

**Birds and Burns Network  
Summary of Point Count Data**

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## INTRODUCTION

The Birds and Burn Network established paired control and treatment units in eight states in 2002 to investigate the role of prescribed fire in maintaining breeding bird diversity in *Pinus ponderosa* (Ponderosa pine) forests in the western United States. 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/>). In order to assess the effects of burning on bird densities, we adopted a Before-After-Control-Impact design (BACI) where control and treatment plots are monitored before and after burning. 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. These sites are located in the Black Hills of 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 on 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).

Between the Fall of 2003 and Spring of 2004, prescribed burning had been conducted on treatment plots in Idaho, Washington, Arizona, and New Mexico (Table 1.). Point count surveys were conducted on seven sites (HEMT, SJCO, OKWA, SYOR, PAID, KAAZ-COAZ, and ASAZ-GINM) in 2004. We determined that prescribed burning would not be conducted on our sites in BHSD, and therefore discontinued monitoring of that location. We present summaries of pre-burn bird densities for all locations, and post-burn densities where possible.

## POINT COUNT METHODS

*Field methods:* To estimate songbird densities, we selected 20 locations within each sampling unit where we conducted 100-m radius point counts (Buckland et al. 2001, USDA Forest Service 2004). Locations of point count stations are stratified by crown closure into two categories: open canopy (< 35% crown closure) and closed canopy ( $\geq$  35% crown closure). The number of closed and open point count stations is proportional to the amount of closed and open habitat available in the sampling unit. Additionally, point count stations are located at least 250 m from each other and 200 m from the edge of the unit. Point counts are conducted between 22 May and 3 July, starting just after the dawn chorus and ending no more than 5 hours later. At each point, the observer stands in the center of the location and records the species and distance from observer of all birds seen or heard within a five minute time period. Additionally, squirrel observations are recorded for sites containing vocal squirrel species. Observations are grouped into distance categories of 0-10 m, >10-25 m, >25-50 m, >50-75 m, 75-100 m, and greater than 100m. Observers are trained to estimate distances, identify species accurately, and avoid double counting birds by initially conducting point counts in pairs and comparing results between observers. When possible, laser range finders are utilized to assist with accurate distance measurements.

*Analysis* : Program Distance was used to estimate bird densities for treatment and control plots in two regions; 1) Arizona-New Mexico sites (Southwest) and 2) the Montana, Idaho, Oregon, and Washington sites (Northwest). Data from the San Juan in Colorado was not included in this analysis, but will be in future analyses. Observations of birds beyond 100 m were removed from the data set prior to estimating densities in Program Distance. We used the Multiple Covariate Distance Sampling engine to incorporate the effects of observer, location, visit, year, treatment (burned versus unburned) and strata (open versus closed) on the detection function. Each variable was entered into the analysis separately, and additional variables were added one at a time. The best fit model was selected according to AICc.

Pre-burn density estimates were calculated for all units, and post-burn estimates were calculated for all paired units in Arizona and New Mexico, one unit in Idaho, and two units in Washington. Densities calculated using the same detection function are not independent of one another, therefore, bootstrapping is necessary to estimate the variance (Len Thomas *pers. comm.*). Bootstrapping will be conducted within Program R with code written by Len Thomas, Tiago Marques, and Robin Russell.

## RESULTS

### Northwest:

In 2004, a total of 1282 point count surveys were conducted in the Northwest region including the San Juan. Since 2002, a total of 25,418 detections of 110 bird species and 3 squirrel species have been recorded in twelve paired units (Table 3). Washington recorded the largest number of detections and the greatest number of bird species (68). Yellow-rumped warblers, *Dendroica coronata*, were the most frequently detected species across the entire region. On the three burned units in Idaho and Washington, Western Tanagers, *Piranga ludoviciana*, was the most frequently recorded species.

Density estimates have been calculated for each of the following ten species on control and treatment units before prescribed burning : Brown Creeper, *Certhia Americana*, Cassin's Vireo, *Vireo cassinii*, Chipping Sparrow, *Spizella passerine*, Dark-eyed Junco, *Junco hyemalis*, Flycatcher spp., (*Empidonax oberholseri* and *Empidonax hammondi*), Mountain Chickadee, *Poecile gambeli*, Red-breasted Nuthatch, *Sitta canadensis*, White-breasted Nuthatch, *Sitta carolinensis*, Western Tanager and Yellow-rumped Warbler. On average across unburned units, Chipping Sparrow had the highest densities of any of the selected species in Washington and Idaho (Figure 1, Appendix A). In Oregon, Mountain Chickadees had the highest densities, and Red-breasted Nuthatches had their highest densities in Montana. Flycatcher densities were very low in Montana compared to other locations. Preliminary results suggest that differences in pre and post burn control and treatment units were highest for Mountain Chickadee populations, which appeared to decline in response to burning (Figure 2, Appendix A). White-breasted Nuthatches, Western Tanagers, Chipping Sparrows, and Cassin's Vireo responded positively to fire, while Brown Creepers, Dark-eyed Junco, the flycatcher species, Red-breasted Nuthatches, and Yellow-rumped Warbler populations declined after fire.

### Southwest:

In 2004, a total of 1072 point count surveys were conducted in the Southwest region of Arizona and New Mexico. Since 2002, a total of 17,435 detections of 76 bird species and one squirrel species have been recorded in four paired units (Table 4.) Dark-eyed Junco was the most frequently recorded species on burned and unburned units, Pygmy Nuthatch, *Sitta*

*pygmaea*, was the second most common species on unburned sites, and Western Bluebird, *Sialia currucoides*, was the second most common species on burned sites.

