

**Status and Population Size of Breeding Grassland Birds on Rancho
Los Fresnos, Northern Sonora, Mexico**

FINAL REPORT

Investigator:

Aaron D. Flesch
School of Natural Resources
University of Arizona
325 Biosciences East, Tucson, Arizona, 85721
(520)-730-4656
flesch@ag.arizona.edu

Partner:

Eduardo E. López Saavedra
Biodiversidad y Desarrollo Armónico, A.C.
Guadalupe Victoria Núm. 46
Col. San Benito, C. P. 83190
Hermosillo, Sonora
01(662)-215-56-31
eelsaavedra@yahoo.com



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ABSTRACT

Despite persistent declines and widespread threats to grassland-dependant wildlife throughout much of North America, Rancho Los Fresnos offers good prospects for conservation and restoration of grasslands in northern Sonora, Mexico. In August 2007, I estimated abundance of breeding grassland birds throughout Rancho Los Fresnos to establish a baseline for long-term monitoring. I used distance-sampling methods during point counts at 66 stations and detected 1,066 individuals of 60 species and an additional 23 species incidentally. Grasshopper Sparrow (*Ammodramus savannarum*) and Botteri's Sparrow (*Aimophila botterrii*) were the most abundant breeding species on the ranch. I estimate there are 0.84 ± 0.09 (\pm SE) Grasshopper Sparrow territories per hectare or 3,256 territories overall on Rancho Los Fresnos. Similarly, I estimate there are 0.47 ± 0.07 Botteri's Sparrow territories per hectare or 1,806 territories overall. Mourning Dove (*Zenaida macroura*), Rufous-crowned Sparrow (*Aimophila ruficeps*), Blue Grosbeak (*Passerina caerulea*), and Eastern Meadowlark (*Sturnella magna*) were also common with estimates of population size ranging from 257 to 790 territories. These results indicate that Rancho Los Fresnos supports relatively large populations of breeding grassland birds including several species that seem to occur at much lower densities in the surrounding landscape. Although surveys during a single occasion each summer may be adequate to monitor changes in population size of abundant species, sampling stations two times per summer will greatly improve precision for monitoring grassland bird communities.

INTRODUCTION

Communities of grassland birds are threatened on global, continental, and regional scales (Goriup 1988). In North America, grassland birds have suffered more consistent and geographically widespread declines than any other group of birds (Knopf 1994). Between 1966 and 1996 for example, 77% of grassland bird species in North America were estimated to have declined (Peterjohn and Sauer 1999). In southern Arizona, the decline or regional extirpation of many species of grassland birds was documented between 1890 and 1930 due to extreme drought and overgrazing by domestic livestock (Brown 1900, Swarth 1929, Monson 1947, Phillips et al. 1964). Since that time, populations of many species have recovered in Arizona (Monson and Phillips 1981, Corman and Wise-Gervais 2005), yet the coverage and overall quality of grassland vegetation have declined (Bahre 1991, McClaran and Van Devender 1995). In adjacent northern Sonora, Mexico, historical data suggest that populations of grassland birds have also declined for reasons similar to those in Arizona (Russell and Monson 1998). However, current information indicates that breeding populations of many species of grassland birds still persist in some regions of northern Sonora, primarily in the upper San Pedro, Santa Cruz, Sasabe watersheds (Flesch, *in press*). Despite presence of these communities, there are currently no estimates of population size anywhere in Sonora.

