.24	13.47	36	86
	2008	7.51	3.95	14.28	40	71
	2009	8.33	5.07	13.66	31	106
Mountain Chickadee	2007	116.39	67.98	199.29	33	129
	2008	27.87	13.83	56.14	44	37
	2009	41.55	22.80	75.71	38	57
Juniper Titmouse	**2007**	**55.89**	**35.66**	**87.60**	**28**	**63**
	2008	**56.37**	**41.23**	**77.07**	**19**	**91**
	2009	**74.07**	**52.80**	**103.92**	**21**	**120**
White-breasted Nuthatch	2007	28.80	13.34	62.21	49	66
	2008	7.17	3.91	13.13	38	23
	2009	13.19	7.94	21.90	31	42
Bewick's Wren	2007	21.49	13.44	34.35	29	65
	2008	28.58	19.31	42.29	24	111

Common Name	Year	D	LCL	UCL	CV	n
Bewick's Wren (cont.)	2009	47.86	32.63	70.20	24	189
Blue-gray Gnatcatcher	2007	32.52	10.31	102.60	78	26
	2008	21.97	7.12	67.81	76	25
	2009	21.35	8.47	53.78	60	25
Mountain Bluebird	2007	14.66	7.38	29.11	43	39
	2008	2.29	1.13	4.62	44	8
	2009	7.10	3.59	14.05	43	21
American Robin	2007	10.39	5.60	19.29	39	45
	2008	3.26	1.08	9.88	75	18
	2009	5.74	2.61	12.59	50	32
Black-throated Gray Warbler	2007	40.45	20.51	79.78	43	64
	2008	53.09	34.25	82.29	27	113
	2009	74.64	48.16	115.67	27	155
Western Tanager	2007	9.75	5.49	17.30	36	50
	2008	9.14	5.68	14.70	29	60
	2009	6.22	3.93	9.86	28	43
Spotted Towhee	2007	36.48	15.92	83.59	54	94
	2008	19.43	5.61	67.24	87	62
	2009	17.80	5.32	59.59	84	58
Chipping Sparrow	2007	45.77	27.05	77.44	33	84
	2008	36.72	23.57	57.21	27	89
	2009	59.57	35.98	98.62	31	134
Dark-eyed Junco	2007	18.13	6.71	48.96	66	39
	2008	5.31	2.31	12.19	53	17
	2009	7.67	3.75	15.68	45	23
Black-headed Grosbeak	2007	5.36	2.92	9.82	38	24
	2008	6.28	3.45	11.43	37	39
	2009	7.31	3.22	16.64	53	41
Brown-headed Cowbird	2007	17.46	9.78	31.18	36	19
	2008	12.01	6.94	20.77	34	17
	2009	25.49	15.50	41.92	31	31

*MIS are in bold**; D** = estimated density (birds/km^2); **LCL** and **UCL** = lower and upper 90% confidence limits on *D*; **%CV** = percent coefficient of variation of *D*; *n* = number of observations used to estimate *D*. We did not include density estimates for species with *n* < 60 across years.

Ponderosa Pine

We conducted 381 point counts along 30 transects in 2009 for an average of 13 points per transect in PP. We recorded 3,597 birds of 79 species, 14 Abert's Squirrels, and 2 Red Squirrels. We were able to calculate densities for 25 species including two MIS, Hairy Woodpecker and Pygmy Nuthatch, from the 2007-2009 PP data. Technicians detected an average of 120 individuals and 28 species of birds and squirrels per transect in PP.

Table 3. Estimated densities of breeding birds in Ponderosa Pine habitat in Kaibab National Forest, 2007-2009*.

Common Name	Year	D	LCL	UCL	CV	n
Mourning Dove	2007	6.71	3.95	11.40	33	34
	2008	5.87	3.07	11.21	41	34
	2009	7.12	3.90	13.00	38	42
Broad-tailed Hummingbird	2007	55.09	30.31	100.13	37	21
	2008	80.71	40.14	162.28	44	38
	2009	17.37	8.27	36.50	47	8
Hairy Woodpecker	**2007**	**16.90**	**10.01**	**28.54**	**32**	**48**
	2008	**11.08**	**6.49**	**18.91**	**33**	**41**
	2009	**15.74**	**10.45**	**23.72**	**25**	**51**
Northern Flicker	2007	9.58	6.66	13.79	22	73
	2008	6.55	4.08	10.54	29	60
	2009	14.02	9.60	20.46	23	125
Western Wood-Pewee	2007	25.85	17.89	37.36	23	113
	2008	23.06	16.11	33.01	22	132
	2009	18.32	12.33	27.23	24	95
Ash-throated Flycatcher	2007	3.04	1.06	8.77	70	10
	2008	10.83	3.44	34.16	78	42
	2009	4.41	1.54	12.63	70	18
Plumbeous Vireo	2007	18.36	11.75	28.68	28	101
	2008	15.02	9.74	23.16	27	106
	2009	18.99	12.58	28.68	25	125
Warbling Vireo	2007	6.25	2.97	13.16	47	30
	2008	3.73	1.58	8.78	55	24
	2009	12.54	6.97	22.54	37	75
Steller's Jay	2007	19.79	12.20	32.09	30	97
	2008	12.43	8.54	18.09	23	82
	2009	21.98	15.45	31.26	22	125
Common Raven	2007	6.68	3.75	11.88	36	24
	2008	8.07	4.01	16.22	44	32
	2009	7.57	3.64	15.73	46	25
Violet-green Swallow	2007	64.07	33.21	123.62	41	57
	2008	54.10	29.03	100.84	39	51
	2009	93.85	39.37	223.75	56	63
Mountain Chickadee	2007	60.62	42.15	87.19	22	161
	2008	43.00	28.85	64.11	25	144
	2009	41.80	30.85	56.64	19	129
White-breasted Nuthatch	2007	31.94	22.73	44.88	21	138
	2008	17.60	12.69	24.41	20	100
	2009	26.69	19.96	35.69	18	140
Pygmy Nuthatch	**2007**	**83.32**	**51.56**	**134.65**	**30**	**192**
	2008	**31.09**	**22.47**	**43.04**	**20**	**105**
	2009	**91.71**	**63.81**	**131.81**	**22**	**216**
House Wren	2007	4.20	1.17	14.98	89	12

Common Name	Year	D	LCL	UCL	CV	n
House Wren (cont.)	2008	3.81	1.13	12.89	82	11
	2009	11.73	4.12	33.41	69	41
Western Bluebird	2007	24.72	17.69	34.55	20	63
	2008	28.89	20.47	40.76	21	94
	2009	33.59	25.81	43.73	16	101
Hermit Thrush	2007	4.60	2.53	8.37	37	42
	2008	3.05	1.76	5.30	34	36
	2009	6.77	4.37	10.49	27	75
American Robin	2007	23.45	14.57	37.75	29	78
	2008	21.61	12.02	38.83	37	84
	2009	16.58	10.26	26.79	30	64
Yellow-rumped Warbler	2007	10.81	6.63	17.63	30	35
	2008	24.95	17.70	35.18	21	102
	2009	23.26	15.05	35.94	27	85
Grace's Warbler	2007	25.81	16.98	39.23	26	111
	2008	26.58	17.25	40.96	27	145
	2009	36.79	23.81	56.86	27	189
Western Tanager	2007	25.54	18.60	35.08	19	143
	2008	24.15	17.78	32.79	19	172
	2009	21.80	17.26	27.54	14	146
Chipping Sparrow	2007	14.27	7.73	26.35	38	26
	2008	19.28	11.05	33.62	35	44
	2009	28.14	17.36	45.62	30	61
Dark-eyed Junco	2007	82.63	60.02	113.75	20	204
	2008	53.45	38.24	74.72	21	168
	2009	53.61	37.27	77.13	22	157
Black-headed Grosbeak	2007	14.63	6.69	32.03	50	26
	2008	14.71	7.11	30.42	46	35
	2009	6.47	2.78	15.06	54	13
Brown-headed Cowbird	2007	6.62	3.49	12.54	40	18
	2008	10.21	4.81	21.66	48	31
	2009	6.69	3.44	12.99	42	17

*MIS are in bold**; D** = estimated density (birds/km^2); **LCL** and **UCL** = lower and upper 90% confidence limits on *D*; **%CV** = percent coefficient of variation of *D*; *n* = number of observations used to estimate *D*. We did not include density estimates for species with $n < 60$ across years.