Density estimates have been calculated for each of the following ten species on control and treatment units before and after prescribed burning: Black-headed Grosbeak, *Pheucticus melanocephalus*, Brown Creeper, Chipping Sparrow, Dark-eyed Junco, Mountain Chickadee, Pygmy Nuthatch, Western Bluebird, and White-breasted Nuthatch. On average across unburned units, Dark-eyed Juncos had the highest densities of all selected bird species on both sites (Gila and Apache Sitgreaves (GIAS) and Kaibab and Coconino (KACO)) (Fig. 3). Pygmy Nuthatches had high densities on the GIAS and Yellow-rumped Warblers had high densities on KACO. Preliminary results indicate that Western Bluebirds and Dark-eyed Juncos response positively to prescribed burning treatments, while Brown Creepers, Pygmy Nuthatches, Mountain Chickadees, White-breasted Nuthatches, and Yellow-rumped Warbler densities declined after fire (Fig. 4).

## **DISCUSSION and FUTURE DIRECTIONS**

The effect of prescribed fire on bird densities was investigated for seven species in ponderosa pine forest in both the Northwest and Southwest. Brown Creepers, Mountain Chickadees, and Yellow-rumped Warblers exhibited negative responses to fire in both regions. Dark-eyed Junco and White-breasted Nuthatch responses were opposite each other, with Dark-eyed Juncos responding negatively in the Northwest and positively in the Southwest while White-breasted Nuthatches responded positively in the Southwest and negatively in the Northwest. Chipping Sparrow and Western Tanager responses were negligible in the Southwest and positive in the Northwest. The statistical significance of these responses had not yet been investigated. A bootstrapping program is being developed in R that will estimate the variance of the densities calculated by Program Distance. We intend to select species for analysis that we expect will respond negatively or positively to prescribed fire, that are of interest as indicator species, and that allow us to compare results for the Northwest and the Southwest. San Juan National Forest data will be incorporated into the Northwest data analysis.

Though all prescribed burning was initiated within one year of when point count surveys were conducted in 2004, burning at each location took place at different times of year and over different time periods. For example on the Kaibab, burning was completed in March 2004, while on the Coconino, burning was completed in the December 2003. Time since burning may be an important factor in determining bird responses to prescribed fire, therefore we will refine our data analyses to estimate treatment effects in different postfire time periods (for example, within 6 months post fire, between 6-12 months, and >12 months postfire). Additionally, we will investigate the influence of habitat variables such as burn severity, snag density, and amount of downed woody debris on song bird populations.

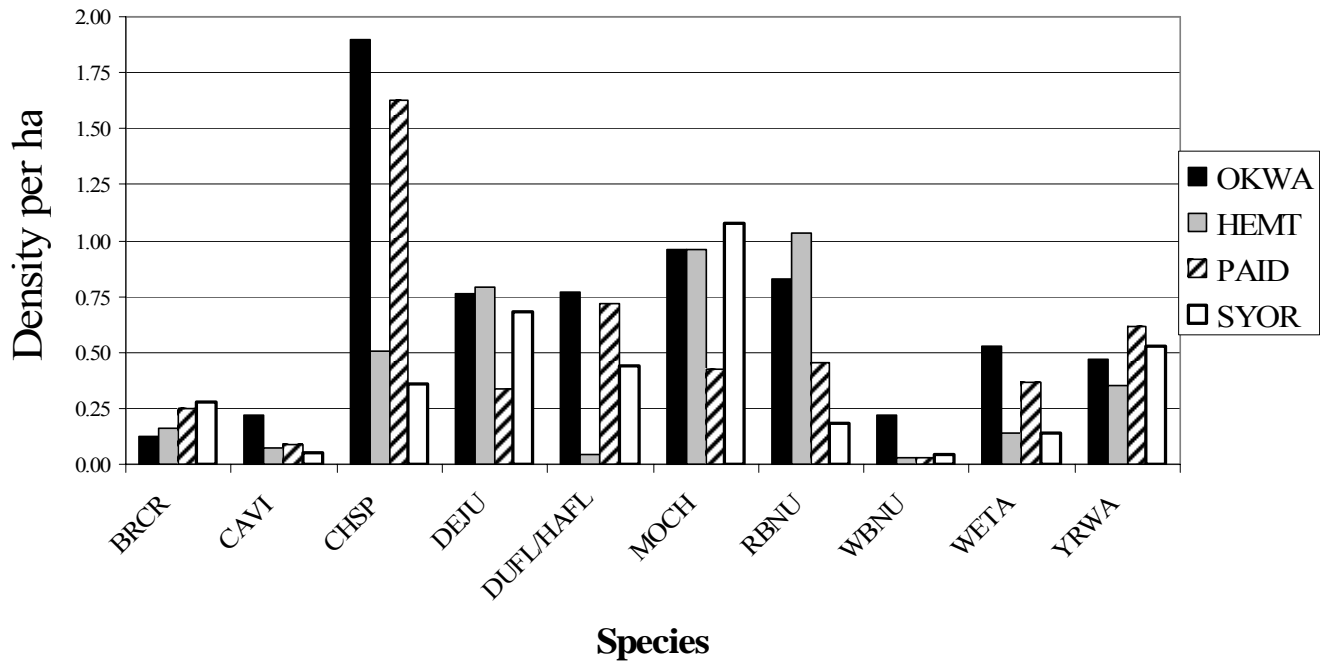


Figure 1. Densities per hectare for ten selected species of breeding birds on unburned sites in Washington, Montana, Idaho, and Oregon.

