

**Birds and Burns Network
Pre-treatment Estimation of Bird Densities**

**Draft Report
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INTRODUCTION

In 2002 and 2003, point count surveys were conducted at eight sites throughout the western United States to estimate songbird densities prior to the initiation of prescribed burn treatments. Sites are located in the Black Hills, South Dakota (BHSD), near Helena, Montana (HEMT), in the San Juan National forest, Colorado (SJCO), in Okanogan and Wenatchee National forests, Washington (OKWA), in the Sycan Marsh, Oregon (SYOR), and in Payette National Forest, Idaho (PAID). Additionally, two sites consist of units located in non-contiguous National Forests. One site includes units within Kaibab and Coconino National Forests in Arizona (KAAZ-COAZ), and the other site consists of units located in Apache-Sitgreaves National Forest, Arizona and Gila National Forest, New Mexico (ASAZ-GINM). Within each site, 200-400 ha units were designated as control (no scheduled burning) or treatment (scheduled for prescribed burning). See our web site for details on site locations: (<http://www.rmrs.nau.edu/lab/4251/birdsnburns/>). We are using a Before-After-Control-Impact design, and will be assessing bird densities on control and treatment plots before and after prescribed fire to determine the effects of burning on bird populations.

We present a summary of survey effort for each site, Program Distance (Thomas et al. 2003) estimates of regional and individual site summaries of bird densities, suggestions regarding which bird species are sufficiently abundant to detect statistically significant changes in density before and after prescribed burning, and recommendations for improving observer accuracy.

METHODS

Only point counts conducted between May 22nd and July 3rd were included in the analysis. Each point was visited 1-4 times during this time period, and the species and distance from the observer of all birds seen or heard within the first five minutes was recorded. Distance estimates were categorized by interval. Intervals were as follows, 0-10m, 10-25m, 25-50m, 50-75m, 75-100m, and beyond 100m. Additionally, squirrel observations were also recorded for sites containing vocal squirrel species. Program Distance was utilized to estimate bird densities by each of four regions; 1) Arizona-New Mexico sites (AZNM), 2) the San Juan, Colorado site (SJCO), 3) the Montana, Idaho, Oregon, and Washington sites (Northwest), and 4) the Black Hills, South Dakota site (BHSD), as well as at treatment and control plots located within individual sites. Observations of clusters of birds and observations of birds beyond 100m were removed from the data set prior to estimating densities in Program Distance.

RESULTS

Survey Effort

Five sites conducted point count surveys at all units in 2002 and 2003. The two combined sites conducted point count surveys in one National Forest location in 2002 and both locations in 2003 (Table 1.) The minimum number of point count surveys conducted for any site was 224. A total number of 138 bird species and 6 squirrel species were recorded by observers (Table 2.). WETA were the most abundant species and were recorded a total of 2881 times. Oregon and Washington sites recorded the most species.

Regional Summaries

Program Distance was utilized to determine regional density estimates and their coefficients of variations across the four regions (Table 3 a-d). Density estimates were generated for six species on all regions and two species for two regions only. These eight species were chosen for their relatively high abundance, wide distribution, and ability to be monitored utilizing point count surveys. The American Robin (AMRO), the Dark-eyed Junco (DEJU), the Yellow-rumped Warbler (YRWA), the Mountain Chickadee (MOCH), the Western Tanager (WETA), and the Chipping Sparrow (CHSP) were detected in all regions (Fig. 1). The White-breasted Nuthatch (WBNU) and the Red-breasted Nuthatch (RBNU), however, displayed distinct regional trends (see Table 2 for a complete list of 4 letter species codes). WBNU were common in the Southwestern sites and uncommon on the Oregon, Idaho, Montana, and South Dakota sites, while RBNU showed the opposite trend. Buckland et al. 2001 recommends a minimum of 60-80 observations in order to determine densities using Program Distance, therefore, regional estimates were only generated for regions where these species were sufficiently abundant on all sites to obtain reasonable density estimates.

Densities estimates were generally higher on the Northwest sites than in the other regions. Smaller coefficients of variation indicate species that we will be more likely to be able to detect small statistically significant changes in abundance after burning. Coefficients of variation for regional estimates that combined sites (the Northwest and Arizona-New Mexico regions) were relatively high indicating that considerable differences exist between the densities of bird species on each site within a region.

Site summaries (Table 4)

Densities, standard errors, and coefficients of variation for particular bird species were estimated from Program Distance for control and treatment units at each site. Global detection functions were fitted to the pooled data due to small sample sizes and an *a priori* assumption that there would be no differences in detection functions between control and treatment plots (see Buckland et al. 2001 for details on detection functions). We were interested in assessing the feasibility of determining statistically significant differences in densities in response to prescribed fire for a particular species. Species were chosen based on their abundance at a particular site as well as their overall abundance in a particular region and their level of research interest.

BHSD

For the Black Hills site, there were six species of interest (AMRO, CHSP, OVEN, RBNU, WETA, YRWA) for which there were approximately the number of recommended observations for both control and treatment units. The coefficient of variation was highest for TOSO which also had small numbers of observations. Sample sizes for DEJU and PLVI were also low, but estimated CVs were similar to other species. Estimates for the WETA, the most abundant species, had the lowest CV for this site.

SJCO

In the San Juan National Forest, there were also six species (AMRO, DEJU, OCWA, PYNU, WETA, YRWA) that had the recommended sample sizes on control and treatment units. CHSP, MOCH, and DUFL had small sample sizes, however, CVs for the CHSP were extremely

high, while CVs for the MOCH were relatively low. WETA were the most abundant species on this site as well, however CVs were lowest for the YRWA.

SYOR

In Sycan Marsh, the most abundant species was the MOCH, however the lowest CVs were associated with estimates of YRWA abundance. Only the DEJU, MOCH, and YRWA had the recommended number of observations on control and treatment sites, however, overall CVs were low for all species at this site. The highest CVs at this site were displayed by the RBNU and the AMRO.