Squirrel Sign

In 2009, observers sampled 33 transects and 397 line segments (250-m each) for squirrel sign in the two habitats used for analysis (MC and PP). Observers covered over 99 hectares within the sampling landscape. We observed 6.89 feeding events per hectare in PP and MC combined. Sign was most dense on transect AZ-PP73 with an average of 26.7 feeding events per hectare sampled. Sign was almost four times as dense on PP transects (16.2 feeding events per hectare) as MC transects (2.2 feeding events per hectare). See Table 4 for feeding observations by transect.

Table 4: Squirrel sign totals by transect in Kaibab National Forest for Mixed-Conifer and Ponderosa Pine habitats, 2009.

Transect	Sum of Cones	Sum of Clippings	Sum of Middens	Total Sign	Effort	Area (ha)	Sign/Area (ha)
AZ-MC10	--	9	--	9	12	3.00	3.00
AZ-MC13	1	7	--	8	15	3.75	2.13
AZ-MC15	--	5	--	5	5	1.25	4.00
AZ-MC16	11	16	--	27	12	3.00	9.00
AZ-MC30	--	4	--	4	4	1.00	4.00
AZ-MC52	3	--	--	3	11	2.75	1.09
AZ-MC63	--	--	--	--	8	2.00	0.00
AZ-MC65	1	--	1	2	15	3.75	0.53
AZ-MC92	--	--	--	--	4	1.00	0.00
AZ-MC93	--	1	--	1	15	3.75	0.27
AZ-MC97	--	--	--	--	6	1.50	0.00
AZ-PP01	--	93	--	93	15	3.75	24.80
AZ-PP02	--	31	--	31	15	3.75	8.27
AZ-PP05	--	--	--	--	10	2.50	0.00
AZ-PP06	--	5	--	5	8	2.00	2.50
AZ-PP07	--	11	--	11	6	1.50	7.33
AZ-PP18	4	29	--	33	15	3.75	8.80
AZ-PP27	2	37	--	39	15	3.75	10.40
AZ-PP28	2	11	--	13	13	3.25	4.00
AZ-PP31	3	20	--	23	15	3.75	6.13
AZ-PP33	--	8	--	8	9	2.25	3.56
AZ-PP34	10	39	--	49	15	3.75	13.07
AZ-PP38	10	31	--	41	14	3.50	11.71
AZ-PP39	4	20	--	24	15	3.75	6.40
AZ-PP67	--	22	--	22	14	3.50	6.29
AZ-PP70	--	51	--	51	15	3.75	13.60
AZ-PP72	1	45	1	47	15	3.75	12.53
AZ-PP73	--	80	--	80	12	3.00	26.67
AZ-PP75	--	17	--	17	13	3.25	5.23
AZ-PP76	--	18	--	18	15	3.75	4.80
AZ-PP79	--	3	--	3	13	3.25	0.92
AZ-PP84	--	16	--	16	15	3.75	4.27
AZ-PP85	--	1	--	1	13	3.25	0.31
Grand Total	52	630	2	684	397	99.25	6.89

DISCUSSION AND RECOMMENDATIONS

The habitat-stratified transects produced excellent estimates with low coefficients of variation for three MIS in at least one habitat surveyed in 2009. Thus we would be able to detect habitat-specific population declines of at least 3% annually for Hairy Woodpecker, Juniper Titmouse, and Pygmy Nuthatch within 30 years or less. We listed all species with management designations observed from 2007-2009 in Appendix B.

We did not sample riparian or wetland habitats in 2009, so we detected few MIS associated with these habitats (Cinnamon Teal, Lincoln's Sparrow, and Yellow-breasted Chat). In the future, we would need to establish and survey at least 20 riparian transects in KNF to obtain enough detections to monitor these species. We also detected very few Red-naped Sapsuckers and Lucy's Warblers. These species occur in low densities in the habitats we surveyed and we are therefore less likely to encounter them. Wild Turkey may be present in sufficient numbers, but are difficult to detect because of their secretive and wary behavior.

This year, our survey technicians detected 110 species in KNF. This is 11 more species than KNF detected in 2007 and 14 more species than we detected in 2008. The number of individual birds detected is very close to the 2008 total. This may be a reflection of observers being more aware of low-density species in 2009. The technicians who conducted transects in 2009 were exceptional birders with particular skills in seeking out low-density species. All 14 species that were detected for the first time in 2009 were detected three times or fewer. In any given year of MBKNF, we can expect to see several detections of low-density species. In 2007, there were 10 species detected that were not detected in 2008-2009. These variations in the number of species recorded can be expected.

The 2009 Mixed Conifer analyses produced density estimates for 14 species that are lower than the 2007-2009 average. Nine species in MC have 2009 density estimates that are higher than the 2007-2009 average. The 2009 Pinyon-Juniper analyses produced density estimates for 10 species that are lower than the 2007-2009 average. 14 species in PJ have 2009 density estimates that are higher than the 2007-2009 average. The 2009 Ponderosa Pine analyses produced density estimates for nine species that are lower than the 2007-2009 average. 16 species in PP have 2009 density estimates that are higher than the 2007-2009 average.

Many of the species with low 2009 density estimates fall within the 90 percent confidence intervals of previous years' estimates. Once we have several more years of data, we will be able to determine what normal annual variation for a species is and what constitutes an alarming decline. For now, we will monitor species with low 2009 estimates in future years. If declines continue and are reinforced by future data, we may recommend management changes to KNF.

The RMBO habitat-based landbird monitoring protocol does not adequately detect some MIS such as the Northern Goshawk and Mexican Spotted Owl. The KNF monitors those species in separate efforts. One way to monitor the health of bird populations, especially small ones, is to monitor reproductive output at nests. Because of the already extensive point count effort undertaken each year, we could implement additional field techniques to target other high-priority species with little extra effort (e.g. call-playback surveys, known nest site visits). In the future, it will also be possible to analyze presence and absence of vegetation variables with those of the bird and squirrel communities. We are currently looking into which vegetation variables are the most useful for analyses. With the recent addition of monitoring projects in

adjacent National Forests (Coconino and Prescott), the expanded monitoring effort will provide more meaningful trend data to help guide management decisions throughout the KNF. If the KNF decides to switch to our new sampling design, we can pool data across forests to come up with detection functions, and therefore density estimates, for more species.

RMBO and its partners developed a new sampling design for monitoring birds. The new design is based on spatially-balanced, random samples placed without regard to existing vegetation conditions. The primary stratification level of the new design is the Bird Conservation Region (BCR) created by NABCI (2007). The transects are no longer linear but arranged in a four by four grid with points spaced 250 meters apart. Field methods remain the same. Benefits of our new design include:

- Spatially-balanced designs are statistically more efficient than simple random samples;
- Strata based on fixed attributes allow for relating changes in bird population to changes on the landscape through time;
- Each BCR within a state can be stratified differently, depending upon local needs and areas to which one wants to make inferences;
- All vegetation types are available for sampling;
- The design can incorporate weighting by factors that influence species' distributions;
- Aggregation of strata-wide estimates to BCR- or state-wide estimates is built into the design;
- Because each stratum has its own spatially-balanced, ordered sample, sampling effort can vary among strata and among years and still provide statistically valid estimates;
- Local population trends can be directly compared to regional trends;
- We can estimate occupancy at the transect level for species without enough detections for distance analysis but with at least 10 detections across all years;
- Incorporating spatial information in data analysis can increase precision; and
- Data from the previous sampling design can be used to calculate and compare densities with the new, BCR-based data (Blakesley and Hanni 2009).

We recommend that if the KNF decides to review its MIS list that it considers adding species that are of concern to agencies and partners within and outside the boundaries of the Forest (Appendix B). Here are the species that we recommend for consideration: Gray Vireo, Pinyon Jay, Virginia's Warbler, Black-throated Gray Warbler, and Grace's Warbler. These species are recognized for their importance as habitat indicators and as regionally emblematic species. We also record these species every year on KNF with enough detections to produce density estimates.

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APPENDIX A

All bird species observed on transects in Kaibab National Forest 2007-2009, with species totals by habitat. The first table has species that we were able to produce density estimates for in 2009. The second table has all other species observed in 2007-2009.