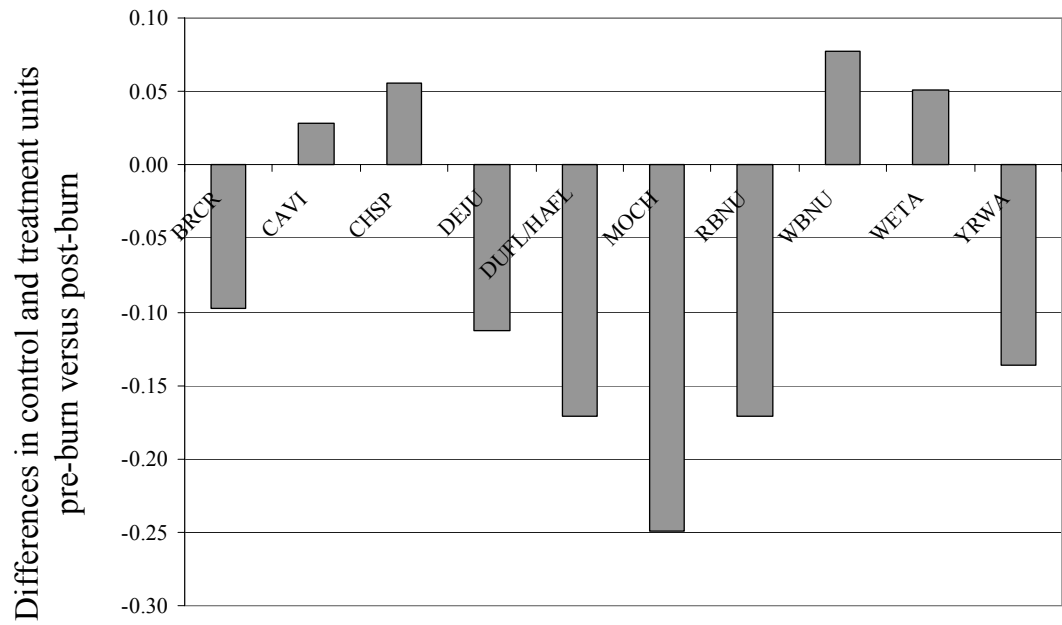


Figure 2. Differences in control and treatment units before burning versus after burning for selected species of breeding birds in Washington and Idaho. Positive numbers suggest higher densities on treatment units compared to control units after prescribed burning.

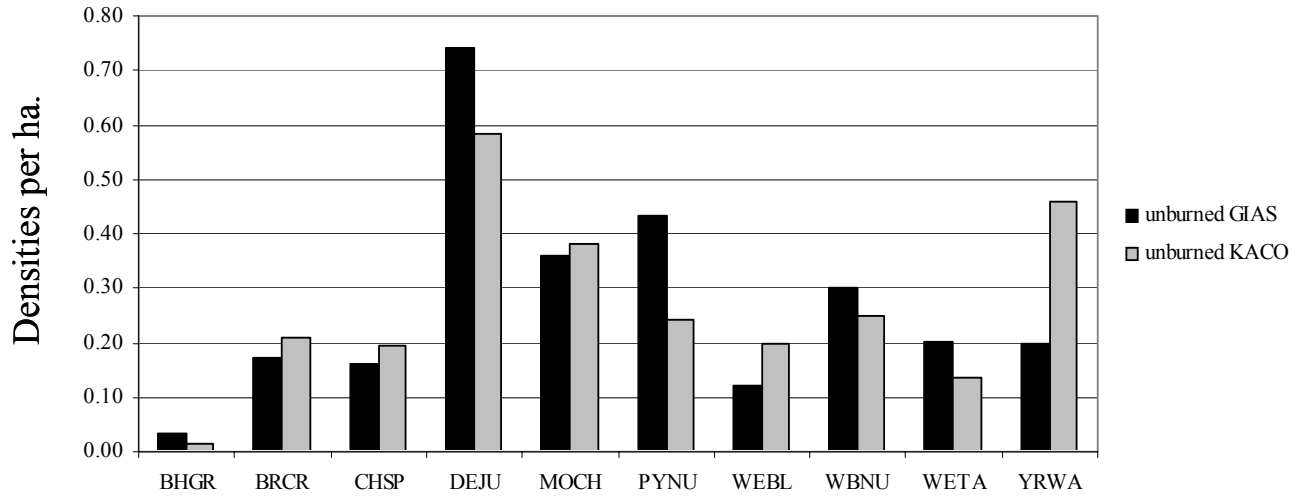


Figure 3. Densities per hectare for ten selected species of breeding birds on unburned sites in Arizona and New Mexico. GIAS is the Gila National Forest in New Mexico and Apache Sitgreaves National Forest in Arizona. KACO is the Kaibab and Coconino National Forests in Arizona.

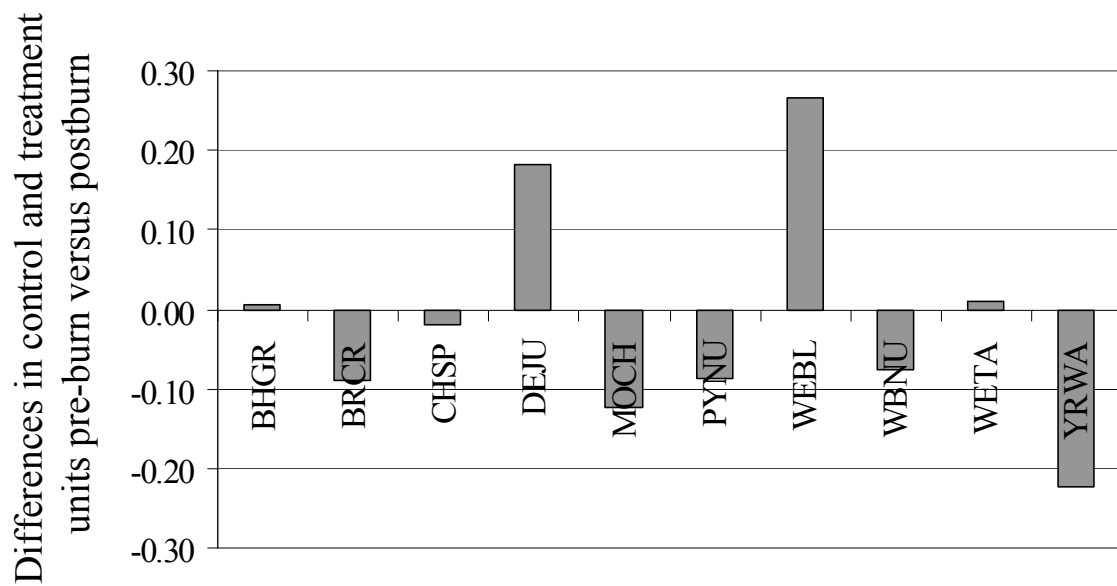


Figure 4. Differences in control and treatment units before burning versus after burning for selected species of breeding birds in Arizona and New Mexico. Positive numbers suggest that burning had a positive effect on bird densities (i.e. [post-burn treatment densities minus control densities]-[pre-burn treatment densities minus control densities] was >0).