PAID

Eight species in the Payette, (including the red squirrel, RESQ) were observed the minimum recommended number of times (AMRO, CHSP, DEJU, RBNU, YRWA, HAFL, and WETA) on control and treatment sites. CVs were generally low at this site except for the TOSO. Transects for one observer were removed for RESQ and TOSO density estimates due to lack of observations attributed to observer error (see observer variability for further discussion).

OKWA

Thirteen species of interest in the Okanogan and Wenatchee National Forests were observed the minimum recommended number of times (AMRO, CHSP, DEJU, DUFL, HAFL, MOCH, RBNU, YRWA, WETA, RESQ, TOSO, WBNU, and GRFL). WETA were the most abundant species, however densities estimates reflected high CVs possibly due to variability between units and/or lack of model fit for this species by Program Distance. Detection probabilities for WETA at this site indicated a relatively uniform probability, possibly due to the high visibility of this species. However, use of the uniform cosine or uniform simple versus the half-normal cosine detection function failed to improve model fit significantly (P-values for Chi-square tests were < 0.001 for all models and delta AICs were less than three) (see Buckland et al. 2001 for details on detection functions in Program Distance). Stratifying the detection function by control and treatment units also failed to improve overall model fit and resulted in increased AIC values.

HEMT

At Helena, the most common bird species was the RBNU. Six species had sample sizes approximating the recommended 60-80 observations for control and treatment units (DEJU, MOCH, RBNU, RCKI, TOSO, and YRWA). Data will be collected for an additional year before prescribed burns take place at this site therefore, it is likely that we will obtain sufficient sample sizes for all species listed in Table 3 for HEMT except possibly AMRO. Coefficients of variations were highest for AMRO and lowest for RBNU, RCKI, and YRWA. One observer's transects were removed for YRWA and RESQ density estimates due to lack of observations attributed to observer error (see observer variability).

ASAZ-GINM

For the Apache-Sitgreaves and Gila National Forests, six species were sufficiently abundant to obtain recommended samples sizes (DEJU, MOCH, PYNU, WBNU, STJA, and WETA) with DEJU being the most abundant species. WEBL estimates reflected the highest CVs, however, CVs were in general higher at this site. The lowest CVs were obtained from

CHSP and GRWA density estimates. There were considerable differences between units regarding species abundance. For example, CHSP was not recorded on any of the ASAZ units. These results indicate that pooling the burned and control units for both of these forests may not be appropriate and/or that particular species will be excluded from analysis at one or both sites. Sample sizes were generally low at all units on this site, due to the lower densities recorded in the Southwest, and because only one year of pre-burn data was collected at ASAZ. However, the MOCH, DEJU, and WETA density estimates all reflected low CVs indicating that at a minimum these species will be appropriate for comparing before and after treatments at these sites.

KAAZ-COAZ

In the Kaibab and Coconino National Forests, eight species were abundant enough to obtain recommended sample sizes (DEJU, GRWA, MOCH, PLVI, PYNU, WBNU, WETA, and YRWA). The most abundant species was the DEJU, which along with GRWA, MOCH, and YRWA, had density estimates with low CVs. CHSP and AMRO had the highest CVs at this site.

Observer analysis (Table 5)

Individual observers can exert considerable influence on the collected data. For example, if an observer consistently misses or double counts a particular species (by recording a visual and auditory detection for one bird), density estimates can be skewed. Additionally, if observers consistently under or over estimate distances, density estimates from Program Distance can be inaccurate. We summarized data anonymously for individual observers in order to assess the accuracy of each observer and the consistency among observers at a particular site. We determined the percentage of points in each interval for a particular observer to assess whether an observer was possibly under or over estimating distances. The percentage of points in each interval should be consistent across observers. Observers with a high percentage of points at near intervals may be underestimating distances, while observers with a high percentage of point at far intervals may be over estimating distances. Additionally, by determining the number of birds observed per point for each observer, we could assess whether an observer was potentially missing or double counting birds. By calculating the number of observation per point for individual species of interest, we determined that some observers were missing a particular species and removed the area of their points from density estimates to avoid underestimating densities.

Laser range finders are recommended training purposes and if possible during actual data collection to ensure accurate distances are recorded (Buckland et al. 2001). Additionally, consistency checks should be made on observers throughout the season by comparing field observations. For example, at the end of a field day or week, data sheets can be scanned to determine if observers are obtaining roughly the same numbers of observations, the proportion of observations in each distance interval is roughly the same across observers, and that a particular species is not being missed or over counted.

Table 1. Summary of survey effort for each of eight sites. Units refers to the number of 200-400 ha areas designated within a location as control (not scheduled for prescribed burning) or treatment (scheduled for prescribed burning). Number of points refers to the number of point count locations with the treatment and control units. Number of samples refers to the total number of point counts surveys conducted within treatment and control units.

Site	Units		# of points		# of samples		Years		
	Treatment	Control	Treatment	Control	Treatment	Control	2002	2003	
BHSD	2	2	40	40	159	160	Y	Y	
HEMT	2	2	40	36	119	105	N	Y	
SJCO	2	2	40	40	117	139	Y	Y	
OKWA	3	3	60	60	359	360	Y	Y	
SYOR	2	2	40	40	160	160	Y	Y	
PAID	3	3	60	50	239	200	Y	Y	
KAAZ-COAZ	KAAZ	1	2	40	50	390	445	Y	Y
	COAZ	1	1	40	40		N	Y	
ASAZ-GINM	ASAZ	1	2	29	30	288	284	N	Y
	GINM	1	1	25	25		Y	Y	
Total	18	20	414	411	1831	1853			

Table 2. List of species recorded at all sites. Total indicates the total number of detections. Groups of birds were counted as the minimum. (For example >5 was =5 for counts)