	Total # of individuals observed by habitat and year for species with Density Estimates[2]											
	2007				2008				2009			
Species[1]	MC[3]	PJ	PP	Total	MC	PJ	PP	Total	MC	PJ	PP	Total
Mourning Dove	6	31	39	76	12	51	64	127	6	135	52	193
Broad-tailed Hummingbird	26	5	24	55	31	14	44	89	36	28	44	108
Williamson's Sapsucker	43	--	2	45	78	--	3	81	78	1	8	87
Hairy Woodpecker	39	14	53	106	41	9	44	94	43	25	68	136
Northern Flicker	56	37	87	180	135	12	91	238	106	53	142	301
Western Wood-Pewee	43	29	121	193	155	15	155	325	68	24	111	203
Gray Flycatcher	1	78	6	85	--	88	30	118	--	191	15	206
Ash-throated Flycatcher	--	138	12	150	--	207	48	255	--	256	20	276
Gray Vireo	--	22	--	22	--	8	--	8	--	48	1	49
Plumbeous Vireo	6	30	103	139	4	64	118	186	10	113	136	259
Warbling Vireo	99	2	31	132	259	3	32	294	260	3	80	343
Steller's Jay	25	33	109	167	84	26	110	220	46	25	164	235
Western Scrub-Jay	1	26	13	40	--	43	3	46	--	77	3	80
Pinyon Jay	--	45	--	45	--	85	11	96	--	248	9	257
Common Raven	20	94	65	179	82	139	78	299	66	153	68	287
Violet-green Swallow	78	16	81	175	189	35	100	324	153	66	220	439
Mountain Chickadee	79	157	175	411	206	64	194	464	114	121	182	417
Juniper Titmouse	--	85	5	90	--	148	7	155	--	181	5	186
Red-breasted Nuthatch	42	6	4	52	81	1	--	82	48	--	1	49
White-breasted Nuthatch	29	70	144	243	20	49	128	197	31	81	164	276
Pygmy Nuthatch	30	33	241	304	9	24	133	166	40	64	364	468
Bewick's Wren	--	66	1	67	1	129	7	137	--	212	5	217
House Wren	52	1	15	68	113	--	20	133	122	12	46	180
Ruby-crowned Kinglet	58	2	6	66	217	--	--	217	287	--	10	297
Blue-gray Gnatcatcher	--	32	--	32	--	27	1	28	--	35	2	37
Western Bluebird	2	13	71	86	27	16	108	151	29	46	150	225
Mountain Bluebird	--	53	17	70	3	10	3	16	1	41	3	45
Hermit Thrush	159	8	43	210	427	7	46	480	300	15	89	404
American Robin	19	46	88	153	75	24	113	212	60	38	87	185
Yellow-rumped Warbler	158	6	42	206	541	23	106	670	456	15	97	568
Black-throated Gray Warbler	--	76	15	91	1	144	24	169	--	186	13	199

Species[1]	Total # of individuals observed by habitat and year for species with Density Estimates[2]											
	2007				2008				2009			
	MC[3]	PJ	PP	Total	MC	PJ	PP	Total	MC	PJ	PP	Total
Grace's Warbler	15	4	116	135	50	15	155	220	28	18	206	252
Western Tanager	136	56	158	350	330	76	201	607	211	53	175	439
Spotted Towhee	3	106	4	113	--	75	11	86	--	70	8	78
Chipping Sparrow	23	96	34	153	177	116	51	344	89	177	77	343
Dark-eyed Junco	94	47	252	393	273	21	204	498	185	31	207	423
Black-headed Grosbeak	16	26	40	82	31	48	46	125	47	49	37	133
Brown-headed Cowbird	1	30	20	51	7	26	32	65	--	53	21	74
Pine Siskin	7	--	3	10	204	2	18	224	133	2	14	149
Red Squirrel	24	5	3	32	72	--	14	86	48	--	2	50

[1] Common Names are from the A.O.U. Check-list of North American Birds, Seventh Edition (2003).
[2] The number of transects and habitats surveyed each year varied.
[3] Habitats: MC=Mixed-Conifer; PJ=Pinyon-Juniper PP=Ponderosa Pine.

Species[1]	Total # of individuals observed by habitat and year for species without Density Estimates[2]											
	2007				2008				2009			
	MC[3]	PJ	PP	Total	MC	PJ	PP	Total	MC	PJ	PP	Total
Common Goldeneye	1	--	2	3	--	--	--	0	--	--	--	0
Dusky Grouse	--	--	--	0	--	--	--	0	2	--	--	2
Wild Turkey	--	1	8	9	2	1	3	6	--	1	2	3
Gambel's Quail	--	--	--	0	--	14	--	14	--	27	--	27
Pied-billed Grebe	--	--	--	0	--	--	--	0	--	--	1	1
Double-crested Cormorant	--	--	--	0	--	--	1	1	--	--	1	1
Great Blue Heron	--	--	1	1	--	--	2	2	--	--	1	1
Turkey Vulture	--	2	2	4	3	3	2	8	2	8	7	17
Cooper's Hawk	2	--	--	2	--	--	--	0	--	1	--	1
Northern Goshawk	1	--	--	1	--	1	--	1	--	--	1	1
Zone-tailed Hawk	--	--	--	0	--	--	--	0	--	1	--	1
Red-tailed Hawk	--	5	3	8	1	3	6	10	3	9	2	14
American Kestrel	--	1	1	2	--	2	--	2	--	--	--	0
Peregrine Falcon	--	--	--	0	2	--	--	2	--	--	--	0
American Coot	--	--	--	0	--	--	--	0	--	--	1	1
Band-tailed Pigeon	1	--	--	1	3	2	--	5	--	1	2	3
Eurasian Collared-Dove	--	--	--	0	--	--	--	0	--	1	--	1
Greater Roadrunner	--	--	--	0	--	4	1	5	--	6	--	6
Northern Pygmy-Owl	--	--	--	0	--	--	--	0	--	--	1	1
Northern Saw-whet Owl	--	--	--	0	--	--	--	0	--	--	1	1
Common Nighthawk	--	1	5	6	--	2	5	7	1	6	5	12
White-throated Swift	8	8	2	18	1	6	--	7	--	9	3	12
Black-chinned Hummingbird	--	2	3	5	--	--	--	0	3	12	--	15
Acorn Woodpecker	1	1	8	10	1	2	3	6	--	1	15	16
Red-naped Sapsucker	2	--	1	3	7	--	--	7	11	--	2	13
Ladder-backed Woodpecker	--	1	--	1	--	--	--	0	--	--	--	0
Downy Woodpecker	3	1	--	4	3	1	--	4	3	--	3	6
American Three-toed Woodpecker	1	--	--	1	1	--	--	1	7	--	5	12
Olive-sided Flycatcher	2	--	1	3	7	3	4	14	1	--	3	4
Greater Pewee	--	--	--	0	--	--	--	0	--	--	1	1
Hammond's Flycatcher	--	--	14	14	--	--	--	0	--	--	3	3
Dusky Flycatcher	--	10	14	24	--	6	--	6	4	21	26	51
Cordilleran Flycatcher	11	--	2	13	19	4	12	35	14	3	16	33
Say's Phoebe	--	1	--	1	--	1	1	2	--	9	--	9