Table 1. Status of prescribed burn treatments for seven sites. Units refer 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).

Sites	Number of units		Burn treatment
	Treatment	Control	
Payette, Idaho	3	3	1 unit treated Spring 2004 2 units scheduled for Spring 2005
Sycan Marsh/Fremont, Oregon	2	2	Scheduled for Spring 2006
Okanogan/Wenatchee, Washington	3	3	2 units treated Spring 2004 1 unit scheduled for Spring 2005
Helena, Montana	2	2	Scheduled for Spring 2006
San Juan, Colorado	2	2	Scheduled for Spring 2006
Kaibab, Arizona and Coconino, AZ	1	2	Fall 2003 and Spring 2004
	1	1	
Gila, New Mexico and Apache/Sitgreaves, Arizona	1	1	Fall 2003 and Spring 2004
	1	1	

Table 2. Number of units, point count locations, and point count visits per year.

	Number of units Number of Point count locations		Total number of Point Count locations visited in each year
	Treatment	Control	Point count Visits per Season
<b>Northwest</b>			
Payette, Idaho	3 60 pts	3 50 pts	110 pts 2 visits
Sycan Marsh/Fremont, Oregon	2 40 pts	2 40 pts	80 pts 2 visits
Okanogan/Wenatchee, Washington	3 60 pts	3 60 pts	120 pts 3 visits
Helena, Montana	3 60 pts	3 60 pts	120 pts 3 visits
San Juan, Colorado	2 40-50 pts	2 40-50 pts	91 pts 1-2 visits
<b>Southwest</b>			
Kaibab, Arizona and Coconino, Arizona	1 30 pts	1 50 pts	80 pts 4 visits
	1 40 pts	1 40 pts	80 pts 4 visits
Gila, New Mexico and Apache/Sitgreaves, Arizona	1 25 pts	1 25 pts	50 pts 4 visits
	1 29 pts	1 29 pts	58 pts 4 visits

Table 3. Number of times a species was detected while conducting point count surveys in the Northwest region including Montana, Oregon, Idaho, Washington, and Colorado

Northwest Total detections								burned Paid (1unit)	burned OKWA (2 units)	Total burned
SPP	MT	OR	PAID	OKWA	SJCO	total Unburned				
AMDI	0	0	0	0	1	1		0	0	0
AMKE	0	1	6	3	0	10		0	0	0
AMRO	71	112	244	275	297	999		12	77	89
AUWA	0	0	2	0	1	3		0	0	0
BBMA	0	0	0	3	0	3		0	0	0
BBWO	0	2	2	0	0	4		0	0	0
BCCH	35	0	3	0	0	38		0	0	0
BHCO	12	152	0	107	0	271		0	17	17
BHGR	0	4	8	3	76	91		0	1	1
Blue Grouse	3	13	20	64	13	113		0	0	0
BRBL	0	1	0	0	0	1		0	0	0
BRCR	30	50	60	34	51	225		9	3	12
BRLH	0	0	0	0	22	22		0	0	0
BRSP	0	0	0	0	2	2		0	0	0
BTAH	0	0	2	0	10	12		0	0	0
BTGW	0	0	0	0	1	1		0	0	0
BUOR	0	2	0	0	0	2		0	2	2
CAFI	0	29	109	255	1	394		5	36	41
CAHU	0	0	18	8	0	26		0	2	2
CANW	0	0	2	0	0	2		0	0	0
CAVI	45	28	95	240	0	408		9	29	38
CEDW	0	0	1	0	0	1		1	0	1
CHSP	115	75	547	835	114	1686		17	66	83
CLNU	65	19	23	81	0	188		0	21	21
COFL	0	7	0	0	4	11		0	0	0
COGS	0	0	40	0	0	40		0	0	0
COHA	1	2	1	3	0	7		0	0	0
CONI	0	4	1	21	0	26		0	6	6
CORA	15	4	7	66	0	92		0	6	6
COSN	0	4	0	0	0	4		0	0	0
DEJU	296	239	226	524	236	1521		3	72	75
DOWO	3	0	0	0	6	9		0	0	0
DUFL/HAFL	23	220	569	828	175	1815		42	62	104
DUSCV	0	0	0	1	0	1		0	0	0
EVGR	5	0	5	2	4	16		0	0	0
FLOW	0	0	1	2	0	3		0	1	1
FOSP	0	9	0	0	0	9		0	0	0
GCKI	7	3	2	6	10	28		1	1	2