Threats to grassland birds in the southwestern U.S. and northwestern Mexico include habitat loss, fragmentation, and degradation due to over utilization by domestic livestock, altered fire regimes, shrub encroachment, invasion of exotic species of grass, and loss of keystone species such as prairie dogs (*Cynomys* sp.) (McClaran and Van Devender 1995, Búrquez et al. 1996, Merola-Zwartjes 2005). In northwestern Mexico, few reserves have been established to conserve grasslands and most conservation efforts have been focused in short-grass communities in Chihuahuan desert grassland east of the Sierra Madre Occidental (Cartron et al. 2005, Desmond et al. 2005). West of the Sierra Madre Occidental in the tall-grass communities of northern Sonora, recent efforts to conserve and restore grasslands resulted in the acquisition of Rancho Los Fresnos in 2005 by The Natural Conservancy. Now owned by Naturalia and managed primarily by BIDA (Biodiversidad y Desarrollo Armónico), efforts to conserve and restore native grasslands and wetlands on Rancho Los Fresnos have been ongoing. Located in the upper San Pedro watershed immediately south of the international boundary, Rancho Los Fresnos may be essential to the long-

term persistence of several populations of breeding grassland birds in northern Sonora. This is because grass cover on the ranch is high, shrub density is low, and the overall condition of grasslands is better than throughout much of the surrounding landscape (Flesch, *pers. obs.*), in part because elevation and rainfall are relatively high and livestock grazing has been well managed (E. Lopez Saavedra, *pers. comm.*). These conditions combined with ongoing efforts to restore and enhance grasslands and wetlands are creating excellent opportunities to preserve communities of grassland-dependent wildlife in northern Sonora.

To estimate the distribution and population size of breeding grassland birds and to provide a baseline for evaluating future changes in these parameters over time, I surveyed birds on Rancho Los Fresnos in August 2007. My goals were to design a repeatable, cost-efficient program to 1) estimate distribution and abundance of breeding populations of grassland birds, 2) monitor population trends over time, and 3) provide information for ongoing management and restoration efforts.

METHODS

To survey birds, I used point counts and distance sampling (Buckland 2001). Point counts involve counting all individual birds detected by sight or sound during a standardized time period at fixed stations (Verner 1985). Distance sampling involves estimating the horizontal distance to each bird during surveys, which allows estimates of abundance to be adjusted for variation in detection probability over time, space, and among species. By considering detection probability, individuals that are present but not detected during surveys are included in estimates of population size, which can increase the efficiency and precision of trend estimates over time (Thompson et al. 1998, Pollock et al. 2002, Powell et al. 2007).

To select stations for point counts, I established a network of 62 points spaced 400 to 800 m apart along the entire road system on the ranch (Fig. 1). I used roadways because driving between stations greatly reduces travel time and thereby augments the number of stations that can be sampled during times when birds were actively singing and detectable. In addition to driving, I established 4 stations away from roads to yield a total of 66 stations. At each station, I counted all birds that I detected for 5 minutes and measured distance to birds with use of a rangefinder. I noted whether birds were singing, calling, or detected visually, the sex of birds if known, and the number of individuals in each flock or group. I began sampling within 15 minutes of local sunrise and completed sampling within 3 hours after sunrise. I recorded the location (UTM coordinates) of each station with use of a global positioning system so that stations could be easily located for repeated sampling (Appendix A). I also recorded all species that I detected incidentally and noted any evidence of breeding.

To estimate density and population size, I used program DISTANCE (Thomas et al. 2005). I selected the most appropriate detection function for each species by pooling distance data among stations for each species and considered half-normal and hazard rate key functions with cosine, polynomial, and Hermite expansion terms with use of conventional distance sampling. I used multiple-covariates distance sampling in program DISTANCE to assess if three potential covariates (hour-of-day, day-of-year, and group size) influenced the scale of detection functions. I selected among potential models for each species with use of Information-Theoretic model selection procedures and AIC as the criterion; I then confirmed model fit with a Goodness-of-fit test (Buckland et al. 2001). To smooth distance data and improve the overall fit of detection functions, I binned distance data by visually inspecting histograms of the proportion of observations across distance and truncated approximately 1 to 3% of outlying observations.