<u>Common Name</u>	<u>CODE</u>	<u>Scientific name</u>	<u>Total</u>	<u>BHSD</u>	<u>SJCO</u>	<u>SYOR</u>	<u>OKWA</u>	<u>HEMT</u>	<u>PAID</u>	<u>GIAS</u>	<u>KACO</u>
Acorn Woodpecker	ACWO	<i>Melanerpes formicivorus</i>	2							2	
American Crow	AMCR	<i>Corvus brachyrhynchos</i>	32	29						2	1
American Bittern	AMBI	<i>Botaurus lentiginosus</i>	1			1					
American Dipper	AMDI	<i>Cinclus mexicanus</i>	1		1						
American Goldfinch	AMGO	<i>Carduelis tristis</i>	8	8							
American Kestrel	AMKE	<i>Falco sparverius</i>	20	4	1	1	4		5		5
American Robin	AMRO	<i>Turdus migratorius</i>	1356	115	371	127	220	43	189	56	235
Ash-throated Flycatcher	ATFL	<i>Myiarchus cinerascens</i>	18							9	9
Audubon's Warbler	AUWA	<i>Dendroica c. auduboni</i>	2						2		
Bald Eagle	BAEA	<i>Haliaeetus leucocephalus</i>	1	1							
Barn Owl	BAOW	<i>Tyto deroepstorffi</i>	1					1			
Black-billed Magpie	BBMA	<i>Pica hudsonia</i>	5	3			2				
Black-backed Woodpecker	BBWO	<i>Picoides arcticus</i>	4			2			2		
Black-capped Chickadee	BCCH	<i>Poecile atricapilla</i>	104	75				26	3		
Black-chinned Hummingbird	BCHU	<i>Archilocus alexandri</i>	2								2
Blue-gray Gnatcatcher	BGGN	<i>Polioptila caerulea</i>	5		5						
Brown-headed Cowbird	BHCO	<i>Molothrus ater</i>	389	57		148	83	5		2	94
Black-headed Grosbeak	BHGR	<i>Pheucticus melanocephalus</i>	151	11	38	3	4		6	42	47
Blue Grosbeak	BLGR	<i>Passerina caerulea</i>	25		12	11		2			
Blue Jay	BLJA	<i>Cyanocitta cristata</i>	10	10							
Black Tern	BLTE	<i>Chlidonias niger</i>	3				3				
Blue Grouse	BLUG	<i>Dendragapus obscurus</i>	15						15		
Brewer's Blackbird	BRBL	<i>Euphagus cyanocephalus</i>	3				3				
Brown Creeper	BRCR	<i>Certhia americana</i>	344	10	55	34	34	18	51	40	102
Black-throated gray warbler	BTGW	<i>Dendroica nigrescens</i>	131		1					120	10
Broad-tailed hummingbird	BTHU-BTLH	<i>Selasphorus platycercus</i>	126		64				1	14	47
Band-tailed Pigeon	BTPI	<i>Columba fasciata</i>	19							19	
Blue Grouse	BUGR	<i>Dendragapus obscurus</i>	51			1	50				
Bullock's Oriole	BUOR	<i>Icterus bullockii</i>	4			2	2				
Bushtit	BUSH	<i>Psaltriparus minimus</i>	38							23	15
Blue-winged Warbler	BWWA	<i>Vermivora pinus</i>	1	1							
Canada Goose	CAGO	<i>Branta canadensis</i>	6			3		3			
Cassin's Finch	CAFI	<i>Carpodacus cassinii</i>	302		1	46	174		81		
Calliope Hummingbird	CAHU	<i>Stellula calliope</i>	21				7		14		
Canyon Wren	CANW	<i>Catherpes mexicanus</i>	5	3					2		
Cassin's Vireo	CAVI	<i>Vireo cassinii</i>	330			23	195	23	89		
Cedar Waxwing	CEDW	<i>Bombycilla cedrorum</i>	14	14							
Chipping Sparrow	CHSP	<i>Spizella passerina</i>	1887	182	96	72	705	70	429	74	259
Clark's Nutcracker	CLNU	<i>Nucifraga columbiana</i>	203	1	1	28	99	44	22		8
Cordilleran Flycatcher	COFL	<i>Empidonax occidentalis</i>	85	15	5	5				23	37
Cooper's Hawk	COHA	<i>Accipiter cooperii</i>	7			2	3		2		
Common Nighthawk	CONI	<i>Chordeiles minor</i>	84	6	1	17	32			10	18

Table 2 cont'd. List of species recorded at all sites

Common Name	CODE	Scientific name	Total	BHSD	SJCO	SYOR	OKWA	HEMT	PAID	GIAS	KACO
Common Pochard	COPO	<i>Aythya ferina</i>	1	1							
Common Raven	CORA	<i>Corvus corax</i>	534		80	26	64	52	7	52	253
Common Snipe	COSN	<i>Gallinago gallinago</i>	28			28					
Dark-eyed Junco	DEJU	<i>Junco hyemalis</i>	2288	101	292	207	401	133	200	345	609
Downy Woodpecker	DOWO	<i>Picoides pubescens</i>	12	2	8			1		1	
Dusky Flycatcher	DUFL	<i>Empidonax oberholseri</i>	711	40	108	100	418	7	38		
Eastern Bluebird	EABL	<i>Sialia sialis</i>	3	3							
Evening Grosbeak	EVGR	<i>Coccothraustes vespertinus</i>	55		21		2	28	4		
Field Sparrow	FISP	<i>Spizella pusilla</i>	11	11							
Flammulated Owl	FLOW	<i>Otus flammeolus</i>	3				2		1		
Fox Sparrow	FOSP	<i>Passerella iliaca</i>	4			4					
Great Crested Flycatcher	GCFL	<i>Myiarchus crinitus</i>	1	1							
Golden-crowned Kinglet	GCKI	<i>Regulus satrapa</i>	22		4	9	1	7	1		
Great Horned Owl	GHOW	<i>Bubo virginianus</i>	5			2	3				
Golden Eagle	GOEA	<i>Aquila chrysaetos</i>	1	1							
American Goldfinch	GOLDF	<i>Carduelis tristis</i>	2								2
Gray Jay	GRAJ	<i>Perisoreus canadensis</i>	54	13		8	5	20	8		
Gray Flycatcher	GRFL	<i>Empidonax wrightii</i>	373			1	264			7	101
Grasshopper Sparrow	GRSP	<i>Ammodramus savannarum</i>	23	23							
Grace's Warbler	GRWA	<i>Dendroica graciae</i>	600		16					86	498
Green-tailed Towhee	GTTO	<i>Pipilo chlorurus</i>	36		27	9					
Hammond's Flycatcher	HAFL	<i>Empidonax hammondii</i>	693		7	66	201	1	418		
Hairy Woodpecker	HAWO	<i>Picoides villosus</i>	426	12	53	13	55	24	54	82	133
Hepatic Tanager	HETA	<i>Piranga flava</i>	15							1	14
Hermit Thrush	HETH	<i>Catharus guttatus</i>	420		141	46	14	97	39	58	25
House Wren	HOWR	<i>Troglodytes aedon</i>	88	2	70		13		3		
Juniper Titmouse	JUTI	<i>Baeolophus ridgwayi</i>	1								1
killdeer	KILL	<i>Charadrius vociferus</i>	2			2					
Lark Sparrow	LASP	<i>Chondestes grammacus</i>	16		1						15
Lazuli Bunting	LAZB	<i>Passerina amoena</i>	8	1			3	2	2		
Long-billed Curlew	LBCU	<i>Numenius americanus</i>	1			1					
Lesser Goldfinch	LEGO	<i>Carduelis psaltria</i>	8							3	5
Lincoln's Sparrow	LISP	<i>Melospiza lincolni</i>	2		1			1			
Mallard	MALL	<i>Anas platyrhynchos</i>	6			6					
MacGillivray's Warbler	MGWA	<i>Oporornis tolmiei</i>	84		8		2	4	70		
Mountain Bluebird	MOBL	<i>Sialia currucoides</i>	18	1	1	4		2	3		7
Mountain Chickadee	MOCH	<i>Poecile gambeli</i>	1959		205	394	554	170	215	167	254
Mourning Dove	MODO	<i>Zenaida macroura</i>	495	56	9	8	14	17		51	340
Nashville Warbler	NAWA	<i>Vermivora ruficapilla</i>	64				34		30		
Northern Flicker	NOFL	<i>Colaptes auratus</i>	515	12	138	35	109	10	25	70	116
Northern Goshawk	NOGO	<i>Accipiter gentilis</i>	10		1	2			2	5	
Northern Pygmy-Owl	NOPO	<i>Glaucidium gnoma</i>	26		23				1		2