Species[1]	Total # of individuals observed by habitat and year for species without Density Estimates[2]											
	2007				2008				2009			
	MC[3]	PJ	PP	Total	MC	PJ	PP	Total	MC	PJ	PP	Total
Cassin's Kingbird	--	3	--	3	--	15	--	15	--	30	11	41
Western Kingbird	--	3	1	4	--	--	--	0	--	7	--	7
Loggerhead Shrike	--	--	--	0	--	--	--	0	--	1	--	1
Clark's Nutcracker	4	--	3	7	45	27	15	87	17	--	10	27
American Crow	--	20	--	20	--	--	8	8	--	9	13	22
Horned Lark	--	--	--	0	--	--	--	0	--	3	--	3
Purple Martin	2	--	5	7	--	--	1	1	--	3	11	14
Tree Swallow	--	1	2	3	--	--	--	0	--	--	--	0
Northern Rough-winged Swallow	--	5	3	8	--	3	--	3	--	--	--	0
Bushtit	--	10	--	10	--	15	--	15	--	21	--	21
Brown Creeper	9	4	13	26	40	1	21	62	11	--	21	32
Rock Wren	--	1	--	1	7	11	2	20	1	6	3	10
Canyon Wren	2	--	1	3	2	--	--	2	--	2	--	2
Golden-crowned Kinglet	--	--	1	1	--	--	--	0	--	--	--	0
Black-tailed Gnatcatcher	--	2	--	2	--	--	--	0	--	--	--	0
Townsend's Solitaire	12	2	13	27	2	--	4	6	14	1	16	31
Northern Mockingbird	--	30	--	30	--	39	--	39	--	102	--	102
Curve-billed Thrasher	--	--	--	0	--	--	--	0	--	3	--	3
Olive Warbler	2	2	11	15	--	--	--	0	1	1	11	13
Orange-crowned Warbler	--	--	--	0	--	--	--	0	1	--	--	1
Virginia's Warbler	18	9	28	55	24	13	27	64	8	2	9	19
Lucy's Warbler	--	--	1	1	--	--	--	0	--	--	--	0
Yellow Warbler	4	1	10	15	1	1	1	3	--	--	--	0
MacGillivray's Warbler	--	2	--	2	--	--	--	0	--	--	--	0
Red-faced Warbler	--	--	--	0	8	1	--	9	3	--	6	9
Hepatic Tanager	--	1	2	3	1	8	5	14	--	35	17	52
Green-tailed Towhee	--	2	--	2	--	3	--	3	--	10	--	10
Canyon Towhee	--	--	--	0	--	--	--	0	--	2	--	2
Brewer's Sparrow	--	11	1	12	--	7	--	7	--	13	--	13
Black-chinned Sparrow	--	3	--	3	--	1	--	1	--	7	--	7
Vesper Sparrow	--	12	10	22	--	14	6	20	--	33	--	33
Lark Sparrow	2	19	4	25	2	41	1	44	--	38	--	38
Black-throated Sparrow	--	8	--	8	--	15	--	15	--	5	--	5
Lincoln's Sparrow	--	1	--	1	--	--	--	0	--	--	--	0

Species[1]	Total # of individuals observed by habitat and year for species without Density Estimates[2]											
	2007				2008				2009			
	MC[3]	PJ	PP	Total	MC	PJ	PP	Total	MC	PJ	PP	Total
White-crowned Sparrow	--	--	--	0	--	--	--	0	1	--	--	1
Blue Grosbeak	--	1	--	1	--	--	--	0	--	--	--	0
Lazuli Bunting	--	--	--	0	2	4	--	6	--	--	--	0
Red-winged Blackbird	--	--	--	0	--	--	2	2	--	--	7	7
Eastern Meadowlark	--	--	--	0	--	3	--	3	--	3	--	3
Western Meadowlark	--	15	10	25	--	--	12	12	--	3	6	9
Brewer's Blackbird	--	--	--	0	--	--	--	0	--	--	1	1
Bullock's Oriole	--	--	--	0	--	1	--	1	--	1	--	1
Scott's Oriole	--	--	--	0	--	2	--	2	--	17	--	17
Pine Grosbeak	3	--	--	3	5	--	--	5	--	--	--	0
Cassin's Finch	5	--	--	5	11	--	2	13	10	1	5	16
House Finch	4	7	3	14	--	25	--	25	1	17	2	20
Red Crossbill	--	--	--	0	11	16	7	34	63	3	197	263
Lesser Goldfinch	--	--	--	0	1	5	2	8	--	19	1	20
American Goldfinch	--	--	2	2	--	--	--	0	--	--	--	0
Evening Grosbeak	--	--	--	0	5	--	--	5	9	--	--	9
Aberts Squirrel	21	2	9	32	--	1	11	12	6	4	14	24

[1] Common Names are from the A.O.U. Check-list of North American Birds, Seventh Edition (2003).
[2] The number of transects and habitats surveyed each year varied.
[3] Habitats: MC=Mixed-Conifer; PJ=Pinyon-Juniper PP=Ponderosa Pine.

APPENDIX B

List of bird species with management designation observed on transects in Kaibab National Forest, 2007-2009.

Species[1]	Species Management Designation[2]							
		USFS[3]		USFWS[4]			PIF[5]	
	AZGFD	Kaibab NF	Region 3	BCR16	BCR34	Region 2	BCR16	BCR34
Dusky Grouse	SGCN						CC	
Wild Turkey	SGCN	MIS						
Gambel's Quail								CS,RS
Double-crested Cormorant	SGCN							
Cooper's Hawk								RS
Northern Goshawk	SGCN	MIS	R3SS		BCC			RC
Peregrine Falcon	SGCN		R3SS	BCC	BCC	BCC		
Band-tailed Pigeon							CC	CC
Common Nighthawk							RC	
White-throated Swift							CC,RS	CC,RS
Black-chinned Hummingbird					BCC			
Broad-tailed Hummingbird							RS	
Williamson's Sapsucker				BCC			CS,RS	
Red-naped Sapsucker	SGCN	MIS						
Downy Woodpecker	SGCN							
Hairy Woodpecker		MIS						
American Three-toed Woodpecker	SGCN							
Olive-sided Flycatcher	SGCN						CC	CC
Cordilleran Flycatcher							RS	RS
Say's Phoebe							RS	
Cassin's Kingbird								RC,RS
Gray Vireo				BCC		BCC	CC,RC,RS	CC,RC,RS
Plumbeous Vireo							RS	RS
Warbling Vireo							RS	
Pinyon Jay				BCC			CC,RC,CS,RS	CC,RC
Clark's Nutcracker	SGCN						CS,RS	
Purple Martin	SGCN							
Tree Swallow	SGCN							
Violet-green Swallow							RS	
Juniper Titmouse		MIS					RC,RS	RC,RS
Pygmy Nuthatch		MIS					RC	RS
Rock Wren							RS	

Species[1]	Species Management Designation[2]							
	AZGFD	USFS[3]		USFWS[4]			PIF[5]	
		Kaibab NF	Region 3	BCR16	BCR34	Region 2	BCR16	BCR34
Canyon Wren							RC	RS
Golden-crowned Kinglet	SGCN							
Ruby-crowned Kinglet	SGCN							
Western Bluebird							RS	RS
Mountain Bluebird							RC,CS,RS	
Olive Warbler					BCC	BCC		RS
Orange-crowned Warbler	SGCN							
Virginia's Warbler				BCC			CC,RC,RS	CC,RS
Lucy's Warbler		MIS						CC,RC,CS,RS
Black-throated Gray Warbler				BCC	BCC	BCC	RC	RC
Grace's Warbler				BCC	BCC	BCC	CC,RC	
MacGillivray's Warbler	SGCN							
Red-faced Warbler					BCC			CC,CS,RS
Hepatic Tanager								RS
Green-tailed Towhee	SGCN						CS,RS	
Spotted Towhee								RC,RS
Abert's Towhee								CC
Brewer's Sparrow							CC,RC	
Black-chinned Sparrow						BCC	CC	CC,RS
Black-throated Sparrow							RC	RS
Lincoln's Sparrow	SGCN	MIS						
Eastern Meadowlark								RC
Hooded Oriole						BCC		RS
Scott's Oriole								CS,RS
Pine Grosbeak	SGCN							
Cassin's Finch	SGCN						RC	
Pine Siskin							RC,RS	
Evening Grosbeak	SGCN							

[1] Common Names are from the A.O.U. Check-list of North American Birds, Seventh Edition (2003).
[2] AZGFD = Arizona Game and Fish Department, SGCN = Species of Greatest Conservation Need (Arizona's Comprehensive Wildlife Conservation Strategy: 2005-2015 [2006]).
[3] USFS = United States Forest Service, KN F= Kaibab National Forest, MIS = Management Indicator Species; Region3 = USFS Region 3, R3SS = USFS Region 3 Sensitive Species.
[4] USFWS = U.S. Fish and Wildlife Service, BCR=Bird Conservation Region, Region 2 = USFWS Region 2, BCC = Bird of Conservation Concern.
[5] PIF = Partners in Flight, BCR = Bird Conservation Region, CC = Continental Concern Species, RC = Regional Concern Species, CS = Continental Stewardship Species, RS = Regional Stewardship Species.

APPENDIX C

All bird species observed on transects in Kaibab National Forest, by ranger district, 2007-2009.