Table 3. cont'd

GHOW	0	4	0	2	0	6	0	0	0
GLNU	0	0	0	1	0	1	0	0	0
GMGS	0	0	2	0	0	2	1	0	1
GRFL	0	1	0	197	0	198	0	51	51
GRJA-GRAJ	36	5	12	4	0	57	0	0	0
GRWA	0	0	0	0	33	33	0	0	0
GTTO	0	20	0	0	36	56	0	0	0
HAFI	0	0	0	1	0	1	0	0	0
HAWO	36	22	68	65	49	240	4	13	17
HETA	0	0	0	0	1	1	0	0	0
HETH	128	35	52	22	89	326	14	1	15
HOWR	0	0	3	15	83	101	0	13	13
LABU	2	0	0	0	0	2	0	0	0
LASP	0	0	0	0	1	0	0	0	0
LAZB	0	0	2	3	0	5	0	0	0
LISP	3	0	0	0	0	3	0	0	0
MALL	0	4	0	8	0	12	0	0	0
MGWA	10	0	81	0	8	99	4	0	4
MOBL	2	2	3	0	1	8	0	0	0
MOCH	353	364	243	692	132	1784	13	85	98
MODO	21	9	0	14	3	47	0	1	1
NAWA	0	0	31	43	0	74	0	0	0
NOFL	5	24	36	106	44	215	1	26	27
NOGO	0	2	2	0	0	4	0	1	1
NOPO	0	0	1	0	4	5	0	0	0
OCWA	7	0	11	1	236	255	2	0	2
OSFL	1	27	0	5	0	33	2	0	2
PISI	46	10	50	451	53	610	4	43	47
PIWO	4	1	6	21	0	32	0	6	6
PLVI	0	0	0	0	19	19	0	0	0
PYNU	0	10	0	38	217	265	0	10	10
RBNA	0	1	0	0	0	1	0	0	0
RBNU	670	113	446	924	5	2158	21	152	173
RBSA	0	8	0	0	0	8	0	0	0
RCKI	195	0	25	102	44	366	3	7	10
RECR	42	6	62	100	0	210	0	13	13
RESQ* with TADO	383	12	489	262	0	1146	51	32	83
RNSA	21	0	1	0	10	32	0	0	0
ROWR	0	0	7	4	0	11	0	1	1
RTHA	1	1	4	7	0	13	1	0	1
RUGR	0	0	8	3	0	11	0	0	0
RUHU	0	3	1	1	0	5	0	0	0
RWBL	0	5	0	0	0	5	0	0	0
SACR	0	1	0	0	0	1	0	0	0

Table 3. cont'd

SCGR	0	0	0	1	0	1	0	0	0
SORA	0	1	0	0	0	1	0	0	0
SOSP	0	0	4	0	5	9	0	0	0
SPTO	1	5	4	79	6	95	0	3	3
SSHA	0	1	1	1	0	3	0	0	0
STJA	0	46	8	22	146	222	1	6	7
SWTH	1	0	64	84	0	149	7	0	7
TOSO	192	57	72	413	42	776	8	57	65
TOWA	0	2	91	24	0	117	2	1	3
TRES	0	0	0	0	1	1	0	0	0
TRSW	0	0	0	1	0	1	0	0	0
TTWO	3	0	0	0	13	16	0	0	0
VESP	0	1	0	4	0	5	0	0	0
VGSW	1	0	0	9	69	79	0	1	1
VIWA	0	0	0	0	56	56	0	0	0
WAVI	68	0	114	54	83	319	14	2	16
WBNU	18	21	20	234	83	376	0	54	54
WEBL	0	1	0	25	0	26	0	27	27
WEME	0	5	0	1	0	6	0	0	0
WETA	142	136	574	1107	330	2289	27	182	209
WEWP	0	4	2	47	73	126	0	12	12
WHWO	0	6	0	2	0	8	0	0	0
WISA	0	11	6	53	30	100	0	9	9
WITU	0	0	0	0	3	3	0	0	0
WIWA	0	0	2	5	8	15	0	1	1
WIWR	0	0	9	0	0	9	0	0	0
WTSW	0	0	0	0	6	6	0	0	0
WWPE	0	14	7	1	0	22	0	0	0
YEWA	0	1	0	0	0	1	0	0	0
YPCH	0	1	72	0	0	73	1	0	1
YRWA	273	372	724	785	282	2436	40	74	114

Table 4. Number of times a species was detected while conducting point count surveys in the Southwest region (Arizona and New Mexico).

	GINM-ASAZ unburned	GINM-ASAZ burned	KAAZ-COAZ unburned	KACO-COAZ burned		Total Unburned	Total burned
ABSQ	3	5	0	0		11	5
ACWO	2	1	0	0		5	1
AMCR	0	0	2	0		2	0
AMKE	0	0	3	3		3	3
AMRO	75	41	200	80		391	121
ATFL	24	10	11	0		69	10
BCHU	0	0	1	0		1	0
BHCO	3	5	100	40		111	45
BHGR	52	14	44	2		162	16
BRCR	53	6	99	28		211	34
BTGW	162	63	3	0		390	63
BTHU	5	3	53	11		66	14
BTPI	11	1	0	0		23	1
BUSH	39	1	5	2		84	3
CAKI	0	0	5	0		5	0
CHSP	93	33	213	57		432	90
CLNU	0	0	3	0		3	0
COFL	35	14	38	2		122	16
COHA	0	0	1	0		1	0
CONI	10	1	10	1		31	2
CORA	41	4	44	14		130	18
DEJU	502	229	688	241		1921	470
DOWO	4	2	0	0		10	2
DRUM	0	0	2	3		2	3
FLYC	0	0	2	0		2	0
GHOW	0	0	0	1		0	1
GRFL	18	0	109	53		145	53
GRVI	0	1	0	0		1	1
GRWA	132	38	482	216		784	254
GTTO	0	1	0	0		1	1
HAWK	0	0	2	0		2	0
HAWO	121	54	116	46		412	100
HETA	19	5	14	4		57	9
HETH	75	19	18	2		187	21
HUMM	0	0	4	0		4	0
JUTI	0	0	0	2		0	2
LASP	0	0	17	6		17	6
LEGO	2	0	3	2		7	2
MOBL	0	0	4	1		4	1
MOCH	268	129	390	69		1055	198
MODO	54	15	223	7		346	22