Table 2 cont'd. List of species recorded at all sites

Common Name	CODE	Scientific name	Total	BHSD	SJCO	SYOR	OKWA	HEMT	PAID	GIAS	KACO
Orange-crowned Warbler	OCWA	<i>Vermivora celata</i>	165		153		1	4	7		
Olive Warbler	OLWA	<i>Peucedramus taeniatus</i>	11								11
Olive-sided Flycatcher	OSFL	<i>Contopus cooperi</i>	61		6	45	6				4
Ovenbird	OVEN	<i>Seiurus aurocapillus</i>	194	194							
Pinyon Jay	PIJA	<i>Gymnorhinus cyanocephalus</i>	150	5						2	143
Pine Siskin	PISI	<i>Carduelis pinus</i>	708	4	51	31	450	119	30		23
Pileated Woodpecker	PIWO	<i>Dryocopus pileatus</i>	40				31	6	3		
Plumbeous Vireo	PLVI	<i>Vireo plumbeus</i>	442	61	7					43	331
Pygmy Nuthatch	PYNU	<i>Sitta pygmaea</i>	1004		339	7	33			297	328
Red-breasted Nuthatch	RBNU	<i>Sitta canadensis</i>	1720	169	18	116	722	331	364		
Red-breasted Sapsucker	RBSA	<i>Sphyrapicus ruber</i>	6			6					
Ruby-crowned Kinglet	RCKI	<i>Regulus calendula</i>	309		57		77	144	29	2	
Red Crossbill	RECR	<i>Loxia curvirostra</i>	585	80		94	155	89	62		105
Red-eyed Vireo	REVI	<i>Vireo olivaceus</i>	2	2							
Red-faced Warbler	RFWA	<i>Cardellina rubrifrons</i>	33							14	19
Red-naped Sapsucker	RNSA	<i>Sphyrapicus nuchalis</i>	16		4			12			
Rock Wren	ROWR	<i>Salpinctes obsoletus</i>	11	1			3		7		
Red-tailed Hawk	RTHA	<i>Buteo jamaicensis</i>	31		4	6	10	3	6		2
Ruby-throated Hummingbird	RTHU	<i>Archilochus colubris</i>	1	1							
Ruffed Grouse	RUGR	<i>Bonasa umbellus</i>	12				4		8		
rufous hummingbird	RUHU	<i>Selasphorus rufus</i>	3			2	1				
Red-winged Blackbird	RWBL	<i>Agelaius phoeniceus</i>	33			32	1				
Sage Sparrow	SASP	<i>Amphispiza belli</i>	1			1					
Sora	SORA	<i>Porzana carolina</i>	3			3					
Song Sparrow	SOSP	<i>Melospiza melodia</i>	13		9				4		
Spotted Towhee	SPTO	<i>Pipilo maculatus</i>	157	70	1	10	58	1	3	14	
Sharp-shinned Hawk	SSHA	<i>Accipiter striatus</i>	7	2		2	2		1		
Steller's Jay	STJA	<i>Cyanocitta stelleri</i>	800		246	40	20		6	189	299
Swainson's Thrush	SWTH	<i>Catharus ustulatus</i>	130				81	3	46		
Townsend's Solitaire	TOSO	<i>Myadestes townsendi</i>	793	49	101	59	347	134	63	17	23
Townsend's Warbler	TOWA	<i>Dendroica townsendi</i>	101				19		82		
Tree Swallow	TRES	<i>Tachycineta bicolor</i>	2		2						
Tree Swallow	TRSW	<i>Tachycineta bicolor</i>	1	1							
Three-toed Woodpecker	TTWO	<i>Picoides tridactylus</i>	30		28			2			
Turkey Vulture	TUVU	<i>Cathartes aura</i>	19	8	3	3					5
Vesper Sparrow	VESP	<i>Pooecetes gramineus</i>	138	67		1		3			67
Violet-green Swallow	VGSW	<i>Tachycineta thalassina</i>	297	3	188		5			19	82
Virginia's Warbler	VIWA	<i>Vermivora virginiae</i>	81		32					38	11
Warbling Vireo	WAVI	<i>Vireo gilvus</i>	225	14	47		44	29	89	1	1
White-breasted Nuthatch	WBNU	<i>Sitta carolinensis</i>	862	14	76	22	163	7	14	154	412
White-crowned Sparrow	WCSP	<i>Zonotrichia leucophrys</i>	2		1	1					
Western Bluebird	WEBL	<i>Sialia mexicana</i>	415			1	20			79	315