	North District												
	Mid-elevation Conifer				Pinyon-Juniper				Ponderosa Pine				District Total
Species	2007	2008	2009	Total	2007	2008	2009	Total	2007	2008	2009	Total	
Abert's Squirrel	17	--	6	23	2	--	--	2	1	5	1	7	32
Acorn Woodpecker	--	--	--	--	--	--	--	--	--	--	6	6	6
American Coot	--	--	--	--	--	--	--	--	--	--	--	--	--
American Crow	--	--	--	--	1	--	6	7	--	--	1	1	8
American Goldfinch	--	--	--	--	--	--	--	--	2	--	--	2	2
American Kestrel	--	--	--	--	--	--	--	--	--	--	--	--	--
American Robin	9	67	57	133	6	--	14	20	14	27	24	65	218
American Three-toed Woodpecker	1	1	7	9	--	--	--	--	--	--	4	4	13
Ash-throated Flycatcher	--	--	--	--	21	38	55	114	--	--	1	1	115
Band-tailed Pigeon	--	--	--	--	--	2	--	2	--	--	--	--	2
Bewick's Wren	--	1	--	1	14	26	23	63	--	1	--	1	65
Black-chinned Hummingbird	--	--	3	3	--	--	5	5	2	--	--	2	10
Black-chinned Sparrow	--	--	--	--	1	1	--	2	--	--	--	--	2
Black-headed Grosbeak	14	22	41	77	2	10	16	28	7	7	5	19	124
Black-tailed Gnatcatcher	--	--	--	--	--	--	--	--	--	--	--	--	--
Black-throated Gray Warbler	--	--	--	--	2	35	20	57	--	--	1	1	58
Black-throated Sparrow	--	--	--	--	5	13	--	18	--	--	--	--	18
Blue Grosbeak	--	--	--	--	--	--	--	--	--	--	--	--	--
Blue-gray Gnatcatcher	--	--	--	--	7	16	13	36	--	--	1	1	37
Brewer's Blackbird	--	--	--	--	--	--	--	--	--	--	1	1	1
Brewer's Sparrow	--	--	--	--	--	--	3	3	--	--	--	--	3
Broad-tailed Hummingbird	17	25	23	65	1	5	5	11	18	30	17	65	141
Brown Creeper	6	37	8	51	--	--	--	--	6	10	5	21	72
Brown-headed Cowbird	1	2	--	3	--	2	16	18	1	1	4	6	27
Bullock's Oriole	--	--	--	--	--	--	--	--	--	--	--	--	--
Bushtit	--	--	--	--	--	10	14	24	--	--	--	--	24
Canyon Towhee	--	--	--	--	--	--	--	--	--	--	--	--	--
Canyon Wren	--	--	--	--	--	--	--	--	--	--	--	--	--
Cassin's Finch	5	11	10	26	--	--	--	--	--	2	--	2	28
Cassin's Kingbird	--	--	--	--	--	3	6	9	--	--	--	--	9
Chipping Sparrow	23	174	87	284	6	13	38	57	15	23	40	78	419

	North District												
	Mid-elevation Conifer				Pinyon-Juniper				Ponderosa Pine				District Total
Species	2007	2008	2009	Total	2007	2008	2009	Total	2007	2008	2009	Total	
Clark's Nutcracker	3	34	16	53	--	13	--	13	3	10	7	20	86
Common Goldeneye	1	--	--	1	--	--	--	--	2	--	--	2	3
Common Nighthawk	--	--	--	--	--	2	4	6	5	2	--	7	13
Common Raven	18	78	55	151	6	3	37	46	10	15	12	37	234
Cooper's Hawk	2	--	--	2	--	--	--	--	--	--	--	--	2
Cordilleran Flycatcher	--	1	7	8	--	--	--	--	--	1	1	2	10
Curve-billed Thrasher	--	--	--	--	--	--	--	--	--	--	--	--	--
Dark-eyed Junco	67	253	161	481	--	1	8	9	76	91	60	227	717
Double-crested Cormorant	--	--	--	--	--	--	--	--	--	--	--	--	--
Downy Woodpecker	1	3	2	6	--	--	--	--	--	--	2	2	8
Dusky Flycatcher	--	--	3	3	--	--	8	8	1	--	12	13	24
Dusky Grouse	--	--	2	2	--	--	--	--	--	--	--	--	2
Eastern Meadowlark	--	--	--	--	--	--	--	--	--	--	--	--	--
Eurasian Collared-Dove	--	--	--	--	--	--	--	--	--	--	--	--	--
Evening Grosbeak	--	5	8	13	--	--	--	--	--	--	--	--	13
Gambel's Quail	--	--	--	--	--	--	--	--	--	--	--	--	--
Golden-crowned Kinglet	--	--	--	--	--	--	--	--	--	--	--	--	--
Grace's Warbler	3	49	27	79	--	--	--	--	56	98	118	272	351
Gray Flycatcher	--	--	--	--	11	33	44	88	--	2	--	2	90
Gray Vireo	--	--	--	--	3	6	13	22	--	--	--	--	22
Great Blue Heron	--	--	--	--	--	--	--	--	--	--	--	--	--
Greater Pewee	--	--	--	--	--	--	--	--	--	--	1	1	1
Greater Roadrunner	--	--	--	--	--	--	--	--	--	--	--	--	--
Green-tailed Towhee	--	--	--	--	--	2	--	2	--	--	--	--	2
Hairy Woodpecker	33	38	35	106	1	2	8	11	33	26	31	90	207
Hammond's Flycatcher	--	--	--	--	--	--	--	--	4	--	--	4	4
Hepatic Tanager	--	1	--	1	--	2	--	2	--	--	2	2	5
Hermit Thrush	145	404	266	815	--	--	4	4	33	40	58	131	950
Horned Lark	--	--	--	--	--	--	--	--	--	--	--	--	--
House Finch	4	--	1	5	--	16	6	22	1	--	--	1	28
House Wren	34	99	103	236	--	--	--	--	12	17	27	56	292
Juniper Titmouse	--	--	--	--	3	18	59	80	2	1	--	3	83
Ladder-backed Woodpecker	--	--	--	--	--	--	--	--	--	--	--	--	--
Lark Sparrow	--	2	--	2	--	--	5	5	--	--	--	--	7
Lazuli Bunting	--	2	--	2	--	4	--	4	--	--	--	--	6

	North District												
	Mid-elevation Conifer				Pinyon-Juniper				Ponderosa Pine				District Total
Species	2007	2008	2009	Total	2007	2008	2009	Total	2007	2008	2009	Total	
Lesser Goldfinch	--	1	--	1	--	1	--	1	--	1	--	1	3
Lincoln's Sparrow	--	--	--	--	--	--	--	--	--	--	--	--	--
Loggerhead Shrike	--	--	--	--	--	--	--	--	--	--	--	--	--
Lucy's Warbler	--	--	--	--	--	--	--	--	--	--	--	--	--
MacGillivray's Warbler	--	--	--	--	--	--	--	--	--	--	--	--	--
Mountain Bluebird	--	1	1	2	--	4	28	32	2	--	--	2	36
Mountain Chickadee	61	183	93	337	28	9	59	96	52	45	37	134	567
Mourning Dove	5	11	3	19	--	17	20	37	17	37	8	62	118
Northern Flicker	45	125	90	260	4	1	18	23	30	48	62	140	423
Northern Goshawk	1	--	--	1	--	--	--	--	--	--	1	1	2
Northern Mockingbird	--	--	--	--	--	--	13	13	--	--	--	--	13
Northern Pygmy-Owl	--	--	--	--	--	--	--	--	--	--	--	--	--
Northern Rough-winged Swallow	--	--	--	--	--	--	--	--	--	--	--	--	--
Northern Saw-whet Owl	--	--	--	--	--	--	--	--	--	--	--	--	--
Olive Warbler	--	--	--	--	--	--	--	--	3	--	--	3	3
Olive-sided Flycatcher	--	3	--	3	--	--	--	--	1	4	2	7	10
Orange-crowned Warbler	--	--	1	1	--	--	--	--	--	--	--	--	1
Peregrine Falcon	--	--	--	--	--	--	--	--	--	--	--	--	--
Pied-billed Grebe	--	--	--	--	--	--	--	--	--	--	--	--	--
Pine Grosbeak	3	5	--	8	--	--	--	--	--	--	--	--	8
Pine Siskin	4	203	131	338	--	1	--	1	3	14	8	25	364
Pinyon Jay	--	--	--	--	10	8	31	49	--	--	--	--	49
Plumbeous Vireo	--	1	7	8	2	11	23	36	21	27	42	90	134
Purple Martin	--	--	--	--	--	--	--	--	--	--	1	1	1
Pygmy Nuthatch	26	3	28	57	--	--	6	6	143	41	92	276	339
Red Crossbill	--	10	58	68	--	16	2	18	--	2	103	105	191
Red Squirrel	23	71	44	138	1	--	--	1	1	9	--	10	149
Red-breasted Nuthatch	35	59	37	131	--	1	--	1	3	--	1	4	136
Red-faced Warbler	--	1	--	1	--	--	--	--	--	--	--	--	1
Red-naped Sapsucker	2	6	10	18	--	--	--	--	1	--	--	1	19
Red-tailed Hawk	--	1	3	4	--	1	4	5	2	2	1	5	14
Red-winged Blackbird	--	--	--	--	--	--	--	--	--	--	--	--	--
Rock Wren	--	1	1	2	1	4	--	5	--	1	1	2	9
Ruby-crowned Kinglet	55	217	272	544	--	--	--	--	5	--	6	11	555
Say's Phoebe	--	--	--	--	--	1	--	1	--	--	--	--	1