NOFL	81	38	61	26		261	64
NOGO	5	1	2	0		13	1
NUTH	0	0	1	0		1	0
OLWA	12	13	10	4		47	17
OSFL	1	5	0	0		7	5
PIJA	2	1	30	0		35	1
PISI	0	1	7	1		8	2
PLVI	58	35	414	125		565	160
PYNU	412	102	366	143		1292	245
RBNU	0	1	0	0		1	1
RCKI	2	0	0	0		4	0
RECR	1	15	32	1		49	16
RFWA	18	0	21	1		57	1
ROWR	0	0	1	1		1	1
SPTO	15	16	0	0		46	16
Squirrel	5	1	0	0		11	1
STJA	231	73	169	55		704	128
TOSO	26	4	10	0		66	4
TTWO	0	0	0	2		0	2
VESP	1	0	49	15		51	15
VGSW	20	0	51	21		91	21
VIWA	41	9	10	5		101	14
WARB	1	0	12	1		14	1
WAVI	3	6	6	1		18	7
WBNU	220	81	278	121		799	202
WEBL	122	48	292	221		584	269
WEME	0	0	4	0		4	0
WETA	266	137	291	105		960	242
WISA	0	0	0	1		0	1
WITU	2	1	3	3		8	4
WOOD	5	0	11	0		21	0
WSJA	8	1	0	0		17	1
WTSW	0	0	1	0		1	0
WWPE	30	25	230	98		315	123
YEWA	0	0	1	0		1	0
YRWA	105	21	527	140		758	161

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	DUFL/HAFL				cover		MOCH				obs year visit		
Location	Period	Unit	density estimate	difference trt-control	Changes in differences between post-burn & pre-burn	Location	Period	Unit	density estimate	difference trt-control	Changes in differences between post-burn & pre-burn		
OKWA	pre	C-TD	0.826	0.215		OKWA	pre	C-TD	0.809	0.088			
		Trt-RY	1.041					Trt-RY	0.897				
	pre	C-LK	0.696	-0.181			-0.141	pre	C-LK	0.953		-0.172	0.258
		Trt-FY	0.515						Trt-FY	0.781			
	post	C-LK	0.586	-0.322			-0.023	post	C-LK	0.726		0.085	-0.476
		Trt-FY	0.265						Trt-FY	0.811			
	pre	C-HR	0.473	0.605			pre	C-HR	0.700	0.915			
		Trt-MT	1.078					Trt-MT	1.615				
	post	C-HR	0.410	0.582			post	C-HR	0.929	0.440			
		Trt-MT	0.992					Trt-MT	1.369				
	HEMT	pre	C-MC	0.022			0.041	HEMT	pre	C-MC		0.926	0.127
			TRT-MT	0.063						TRT-MT		1.053	
pre		C-SC	0.075	-0.068	pre	C-SC	0.961		-0.077				
		Trt-ST	0.007			Trt-ST	0.884						
PAID	pre	C-BH	0.673	0.108	PAID	pre	C-BH	0.575	-0.180				
		Trt-Fc	0.781				Trt-Fc	0.395					
	pre	C-WM	0.440	0.605		pre	C-WM	0.544	-0.139				
		Trt-DO	1.044				Trt-DO	0.406					
	pre	C-DM	0.455	0.474		-0.348	pre	C-DM	0.233	0.173			
		Trt-PC	0.928					Trt-PC	0.406				
	post	C-DM	0.752	0.125		post	C-DM	0.752	-0.356				
		Trt-PC	0.877				Trt-PC	0.395					
SYOR	pre	C-CS	0.663	-0.435	SYOR	pre	C-CS	1.242	-0.197				
		Trt-TS	0.228				Trt-TS	1.045					
	pre	C-CN	0.239	0.392		pre	C-CN	1.105	-0.187				
		Trt-TN	0.630				Trt-TN	0.918					
					-0.171						-0.249		

	RBNU				year visit		WBNU				cover visit		
Location	Period	Unit	density estimate	difference trt-control	Changes in differences between post-burn & pre-burn	Location	Period	Unit	density estimate	difference trt-control	Changes in differences between post-burn & pre-burn		
OKWA	pre	C-TD	0.645	-0.159		OKWA	pre	C-TD	0.188	0.045			
		Trt-RY	0.486					Trt-RY	0.234				
	pre	C-LK	0.655	0.099			0.124	pre	C-LK	0.303		-0.145	0.234
		Trt-FY	0.754						Trt-FY	0.158			
	post	C-LK	0.659	0.222			-0.520	post	C-LK	0.333		0.089	-0.013
		Trt-FY	0.882						Trt-FY	0.421			
	pre	C-HR	0.557	1.329			pre	C-HR	0.105	0.211			
		Trt-MT	1.885					Trt-MT	0.316				
	post	C-HR	0.823	0.809			post	C-HR	0.172	0.198			
		Trt-MT	1.631					Trt-MT	0.370				
	HEMT	pre	C-MC	1.121			-0.068	HEMT	pre	C-MC		0.035	-0.022
			TRT-MT	1.053						TRT-MT		0.013	
pre		C-SC	0.905	0.154	pre	C-SC	0.032		0.016				
		Trt-ST	1.059			Trt-ST	0.047						
PAID	pre	C-BH	0.793	-0.341	PAID	pre	C-BH	0.044	-0.003				
		Trt-Fc	0.452				Trt-Fc	0.041					
	pre	C-WM	0.238	0.261		pre	C-WM	0.062	-0.049				
		Trt-DO	0.499				Trt-DO	0.013					
	pre	C-DM	0.287	0.152		-0.117	pre	C-DM	0.012	-0.012	0.012		
		Trt-PC	0.438					Trt-PC	0.000				
	post	C-DM	0.331	0.035		post	C-DM	0.000	0.000				
		Trt-PC	0.365				Trt-PC	0.000					
SYOR	pre	C-CS	0.136	-0.059	SYOR	pre	C-CS	0.057	-0.041				
		Trt-TS	0.077				Trt-TS	0.016					
	pre	C-CN	0.156	0.204		pre	C-CN	0.056	-0.021				
		Trt-TN	0.361				Trt-TN	0.036					
					-0.171						0.077		