Table 2 cont'd. List of species recorded at all sites

Common Name	CODE	Scientific name	Total	BHSD	SJCO	SYOR	OKWA	HENT	PAID	GIAS	KACO
Western Flycatcher	WEFL	<i>Empidonax difficilis/occid.</i>	3				3				
Western Meadowlark	WEME	<i>Sturnella neglecta</i>	89	57		28	2				2
Western Tanager	WETA	<i>Piranga ludoviciana</i>	2881	244	349	136	934	91	504	223	400
Western Wood-Pewee	WEWP	<i>Contopus sordidulus</i>	171	47	73	4	47				
White-headed Woodpecker	WHWO	<i>Picoides albolarvatus</i>	6			5	1				
Williamson's Sapsucker	WISA	<i>Sphyrapicus thyroideus</i>	124		55	15	47		7		
Wild Turkey	WITU	<i>Meleagris gallopavo</i>	35	9	26						
Wilson's Warbler	WIWA	<i>Wilsonia pusilla</i>	7		2		4		1		
Winter Wren	WIWR	<i>Troglodytes troglodytes</i>	9						9		
Western Scrub Jay	WSJA	<i>Aphelocoma californica</i>	6							6	
White-throated Swift	WTSW	<i>Aeronautes saxatalis</i>	16	1	12						3
Western Wood Peewee	WWPE	<i>Contopus sordidulus</i>	330			22			9	19	280
Yellow Warbler	YEWA	<i>Dendroica petechia</i>	3			2					1
Yellow-headed Blackbird	YHBL-YHBB	<i>Xanthocephalus xanthocephalus</i>	500			24					476
Yellow-rumped Warbler	YRWA	<i>Dendroica coronata</i>	2617	184	371	326	600	114	600	89	333

Squirrel species

Columbian Ground squirrel	COGS	<i>Spermophilus columbianus</i>	29						29		
Golden-mantled ground squirrel	GMGS	<i>Spermophilus lateralis</i>	3						3		
Red Squirrel	RESQ	<i>Tamiasciurus hudsonicus</i>	439			13		82	344		
Western Gray squirrel	SCGR	<i>Sciurus griseus</i>	35			35					
Douglas Squirrel	TADO	<i>Tamiasciurus douglasii</i>	191				191				
Yellow Pine Chipmunk	YPCH	<i>Eutamias amoenus</i>	61			1			60		

Table. 3a. Summaries for the Arizona-New Mexico sites which consisted of two pairs of sites, Kaibab and Coconino Arizona, and Gila, New Mexico and Apache/Sitgreaves, Arizona.

KAAZ-COAZ and GINM-ASAZ			# at SITE		
Species	Density	CV	KAAZ-COAZ	GINM-ASAZ	Total
AMRO	0.13	31.60	124	55	179
CHSP	0.17	19.57	113	74	187
DEJU	0.59	16.60	363	321	684
GRWA	0.17	36.35	275	83	358
MOCH	0.46	49.84	273	154	427
PLVI	0.21	57.01	225	43	268
PYNU	0.28	14.57	184	246	430
WBNU	0.14	21.42	167	150	317
WEBL	0.18	46.70	124	78	202
WETA	0.21	36.03	192	198	390
YRWA	0.48	66.63	333	88	421

Table 3b. Summaries for the Northwest region which included four sites, Helena, Montana (HEMT), Sycan Marsh, Oregon (SYOR), Okanagon/Wenatchee, Washington (OKWA), and Payette, Idaho (PAID). * indicates samples based on a subset of point counts.

HEMT,SYOR, OKWA, PAID			# at SITE				
Species	Density	CV	HEMT	PAID	OKWA	SYOR*	Total
AMRO	0.46	59.65	39	189	173	66	467
CHSP	1.64	30.18	69	429	588	54	1140
DEJU	1.25	8.31	117	200	356	155	828
MOCH	0.94	27.92	166	215	466	241	1088
RBNU	1.08	39.71	305	364	659	73	1401
RESQ*	0.56	49.73	75*	344*	119	13*	119
TOSO*	0.10	30.00	130	63*	203	47	380
WETA	0.67	43.24	78	504	711	97	1390
YRWA*	1.11	28.26	114*	600	545	248	1393

Tables 3 c and d. Summaries for the Black Hills, South Dakota region (BHSD) and the San Juan, Colorado region (SJCO).

c)

BHSD			
Species	Density	CV	Number
AMRO	0.17	0.18	106
BCCH	0.10	0.23	55
BHCO	0.07	0.27	52
CHSP	0.72	0.22	139
DEJU	0.13	0.21	75
DUFL	0.07	0.29	38
OVEN	0.26	0.14	175
PLVI	0.15	0.17	54
RBNU	0.30	0.29	118
SPTO	0.08	0.25	69
WETA	0.13	0.21	223
YRWA	0.44	0.24	164

d)

SJCO			
Species	Density	CV	Number
AMRO	0.53	0.25	190
CHSP	0.07	0.15	57
DEJU	0.80	0.21	146
DUFL	0.25	0.17	90
MOCH	0.08	0.14	64
OCWA	0.36	0.24	153
PYNU	0.31	0.16	148
WAVI	0.11	0.27	47
WBNU	0.05	0.17	33
WETA	0.45	0.26	198
YRWA	0.51	0.12	225

Table 4. Summaries by individual site. Density estimates were generated by Program Distance. Points were categorized as Treatment if they are scheduled for prescribed fire and Control if they are not.