	North District												
	Mid-elevation Conifer				Pinyon-Juniper				Ponderosa Pine				District Total
Species	2007	2008	2009	Total	2007	2008	2009	Total	2007	2008	2009	Total	
Scott's Oriole	--	--	--	--	--	--	--	--	--	--	--	--	--
Spotted Towhee	2	--	--	2	25	28	22	75	--	4	2	6	83
Steller's Jay	11	63	35	109	--	9	10	19	45	43	38	126	254
Townsend's Solitaire	2	1	8	11	--	--	--	--	5	--	4	9	20
Tree Swallow	--	--	--	--	1	--	--	1	--	--	--	--	1
Turkey Vulture	--	3	1	4	--	--	2	2	1	1	--	2	8
Vesper Sparrow	--	--	--	--	--	1	4	5	--	--	--	--	5
Violet-green Swallow	74	180	125	379	--	2	8	10	30	66	39	135	524
Virginia's Warbler	--	2	1	3	--	10	1	11	3	1	4	8	22
Warbling Vireo	90	252	245	587	--	3	--	3	22	31	63	116	706
Western Bluebird	2	27	24	53	--	5	3	8	19	45	60	124	185
Western Kingbird	--	--	--	--	--	--	--	--	--	--	--	--	--
Western Meadowlark	--	--	--	--	--	--	2	2	--	--	--	--	2
Western Scrub-Jay	--	--	--	--	4	3	18	25	--	1	--	1	26
Western Tanager	122	306	181	609	2	15	12	29	95	128	74	297	935
Western Wood-Pewee	34	142	55	231	--	--	10	10	35	69	34	138	379
White-breasted Nuthatch	7	14	23	44	9	11	32	52	46	44	49	139	235
White-crowned Sparrow	--	--	1	1	--	--	--	--	--	--	--	--	1
White-throated Swift	8	1	--	9	5	2	6	13	1	--	--	1	23
Wild Turkey	--	2	--	2	--	--	--	--	1	--	1	2	4
Williamson's Sapsucker	43	78	73	194	--	--	--	--	2	3	6	11	205
Yellow Warbler	--	--	--	--	--	--	--	--	1	--	--	1	1
Yellow-rumped Warbler	139	519	420	1078	--	--	--	--	12	60	27	99	1177
Zone-tailed Hawk	--	--	--	--	--	--	--	--	--	--	--	--	--

Species	Tusayan District								
	Pinyon-Juniper				Ponderosa Pine				District Total
	2007	2008	2009	Total	2007	2008	2009	Total	
Aberts Squirrel	--	--	--	--	3	--	2	5	5
Acorn Woodpecker	--	--	--	--	--	--	2	2	2
American Coot	--	--	--	--	--	--	--	--	--
American Crow	19	--	3	22	--	--	--	--	22
American Goldfinch	--	--	--	--	--	--	--	--	--
American Kestrel	--	1	--	1	--	--	--	--	1
American Robin	10	2	2	14	10	16	15	41	55
American Three-toed Woodpecker	--	--	--	--	--	--	1	1	1
Ash-throated Flycatcher	60	94	117	271	11	37	14	62	333
Band-tailed Pigeon	--	--	--	--	--	--	--	--	--
Bewick's Wren	30	46	95	171	1	2	5	8	179
Black-chinned Hummingbird	2	--	2	4	1	--	--	1	5
Black-chinned Sparrow	--	--	--	--	--	--	--	--	--
Black-headed Grosbeak	3	6	9	18	12	4	6	22	40
Black-tailed Gnatcatcher	--	--	--	--	--	--	--	--	--
Black-throated Gray Warbler	60	91	127	278	12	20	8	40	318
Black-throated Sparrow	3	--	--	3	--	--	--	--	3
Blue Grosbeak	--	--	--	--	--	--	--	--	--
Blue-gray Gnatcatcher	17	10	17	44	--	--	1	1	45
Brewer's Blackbird	--	--	--	--	--	--	--	--	--
Brewer's Sparrow	--	2	8	10	1	--	--	1	11
Broad-tailed Hummingbird	--	1	11	12	--	1	6	7	19
Brown Creeper	2	--	--	2	3	1	--	4	6
Brown-headed Cowbird	11	12	20	43	2	5	2	9	52
Bullock's Oriole	--	--	--	--	--	--	--	--	--
Bushtit	--	5	5	10	--	--	--	--	10
Canyon Towhee	--	--	--	--	--	--	--	--	--
Canyon Wren	--	--	--	--	--	--	--	--	--
Cassin's Finch	--	--	1	1	--	--	1	1	2
Cassin's Kingbird	1	9	16	26	--	--	11	11	37
Chipping Sparrow	31	36	52	119	2	6	8	16	135
Clark's Nutcracker	--	--	--	--	--	1	3	4	4
Common Goldeneye	--	--	--	--	--	--	--	--	--
Common Nighthawk	--	--	--	--	--	1	2	3	3
Common Raven	28	65	65	158	6	11	13	30	188
Cooper's Hawk	--	--	--	--	--	--	--	--	--
Cordilleran Flycatcher	--	1	2	3	--	1	--	1	4
Curve-billed Thrasher	--	--	--	--	--	--	--	--	--
Dark-eyed Junco	13	6	6	25	49	28	38	115	140
Double-crested Cormorant	--	--	--	--	--	--	--	--	--
Downy Woodpecker	1	--	--	1	--	--	1	1	2
Dusky Flycatcher	3	4	3	10	--	--	6	6	16
Dusky Grouse	--	--	--	--	--	--	--	--	--
Eastern Meadowlark	--	--	--	--	--	--	--	--	--
Eurasian Collared-Dove	--	--	--	--	--	--	--	--	--
Evening Grosbeak	--	--	--	--	--	--	--	--	--
Gambel's Quail	--	--	--	--	--	--	--	--	--
Golden-crowned Kinglet	--	--	--	--	--	--	--	--	--
Grace's Warbler	3	3	3	9	16	37	31	84	93