	WETA				global		YRWA				global			
Location	Period	Unit	density estimate	difference trt-control	Changes in differences between post-burn & pre-burn	Location	Period	Unit	density estimate	difference trt-control	Changes in differences between post-burn & pre-burn			
OKWA	pre	C-TD	0.471	-0.040	0.156	OKWA	pre	C-TD	0.597	-0.010	0.014			
		Trt-RY	0.431					Trt-RY	0.587					
	pre	C-LK	0.358	0.084			0.156	OKWA	pre	C-LK		0.535	0.000	0.014
		Trt-FY	0.442							Trt-FY		0.535		
	post	C-LK	0.315	0.240			0.156	OKWA	post	C-LK		0.492	0.014	0.014
		Trt-FY	0.555							Trt-FY		0.506		
	pre	C-HR	0.460	0.560			0.032	OKWA	pre	C-HR		0.258	0.061	-0.207
		Trt-MT	1.020							Trt-MT		0.319		
	during*	C-HR	0.614	0.592			0.032	OKWA	post	C-HR		0.457	-0.146	-0.207
		Trt-MT	1.205							Trt-MT		0.310		
HEMT	pre	C-MC	0.078	0.033	0.156	HEMT	pre	C-MC	0.295	0.113	0.014			
		TRT-MT	0.110					TRT-MT	0.407					
	pre	C-SC	0.228	-0.078			0.156	HEMT	pre	C-SC		0.368	-0.024	0.014
		Trt-ST	0.150							Trt-ST		0.344		
PAID	pre	C-BH	0.584	-0.118	-0.035	PAID	pre	C-BH	1.038	-0.477	-0.217			
		Trt-Fc	0.467					Trt-Fc	0.561					
	pre	C-WM	0.369	-0.084			-0.035	PAID	pre	C-WM		0.645	-0.032	-0.217
		Trt-DO	0.285							Trt-DO		0.613		
	pre	C-DM	0.180	0.112			-0.035	PAID	pre	C-DM		0.309	0.232	-0.217
		Trt-PC	0.292							Trt-PC		0.541		
	post	C-DM	0.219	0.077			-0.035	PAID	post	C-DM		0.569	0.015	-0.217
		Trt-PC	0.296							Trt-PC		0.584		
SYOR	pre	C-CS	0.154	-0.043	0.051	SYOR	pre	C-CS	0.650	-0.184	-0.137			
		Trt-TS	0.111					Trt-TS	0.466					
	pre	C-CN	0.215	-0.123			0.051	SYOR	pre	C-CN		0.435	0.112	-0.137
		Trt-TN	0.092							Trt-TN		0.547		
					0.051						-0.137			

Appendix A. Density estimates for Black-headed Grosbeak, Brown Creeper, Chipping Sparrow, Dark-eyed Junco, Mountain Chickadee, Pygmy Nuthatch, Western Bluebird, White-breasted Nuthatch, Western Tanager, and Yellow-rumped Warbler for pre and post fire periods in Arizona and New Mexico including Coconino National Forest (COAZ), Kaibab National Forest, (KAAZ), Gila National Forest, (GINM), and Apache Sitgreaves (ASAZ). Listed covariates were included in the best model of the detection function as selected according to AICc.

<b>Density per hectare</b>														
		<b>Species</b> BHGR			<b>Covariate</b> burned unburned					<b>Species</b> BRCR			<b>Covariate</b> burned, visit	
Loc	Period	Unit	density estimate	(trt-control)	post-burn difference minus pre-burn difference	Location	Period	Unit	density estimate	(trt-control)	post-burn difference minus pre-burn difference			
COAZ	pre	C-BU	0.041	-0.030	-0.015	COAZ	pre	C-BU	0.155	0.062	-0.236			
		Trt-IM	0.012					Trt-IM	0.217					
	post	C-BU	0.056	-0.045			post	C-BU	0.294	-0.175				
		Trt-IM	0.012					Trt-IM	0.120					
KAAZ	pre	C-BEMO	0.003	0.001	-0.008	KAAZ	pre	C-BEMO	0.190	0.089	-0.043			
		Trt-KE	0.004					Trt-KE	0.279					
	post	C-BEMO	0.007	-0.007			post	C-BEMO	0.074	0.045				
		Trt-KE	0.000					Trt-KE	0.120					
GINM	pre	C-LJ	0.022	0.000	0.084	GINM	pre	C-LJ	0.198	0.014	-0.031			
		Trt-CP	0.022					Trt-CP	0.212					
	post	C-LJ	0.028	0.084			post	C-LJ	0.099	-0.017				
		Trt-CP	0.113					Trt-CP	0.082					
ASAZ	pre	C-PMPT	0.033	0.029	-0.041	ASAZ	pre	C-PMPT	0.192	-0.107	-0.043			
		Trt-LK	0.061					Trt-LK	0.085					
	post	C-PMPT	0.029	-0.012			post	C-PMPT	0.150	-0.150				
		Trt-LK	0.016					Trt-LK	0.000					
Overall difference					0.005	Overall difference					-0.088			

		CHSP			global			DEJU			burned, location cover, year
Loc	Period	Unit	density estimate	(trt- control)	post-burn difference minus pre-burn difference	Loc	Period	Unit	density estimate	(trt-control)	post-burn difference minus pre-burn difference
COAZ	pre	C-BU	0.113	0.076	-0.076	COAZ	pre	C-BU	0.390	0.119	0.050
		Trt-IM	0.189					Trt-IM	0.508		
	post	C-BU	0.472	0.000			post	C-BU	0.745	0.168	
		Trt-IM	0.472					Trt-IM	0.914		
KAAZ	pre	C-BEMO	0.378	-0.277	0.041	KAAZ	pre	C-BEMO	0.759	-0.081	-0.131
		TRT-KE	0.101					TRT-KE	0.677		
	post	C-BEMO	0.302	-0.236			post	C-BEMO	1.396	-0.212	
		Trt-KE	0.066					Trt-KE	1.183		
GINM	pre	C-LJ	0.190	0.268	-0.041	GINM	pre	C-LJ	0.813	0.085	0.464
		Trt-CP	0.458					Trt-CP	0.898		
	post	C-LJ	0.272	0.227			post	C-LJ	1.247	0.549	
		Trt-CP	0.499					Trt-CP	1.796		
ASAZ	pre	C-PMPT	0.000	0.000	0.000	ASAZ	pre	C-PMPT	0.677	-0.105	0.347
		Trt-LK	0.000					Trt-LK	0.572		
	post	C-PMPT	0.000	0.000			post	C-PMPT	0.958	0.242	
		Trt-LK	0.000					Trt-LK	1.200		
Overall difference					-0.019	0.183					