	Numbers								
	Treatment	Control	Density	SE	CV	Density	SE	CV	
BHSD	# of samples	159							
	# of birds	770	861						
	AMRO	54	52	0.17	0.04	20.38	0.17	0.03	20.32
	CHSP	68	71	0.71	0.17	24.29	0.74	0.17	23.63
	DEJU	35	40	0.12	0.03	24.55	0.14	0.03	24.02
	OVEN	58	117	0.17	0.03	17.17	0.34	0.05	15.18
	PLVI	22	32	0.13	0.04	28.01	0.18	0.04	24.05
	TOSO	17	24	0.38	0.11	30.08	0.22	0.07	31.77
	RBNU	74	44	0.03	0.01	24.46	0.05	0.01	19.78
	WETA	108	115	0.46	0.05	11.67	0.49	0.06	11.30
YRWA	88	76	0.47	0.12	25.33	0.40	0.10	25.49	
SJCO	# of samples	117	139						
	# of birds	945	1057						
	AMRO	65	127	0.39	0.11	27.72	0.65	0.17	25.56
	CHSP	20	38	0.05	0.03	48.75	0.09	0.03	34.87
	DEJU	80	67	0.99	0.22	22.24	0.70	0.16	22.29
	DUFL	40	51	0.23	0.06	25.09	0.24	0.05	21.02
	MOCH	33	32	0.08	0.01	19.51	0.09	0.02	19.64
	OCWA	91	63	0.55	0.16	28.52	0.32	0.09	29.19
	PYNU	75	74	0.46	0.10	19.92	0.20	0.05	24.70
	WETA	112	87	0.43	0.12	27.49	0.46	0.12	26.86
YRWA	84	142	0.41	0.06	14.52	0.59	0.08	12.93	
SYOR	# of samples	130	118						
	# of birds	753	749						
	AMRO	37	29	0.21	0.05	24.57	0.18	0.05	25.48
	CHSP	32	22	0.26	0.05	19.92	0.20	0.04	21.35
	DEJU	77	78	1.76	0.33	18.51	1.97	0.37	18.84
	DUFL	38	47	0.38	0.07	19.41	0.52	0.10	19.30
	MOCH	110	131	1.54	0.24	15.64	2.02	0.31	15.45
	RBNU	49	24	0.24	0.05	21.84	0.13	0.03	27.01
	WETA	35	62	0.18	0.04	21.21	0.36	0.07	18.90
	YRWA	128	120	1.07	0.11	9.98	1.11	0.12	10.72
BHCO	39	65	0.63	0.12	19.71	1.15	0.18	16.01	
PAID	# of samples	239	200						
	# of birds	2474	1992						
	AMRO	102	87	0.81	0.14	17.71	0.82	0.15	18.83
	CHSP	239	201	2.24	0.27	12.19	2.53	0.32	12.63
	DEJU	108	92	1.57	0.22	14.27	1.59	0.25	15.38
	MOCH	113	102	0.82	0.15	18.22	0.89	0.15	17.08
	RBNU	186	178	1.73	0.20	11.73	1.98	0.24	12.04
	TOSO*	40	24	0.21	0.08	35.85	0.15	0.06	37.69
	YRWA	315	285	1.45	0.18	12.15	1.57	0.19	12.18
	WETA	284	220	1.53	0.19	12.27	1.42	0.18	12.64
RESQ	210	133	1.68	0.22	13.23	1.27	0.17	13.57	
WAVI	66	23	0.15	0.03	22.19	0.06	0.02	35.39	
HAFL	237	181	1.38	0.18	13.18	1.26	0.18	14.00	

Table 4 cont'd.

	Numbers		Treatment			Control			
	Treatment	Control	Density	SE	CV	Density	SE	CV	
	# of samples	# of birds							
OKWA	# of samples	359	360						
	# of birds	2960	3054	Density	SE	CV	Density	SE	CV
	AMRO	108	65	0.17	0.03	15.72	0.10	0.02	17.45
	CHSP	274	314	1.88	0.19	10.21	2.15	0.21	9.87
	DEJU	172	184	1.08	0.14	13.23	1.16	0.16	13.60
	DUFL	178	191	0.30	0.06	20.68	0.32	0.07	20.47
	GRFL	92	63	0.19	0.03	16.14	0.13	0.02	18.77
	HAFL	106	79	0.30	0.04	12.05	0.22	0.03	13.58
	MOCH	226	240	0.53	0.05	8.96	0.57	0.05	9.02
	RBNU	347	312	0.59	0.07	12.60	0.53	0.07	12.59
	RESQ	61	62	0.13	0.03	19.25	0.14	0.03	18.97
	TOSO	129	93	0.11	0.01	9.59	0.08	0.01	10.38
	WBNU	75	81	0.14	0.03	20.22	0.17	0.03	19.41
	WETA	361	350	0.42	0.18	41.71	0.41	0.17	41.76
YRWA	259	286	0.53	0.04	8.48	0.58	0.05	8.18	
HEMT	# of samples	119	105						
	# of birds	812	745	Density	SE	CV	Density	SE	CV
	AMRO	15	24	0.18	0.08	45.12	0.34	0.14	40.78
	CHSP	29	40	0.29	0.07	22.80	0.45	0.10	21.59
	DEJU	51	66	0.87	0.19	21.95	1.27	0.28	21.69
	HETH	48	21	0.13	0.03	26.92	0.06	0.02	32.59
	MOCH	88	78	1.12	0.37	33.35	1.45	0.35	24.11
	RBNU	154	151	1.52	0.24	16.04	1.69	0.28	16.46
	RCKI	73	49	0.39	0.07	16.78	0.30	0.06	19.12
	RESQ*	44	32	0.28	0.06	19.73	0.23	0.05	21.55
	TOSO	63	48	0.21	0.04	19.25	0.18	0.04	20.65
	WETA	41	37	0.27	0.06	21.39	0.27	0.06	22.40
	YRWA*	64	50	1.19	0.18	15.21	1.06	0.20	18.64
	ASAZ-GINM	# of samples	288	284					
# of birds		1308	1057	Density	SE	CV	Density	SE	CV
AMRO		24	31	0.03	0.01	33.30	0.03	0.01	30.83
BTGW		80	38	0.18	0.10	56	0.06	0.02	31.68
CHSP		53	21	0.13	0.03	22.68	0.05	0.02	28.17
DEJU		160	161	0.31	0.04	11.21	0.32	0.04	11.53
GRWA		45	38	0.12	0.03	21.63	0.10	0.02	22.46
MOCH		79	75	0.19	0.03	16.37	0.18	0.03	15.94
PYNU		125	121	0.25	0.09	33.62	0.25	0.08	33.83
WBNU		70	80	0.17	0.07	42.41	0.15	0.06	42.58
WEBL		40	38	0.08	0.05	60.23	0.08	0.05	60.39
WETA		141	57	0.17	0.03	15.19	0.07	0.01	17.81
YRWA		56	32	0.11	0.02	21.47	0.06	0.02	24.41
STJA		80	70	0.17	0.07	42.41	0.15	0.06	42.58
KAAZ-COAZ	# of samples	390	445						
	# of birds	1625	1895	Density	SE	CV	Density	SE	CV
	AMRO	40	84	0.14	0.04	29.50	0.26	0.07	27.15
	CHSP	35	78	0.12	0.03	28.61	0.23	0.06	25.12
	DEJU	166	197	0.74	0.09	12.79	0.77	0.10	12.67
	GRWA	151	124	0.25	0.03	12.21	0.18	0.02	12.29
	MOCH	117	156	0.59	0.09	14.54	0.69	0.09	13.62
	PLVI	78	147	0.23	0.05	20.20	0.37	0.07	18.79
	PYNU	106	78	0.49	0.09	17.83	0.31	0.06	18.97
	STJA	58	67	0.22	0.05	24.19	0.22	0.05	23.87
	WBNU	90	77	0.26	0.06	22.93	0.19	0.05	23.31
	WEBL	81	43	0.35	0.08	21.54	0.16	0.04	24.52
	WETA	81	111	0.24	0.05	21.48	0.29	0.06	20.19
	YRWA	137	186	0.72	0.10	13.42	0.80	0.10	12.66