Species	Tusayan District								
	Pinyon-Juniper				Ponderosa Pine				District Total
	2007	2008	2009	Total	2007	2008	2009	Total	
Gray Flycatcher	38	34	92	164	3	16	11	30	194
Gray Vireo	17	--	29	46	--	--	1	1	47
Great Blue Heron	--	--	--	--	--	--	--	--	--
Greater Pewee	--	--	--	--	--	--	--	--	--
Greater Roadrunner	--	--	4	4	--	--	--	--	4
Green-tailed Towhee	2	1	3	6	--	--	--	--	6
Hairy Woodpecker	8	6	11	25	15	8	9	32	57
Hammond's Flycatcher	--	--	--	--	8	--	--	8	8
Hepatic Tanager	--	--	4	4	1	2	3	6	10
Hermit Thrush	8	1	6	15	1	1	5	7	22
Horned Lark	--	--	--	--	--	--	--	--	--
House Finch	1	1	1	3	1	--	2	3	6
House Wren	--	--	--	--	--	--	--	--	--
Juniper Titmouse	37	69	74	180	3	3	5	11	191
Ladder-backed Woodpecker	1	--	--	1	--	--	--	--	1
Lark Sparrow	3	2	3	8	--	--	--	--	8
Lazuli Bunting	--	--	--	--	--	--	--	--	--
Lesser Goldfinch	--	1	4	5	--	--	--	--	5
Lincoln's Sparrow	1	--	--	1	--	--	--	--	1
Loggerhead Shrike	--	--	1	1	--	--	--	--	1
Lucy's Warbler	--	--	--	--	1	--	--	1	1
MacGillivray's Warbler	--	--	--	--	--	--	--	--	--
Mountain Bluebird	11	4	4	19	11	--	--	11	30
Mountain Chickadee	92	44	45	181	49	36	33	118	299
Mourning Dove	10	7	22	39	4	9	14	27	66
Northern Flicker	10	3	15	28	10	10	20	40	68
Northern Goshawk	--	1	--	1	--	--	--	--	1
Northern Mockingbird	3	--	10	13	--	--	--	--	13
Northern Pygmy-Owl	--	--	--	--	--	--	1	1	1
Northern Rough-winged Swallow	4	2	--	6	--	--	--	--	6
Northern Saw-whet Owl	--	--	--	--	--	--	--	--	--
Olive Warbler	--	--	--	--	--	--	--	--	--
Olive-sided Flycatcher	--	2	--	2	--	--	--	--	2
Orange-crowned Warbler	--	--	--	--	--	--	--	--	--
Peregrine Falcon	--	--	--	--	--	--	--	--	--
Pied-billed Grebe	--	--	--	--	--	--	--	--	--
Pine Grosbeak	--	--	--	--	--	--	--	--	--
Pine Siskin	--	--	2	2	--	1	1	2	4
Pinyon Jay	13	25	188	226	--	8	9	17	243
Plumbeous Vireo	12	35	53	100	34	30	36	100	200
Purple Martin	--	--	--	--	2	--	--	2	2
Pygmy Nuthatch	23	8	12	43	52	20	85	157	200
Red Crossbill	--	--	1	1	--	3	50	53	54
Red Squirrel	3	--	--	3	2	2	--	4	7
Red-breasted Nuthatch	--	--	--	--	1	--	--	1	1
Red-faced Warbler	--	--	--	--	--	--	1	1	1
Red-naped Sapsucker	--	--	--	--	--	--	--	--	--
Red-tailed Hawk	--	--	1	1	--	1	1	2	3
Red-winged Blackbird	--	--	--	--	--	--	--	--	--

Species	Tusayan District								
	Pinyon-Juniper				Ponderosa Pine				District Total
	2007	2008	2009	Total	2007	2008	2009	Total	
Rock Wren	--	5	3	8	--	--	1	1	9
Ruby-crowned Kinglet	1	--	--	1	1	--	--	1	2
Say's Phoebe	--	--	2	2	--	--	--	--	2
Scott's Oriole	--	--	3	3	--	--	--	--	3
Spotted Towhee	42	31	26	99	4	4	--	8	107
Steller's Jay	12	3	4	19	30	15	38	83	102
Townsend's Solitaire	1	--	--	1	2	2	2	6	7
Tree Swallow	--	--	--	--	2	--	--	2	2
Turkey Vulture	1	1	3	5	--	--	2	2	7
Vesper Sparrow	10	6	6	22	1	--	--	1	23
Violet-green Swallow	13	18	47	78	30	21	53	104	182
Virginia's Warbler	3	--	--	3	12	3	1	16	19
Warbling Vireo	--	--	2	2	5	--	1	6	8
Western Bluebird	5	6	22	33	13	18	35	66	99
Western Kingbird	--	--	4	4	--	--	--	--	4
Western Meadowlark	--	--	--	--	--	--	--	--	--
Western Scrub-Jay	12	11	24	47	4	2	1	7	54
Western Tanager	14	18	7	39	28	26	25	79	118
Western Wood-Pewee	15	1	--	16	21	13	18	52	68
White-breasted Nuthatch	45	26	33	104	28	23	30	81	185
White-crowned Sparrow	--	--	--	--	--	--	--	--	--
White-throated Swift	1	--	2	3	--	--	1	1	4
Wild Turkey	--	1	1	2	2	--	--	2	4
Williamson's Sapsucker	--	--	--	--	--	--	1	1	1
Yellow Warbler	1	--	--	1	--	--	--	--	1
Yellow-rumped Warbler	3	4	3	10	12	10	11	33	43
Zone-tailed Hawk	--	--	1	1	--	--	--	--	1

Species	Williams District												
	Mid-elevation Conifer				Pinyon-Juniper				Ponderosa Pine				District Total
	2007	2008	2009	Total	2007	2008	2009	Total	2007	2008	2009	Total	
Aberts Squirrel	4	--	--	4	--	1	4	5	5	6	11	22	31
Acorn Woodpecker	1	1	--	2	1	2	1	4	8	3	7	18	24
American Coot	--	--	--	--	--	--	--	--	--	--	1	1	1
American Crow	--	--	--	--	--	--	--	--	--	8	12	20	20
American Goldfinch	--	--	--	--	--	--	--	--	--	--	--	--	--
American Kestrel	--	--	--	--	1	1	--	2	1	--	--	1	3
American Robin	10	8	3	21	30	22	22	74	64	70	48	182	277
American Three-toed Woodpecker	--	--	--	--	--	--	--	--	--	--	--	--	--
Ash-throated Flycatcher	--	--	--	--	57	75	84	216	1	11	5	17	233
Band-tailed Pigeon	1	3	--	4	--	--	1	1	--	--	2	2	7
Bewick's Wren	--	--	--	--	22	57	94	173	--	4	--	4	177
Black-chinned Hummingbird	--	--	--	--	--	--	5	5	--	--	--	--	5
Black-chinned Sparrow	--	--	--	--	2	--	7	9	--	--	--	--	9
Black-headed Grosbeak	2	9	6	17	21	32	24	77	21	35	26	82	176
Black-tailed Gnatcatcher	--	--	--	--	2	--	--	2	--	--	--	--	2
Black-throated Gray Warbler	--	1	--	1	14	18	39	71	3	4	4	11	83
Black-throated Sparrow	--	--	--	--	--	2	5	7	--	--	--	--	7
Blue Grosbeak	--	--	--	--	1	--	--	1	--	--	--	--	1
Blue-gray Gnatcatcher	--	--	--	--	8	1	5	14	--	1	--	1	15
Brewer's Blackbird	--	--	--	--	--	--	--	--	--	--	--	--	--
Brewer's Sparrow	--	--	--	--	11	5	2	18	--	--	--	--	18
Broad-tailed Hummingbird	9	6	13	28	4	8	12	24	6	13	21	40	92
Brown Creeper	3	3	3	9	2	1	--	3	4	10	16	30	42
Brown-headed Cowbird	--	5	--	5	19	12	17	48	17	26	15	58	111
Bullock's Oriole	--	--	--	--	--	1	1	2	--	--	--	--	2
Bushtit	--	--	--	--	10	--	2	12	--	--	--	--	12
Canyon Towhee	--	--	--	--	--	--	2	2	--	--	--	--	2
Canyon Wren	2	2	--	4	--	--	2	2	1	--	--	1	7
Cassin's Finch	--	--	--	--	--	--	--	--	--	--	4	4	4
Cassin's Kingbird	--	--	--	--	2	3	8	13	--	--	--	--	13
Chipping Sparrow	--	3	2	5	59	67	87	213	17	22	29	68	286
Clark's Nutcracker	1	11	1	13	--	14	--	14	--	4	--	4	31
Common Goldeneye	--	--	--	--	--	--	--	--	--	--	--	--	--
Common Nighthawk	--	--	1	1	1	--	2	3	--	2	3	5	9