Location	Period	Unit	MOCH	Difference (trt- control)	burned year cover	Location	Period	Unit	PYNU	Difference (trt-control)	year
			density estimate		post-burn difference minus pre-burn difference				density estimate		post-burn difference minus pre-burn difference
COAZ	pre	C-BU	0.249	-0.016	-0.066	COAZ	pre	C-BU	0.239	-0.026	0.094
		Trt-IM	0.234					Trt-IM	0.213		
	post	C-BU	0.296	-0.082			post	C-BU	0.348	0.068	
		Trt-IM	0.214					Trt-IM	0.416		
KAAZ	pre	C- BEMO	0.548	-0.055	-0.182	KAAZ	pre	C-BEMO	0.139	0.232	-0.133
		TRT-KE	0.493					TRT-KE	0.371		
	post	C- BEMO	0.392	-0.237			post	C-BEMO	0.229	0.099	
		Trt-KE	0.155					Trt-KE	0.328		
GINM	pre	C-LJ	0.299	-0.057	0.170	GINM	pre	C-LJ	0.262	0.014	-0.147
		Trt-CP	0.242					Trt-CP	0.276		
	post	C-LJ	0.436	0.113			post	C-LJ	0.424	-0.133	
		Trt-CP	0.549					Trt-CP	0.291		
ASAZ	pre	C-PMPT	0.397	0.107	-0.411	ASAZ	pre	C-PMPT	0.567	0.065	-0.165
		Trt-LK	0.505					Trt-LK	0.631		
	post	C-PMPT	0.784	-0.304			post	C-PMPT	0.581	-0.100	
		Trt-LK	0.480					Trt-LK	0.481		
Overall difference					-0.122	Overall difference					-0.088

Location	Period	WEBL			burned year	Location	Period	WBNU			burned year cover
		Unit	density estimate	Difference (trt-control)	post-burn difference minus pre-burn difference			Unit	density estimate	Difference (trt-control)	post-burn difference minus pre-burn difference
COAZ	pre	C-BU	0.183	0.135	0.349	COAZ	pre	C-BU	0.330	0.000	-0.039
		Trt-IM	0.318					Trt-IM	0.330		
	post	C-BU	0.339	0.484			post	C-BU	0.414	-0.039	
		Trt-IM	0.823					Trt-IM	0.375		
KAAZ	pre	C-BEMO	0.086	0.118	0.429	KAAZ	pre	C-BEMO	0.121	0.091	-0.083
		TRT-KE	0.205					TRT-KE	0.211		
	post	C-BEMO	0.211	0.547			post	C-BEMO	0.145	0.008	
		Trt-KE	0.758					Trt-KE	0.153		
GINM	pre	C-LJ	0.172	0.069	0.159	GINM	pre	C-LJ	0.160	0.035	-0.196
		Trt-CP	0.241					Trt-CP	0.195		
	post	C-LJ	0.172	0.228			post	C-LJ	0.300	-0.161	
		Trt-CP	0.401					Trt-CP	0.139		
ASAZ	pre	C-PMPT	0.067	-0.067	0.128	ASAZ	pre	C-PMPT	0.410	0.027	0.019
		Trt-LK	0.000					Trt-LK	0.437		
	post	C-PMPT	0.067	0.061			post	C-PMPT	0.321	0.046	
		Trt-LK	0.128					Trt-LK	0.367		
Overall difference					0.266	Overall difference					-0.075

Location	Period	WETA			burned	Location	Period	YRWA			burned year cover
		Unit	density estimate	Difference (trt-control)	post-burn difference minus pre-burn difference			Unit	density estimate	Difference (trt-control)	post-burn difference minus pre-burn difference
COAZ	pre	C-BU	0.114	0.046	-0.065	COAZ	pre	C-BU	0.373	0.229	-0.469
		Trt-IM	0.160					Trt-IM	0.602		
	post	C-BU	0.221	-0.020			post	C-BU	0.755	-0.239	
		Trt-IM	0.201					Trt-IM	0.516		
KAAZ	pre	C-BEMO	0.166	-0.065	0.103	KAAZ	pre	C-BEMO	0.780	-0.226	-0.175
		TRT-KE	0.102					TRT-KE	0.555		
	post	C-BEMO	0.119	0.038			post	C-BEMO	0.811	-0.401	
		Trt-KE	0.157					Trt-KE	0.410		
GINM	pre	C-LJ	0.122	0.233	0.016	GINM	pre	C-LJ	0.254	0.219	-0.263
		Trt-CP	0.355					Trt-CP	0.472		
	post	C-LJ	0.177	0.249			post	C-LJ	0.214	-0.045	
		Trt-CP	0.426					Trt-CP	0.169		
ASAZ	pre	C-PMPT	0.116	0.095	-0.017	ASAZ	pre	C-PMPT	0.040	-0.013	0.019
		Trt-LK	0.210					Trt-LK	0.026		
	post	C-PMPT	0.200	0.078			post	C-PMPT	0.040	0.006	
		Trt-LK	0.277					Trt-LK	0.046		
Overall difference					0.009	Overall difference					-0.222