Table 5. Summaries of observers including the number of surveys conducted (# points), the number of birds detected, and the percentage of observations in each interval. The estimates of density based on a detection function stratified by observer and pooled across all species, the percentage of points in each interval “bin”, and the number of birds per point.

Percentage of observations in interval											
	observers	#points	#birds	Density	STD. Error	0-10	10 to 25	25-50	50-75	75-100	#birds/point
Site1	obs1	163	871	5.22	0.52	0.02	0.14	0.29	0.27	0.28	5.34
	obs2	156	760	1.96	0.14	0.02	0.06	0.21	0.34	0.37	4.87
Site2	obs1	109	969	8.36	0.41	0.05	0.13	0.31	0.37	0.14	8.89
	obs2	240	2596	38.88	2.84	0.14	0.22	0.24	0.22	0.18	10.82
	obs3	71	696	4.35	0.33	0.01	0.09	0.24	0.30	0.36	9.80
	obs4	19	205	23.97	3.78	0.07	0.26	0.28	0.23	0.15	10.79
Site3	obs1	299	1351	5.23	0.39	0.05	0.14	0.24	0.26	0.31	4.52
	obs2	111	383	2.18	0.21	0.01	0.09	0.33	0.31	0.26	3.45
	obs3	298	1352	10.11	0.61	0.08	0.23	0.36	0.20	0.13	4.54
	obs4	128	434	4.56	0.58	0.02	0.20	0.24	0.28	0.26	3.39
Site4	obs1	79	679	4.49	0.30	0.04	0.07	0.21	0.40	0.29	8.59
	obs2	10	59	2.63	0.79	0.00	0.10	0.17	0.41	0.32	5.90
	obs3	40	383	17.80	2.08	0.08	0.21	0.27	0.20	0.24	9.58
	obs4	40	181	3.57	0.88	0.06	0.09	0.20	0.25	0.40	4.53
	obs5	87	700	3.42	0.57	0.01	0.07	0.24	0.22	0.47	8.05
Site5	obs1	170	1603	9.68	0.69	0.03	0.15	0.25	0.29	0.28	9.43
	obs2	143	1069	9.71	0.95	0.04	0.14	0.31	0.34	0.16	7.48
	obs3	60	459	5.01	0.82	0.01	0.11	0.21	0.31	0.36	7.65
	obs4	159	1289	7.84	0.65	0.03	0.13	0.25	0.29	0.30	8.11
	obs5	187	1594	5.29	0.69	0.02	0.07	0.39	0.38	0.15	8.52
Site6	obs1	150	1193	13.52	0.91	0.03	0.24	0.34	0.24	0.15	7.95
	obs2	74	364	1.93	0.20	0.01	0.05	0.20	0.37	0.37	4.92
Site7	obs1	73	275	1.81	0.62	0.00	0.05	0.32	0.37	0.26	3.77
	obs2	61	309	3.87	0.38	0.02	0.11	0.33	0.34	0.20	5.07
	obs3	37	178	2.00	0.28	0.02	0.02	0.25	0.36	0.35	4.81
	obs4	212	782	1.65	0.34	0.01	0.06	0.29	0.35	0.30	3.69
	obs5	91	307	2.38	0.30	0.01	0.12	0.32	0.32	0.23	3.37
	obs6	55	229	1.33	0.18	0.01	0.03	0.15	0.41	0.40	4.16
Site8	obs1	169	996	12.69	1.91	0.06	0.18	0.33	0.29	0.14	5.93
	obs2	68	486	44.23	5.52	0.20	0.34	0.29	0.15	0.03	7.15
	obs3	80	506	5.85	0.42	0.03	0.13	0.38	0.28	0.17	6.33
AVERAGE		117	750			0.04	0.13	0.27	0.30	0.26	6.50