	Williams District												
	Mid-elevation Conifer				Pinyon-Juniper				Ponderosa Pine				District Total
Species	2007	2008	2009	Total	2007	2008	2009	Total	2007	2008	2009	Total	
Common Raven	2	4	11	17	60	71	51	182	49	52	43	144	343
Cooper's Hawk	--	--	--	--	--	--	1	1	--	--	--	--	1
Cordilleran Flycatcher	11	18	7	36	--	3	1	4	2	10	15	27	67
Curve-billed Thrasher	--	--	--	--	--	--	3	3	--	--	--	--	3
Dark-eyed Junco	27	20	24	71	34	14	17	65	127	85	109	321	457
Double-crested Cormorant	--	--	--	--	--	--	--	--	--	1	1	2	2
Downy Woodpecker	2	--	1	3	--	1	--	1	--	--	--	--	4
Dusky Flycatcher	--	--	1	1	7	2	10	19	13	--	8	21	41
Dusky Grouse	--	--	--	--	--	--	--	--	--	--	--	--	--
Eastern Meadowlark	--	--	--	--	--	3	3	6	--	--	--	--	6
Eurasian Collared-Dove	--	--	--	--	--	--	1	1	--	--	--	--	1
Evening Grosbeak	--	--	1	1	--	--	--	--	--	--	--	--	1
Gambel's Quail	--	--	--	--	--	14	27	41	--	--	--	--	41
Golden-crowned Kinglet	--	--	--	--	--	--	--	--	1	--	--	1	1
Grace's Warbler	12	1	1	14	1	12	15	28	44	20	57	121	163
Gray Flycatcher	1	--	--	1	29	21	55	105	3	12	4	19	125
Gray Vireo	--	--	--	--	2	2	6	10	--	--	--	--	10
Great Blue Heron	--	--	--	--	--	--	--	--	1	2	1	4	4
Greater Pewee	--	--	--	--	--	--	--	--	--	--	--	--	--
Greater Roadrunner	--	--	--	--	--	4	2	6	--	1	--	1	7
Green-tailed Towhee	--	--	--	--	--	--	7	7	--	--	--	--	7
Hairy Woodpecker	6	3	8	17	5	1	6	12	5	10	28	43	72
Hammond's Flycatcher	--	--	--	--	--	--	--	--	2	--	3	5	5
Hepatic Tanager	--	--	--	--	1	6	31	38	1	3	12	16	54
Hermit Thrush	14	23	34	71	--	6	5	11	9	5	26	40	122
Horned Lark	--	--	--	--	--	--	3	3	--	--	--	--	3
House Finch	--	--	--	--	6	8	10	24	1	--	--	1	25
House Wren	18	14	19	51	1	--	12	13	3	3	19	25	89
Juniper Titmouse	--	--	--	--	45	61	48	154	--	3	--	3	157
Ladder-backed Woodpecker	--	--	--	--	--	--	--	--	--	--	--	--	--
Lark Sparrow	2	--	--	2	16	39	30	85	4	1	--	5	92
Lazuli Bunting	--	--	--	--	--	--	--	--	--	--	--	--	--
Lesser Goldfinch	--	--	--	--	--	3	15	18	--	1	1	2	20
Lincoln's Sparrow	--	--	--	--	--	--	--	--	--	--	--	--	--
Loggerhead Shrike	--	--	--	--	--	--	--	--	--	--	--	--	--

	Williams District												
	Mid-elevation Conifer				Pinyon-Juniper				Ponderosa Pine				District Total
Species	2007	2008	2009	Total	2007	2008	2009	Total	2007	2008	2009	Total	
Lucy's Warbler	--	--	--	--	--	--	--	--	--	--	--	--	--
MacGillivray's Warbler	--	--	--	--	2	--	--	2	--	--	--	--	2
Mountain Bluebird	--	2	--	2	42	2	9	53	4	3	3	10	65
Mountain Chickadee	18	23	21	62	37	11	17	65	74	113	112	299	426
Mourning Dove	1	1	3	5	21	27	93	141	18	18	30	66	212
Northern Flicker	11	10	18	39	23	8	20	51	47	36	60	143	233
Northern Goshawk	--	--	--	--	--	--	--	--	--	--	--	--	--
Northern Mockingbird	--	--	--	--	27	39	79	145	--	--	--	--	145
Northern Pygmy-Owl	--	--	--	--	--	--	--	--	--	--	--	--	--
Northern Rough-winged Swallow	--	--	--	--	1	1	--	2	3	--	--	3	5
Northern Saw-whet Owl	--	--	--	--	--	--	--	--	--	--	1	1	1
Olive Warbler	2	--	1	3	2	--	1	3	8	--	11	19	25
Olive-sided Flycatcher	2	4	1	7	--	1	--	1	--	--	1	1	9
Orange-crowned Warbler	--	--	--	--	--	--	--	--	--	--	--	--	--
Peregrine Falcon	--	2	--	2	--	--	--	--	--	--	--	--	2
Pied-billed Grebe	--	--	--	--	--	--	--	--	--	--	1	1	1
Pine Grosbeak	--	--	--	--	--	--	--	--	--	--	--	--	--
Pine Siskin	3	1	2	6	--	1	--	1	--	3	5	8	15
Pinyon Jay	--	--	--	--	22	52	29	103	--	3	--	3	106
Plumbeous Vireo	6	3	3	12	16	18	37	71	48	61	58	167	250
Purple Martin	2	--	--	2	--	--	3	3	3	1	10	14	19
Pygmy Nuthatch	4	6	12	22	10	16	46	72	46	72	187	305	399
Red Crossbill	--	1	5	6	--	--	--	--	--	2	44	46	52
Red Squirrel	1	1	4	6	1	--	--	1	--	3	2	5	12
Red-breasted Nuthatch	7	22	11	40	6	--	--	6	--	--	--	--	46
Red-faced Warbler	--	7	3	10	--	1	--	1	--	--	5	5	16
Red-naped Sapsucker	--	1	1	2	--	--	--	--	--	--	2	2	4
Red-tailed Hawk	--	--	--	--	5	2	4	11	1	3	--	4	15
Red-winged Blackbird	--	--	--	--	--	--	--	--	--	2	7	9	9
Rock Wren	--	6	--	6	--	2	3	5	--	1	1	2	13
Ruby-crowned Kinglet	3	--	15	18	1	--	--	1	--	--	4	4	23
Say's Phoebe	--	--	--	--	1	--	7	8	--	1	--	1	9
Scott's Oriole	--	--	--	--	--	2	14	16	--	--	--	--	16
Spotted Towhee	1	--	--	1	39	16	22	77	--	3	6	9	87
Steller's Jay	14	21	11	46	21	14	11	46	34	52	88	174	266

	Williams District												
	Mid-elevation Conifer				Pinyon-Juniper				Ponderosa Pine				District Total
Species	2007	2008	2009	Total	2007	2008	2009	Total	2007	2008	2009	Total	
Townsend's Solitaire	10	1	6	17	1	--	1	2	6	2	10	18	37
Tree Swallow	--	--	--	--	--	--	--	--	--	--	--	--	--
Turkey Vulture	--	--	1	1	1	2	3	6	1	1	5	7	14
Vesper Sparrow	--	--	--	--	2	7	23	32	9	6	--	15	47
Violet-green Swallow	4	9	28	41	3	15	11	29	21	13	128	162	232
Virginia's Warbler	18	22	7	47	6	3	1	10	13	23	4	40	97
Warbling Vireo	9	7	15	31	2	--	1	3	4	1	16	21	55
Western Bluebird	--	--	5	5	8	5	21	34	39	45	55	139	178
Western Kingbird	--	--	--	--	3	--	3	6	1	--	--	1	7
Western Meadowlark	--	--	--	--	15	--	1	16	10	12	6	28	44
Western Scrub-Jay	1	--	--	1	10	29	35	74	9	--	2	11	86
Western Tanager	14	24	30	68	40	43	34	117	35	47	76	158	343
Western Wood-Pewee	9	13	13	35	14	14	14	42	65	73	59	197	274
White-breasted Nuthatch	22	6	8	36	16	12	16	44	70	61	85	216	296
White-crowned Sparrow	--	--	--	--	--	--	--	--	--	--	--	--	--
White-throated Swift	--	--	--	--	2	4	1	7	1	--	2	3	10
Wild Turkey	--	--	--	--	1	--	--	1	5	3	1	9	10
Williamson's Sapsucker	--	--	5	5	--	--	1	1	--	--	1	1	7
Yellow Warbler	4	1	--	5	--	1	--	1	9	1	--	10	16
Yellow-rumped Warbler	19	22	36	77	3	19	12	34	18	36	59	113	224
Zone-tailed Hawk	--	--	--	--	--	--	--	--	--	--	--	--	--