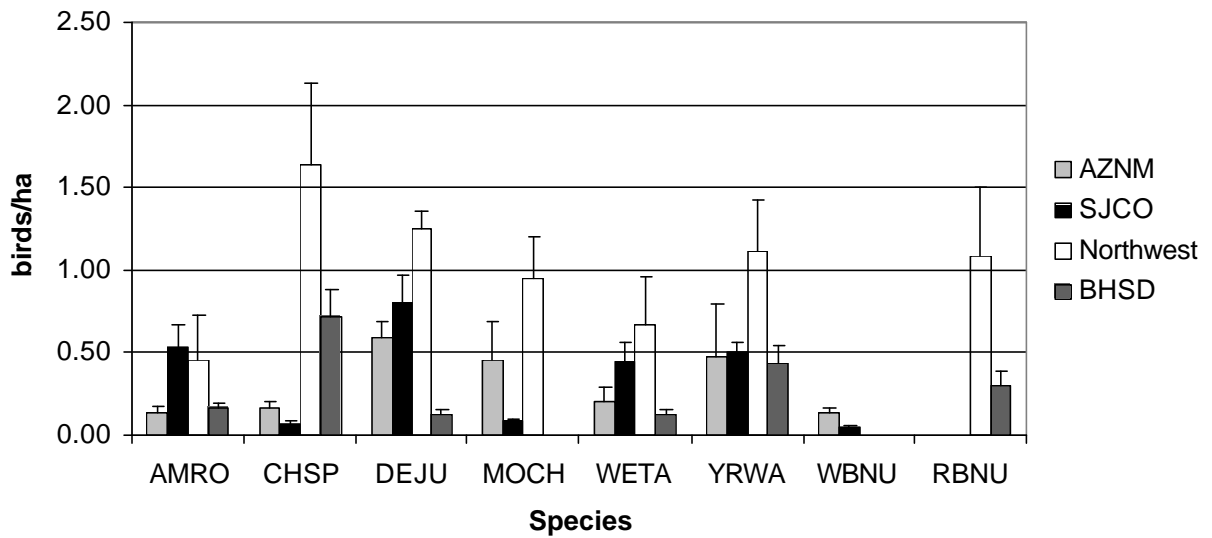


Figure 1. Regional density estimates generated by Program Distance. Densities of birds per ha for four regions. 1) Arizona-New Mexico sites (AZNM) 2) the San Juan, Colorado site (SJCO), 3) the Montana, Idaho, Oregon, and Washington sites (Northwest), and 4) the Black Hills, South Dakota site (BHSD). Regions were determined based on vegetation similarities.

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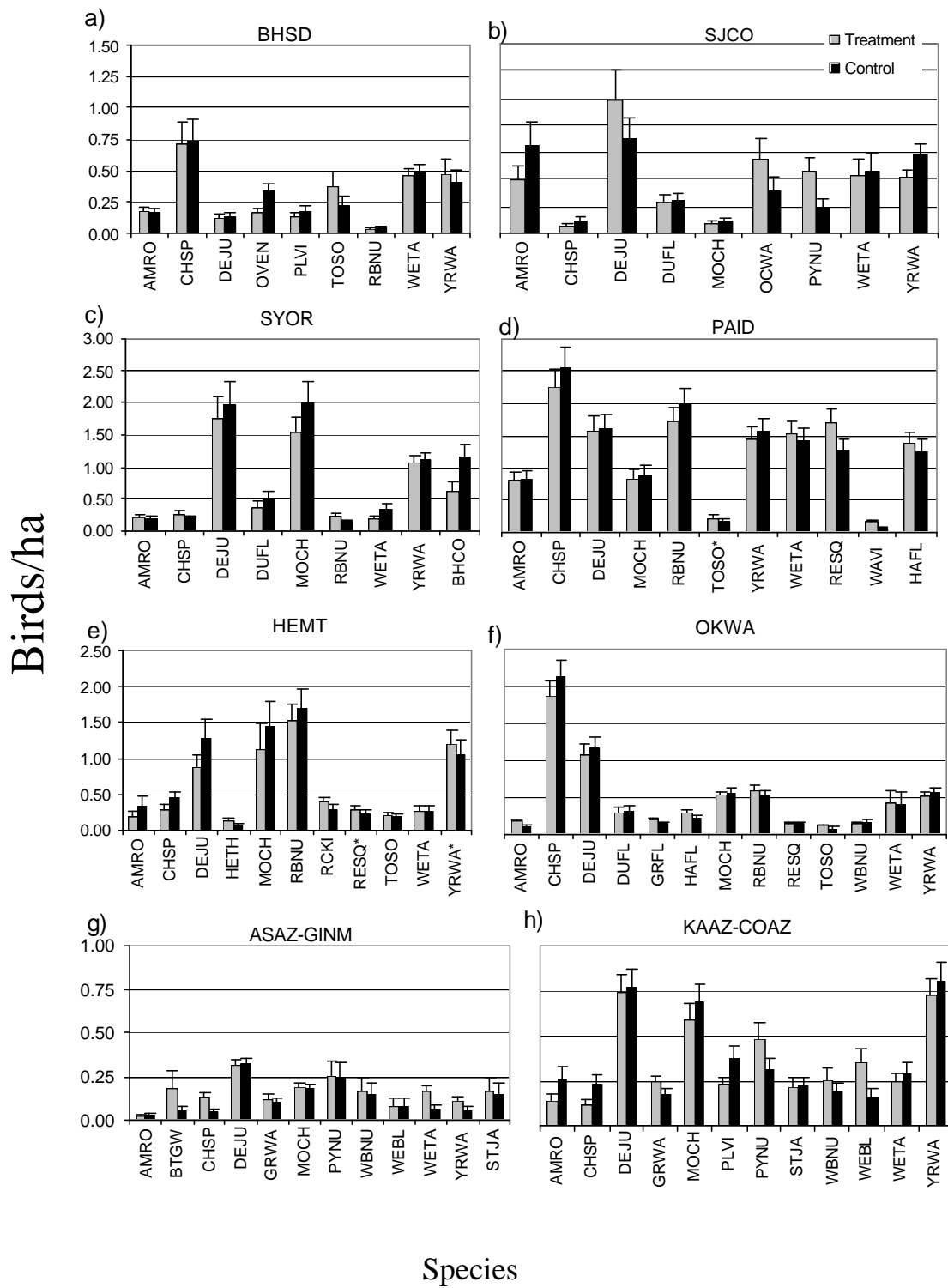


Figure 3. Program Distance estimates of birds per ha for each site. Bars indicate one standard error. * indicate estimates based on a subset of transects.

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