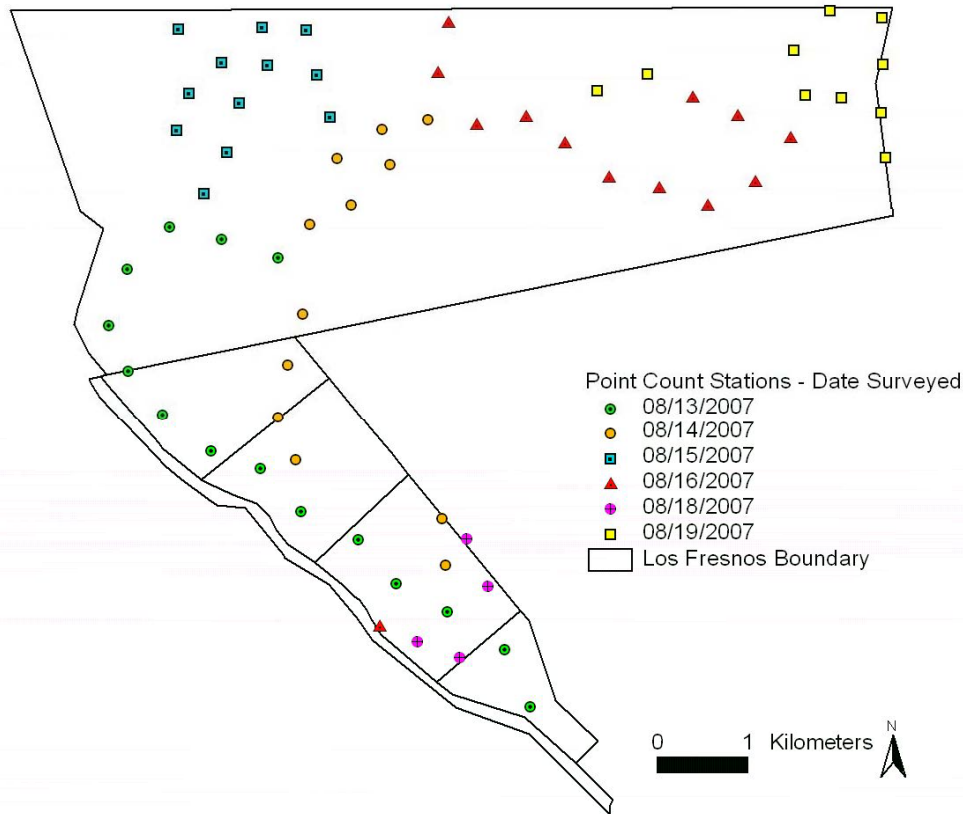


Figure 1: Point-count stations ($n = 66$) used to sample grassland birds between 13 and 19 August 2007 on Rancho Los Fresnos, northern Sonora, Mexico. Symbols and colors of points indicate date of sampling.

To calculate population size, I multiplied estimates of density by the area of the ranch (3,877 ha), which was a reasonable approach because I placed stations uniformly throughout much of the ranch (Fig. 1) in approximate proportion to the coverage of each environment and assumed that roads had little influence of bird distribution because most roads were narrow (<2.5 m wide) and inconspicuous. To estimate a range of likely values of population size, I calculated log-based 95% confidence intervals around each point estimate of population size. To estimate the precision of density estimates, I calculated a coefficient of variation (%). I estimated density and population size for all species for which I obtained ≥ 20 detections during sampling ($n = 9$ species).

For less common species, I estimated relative abundance by totaling the number of individuals, pairs, or singing males that I detected during surveys and calculated frequency of occurrence (%) for each species across all stations combined. To determine breeding status, I used the criteria of the North American Ornithological Atlas Committee (1990) to classify breeding as possible, probable, or confirmed. To determine species that were migratory, I supplemented my observations with data from Sonora (Russell and Monson 1998, Flesch, *unpubl. data*) and adjacent portions of Arizona (Corman and Wise-Gervais 2005). To determine species that were detected for the first time on the ranch, I compared a list of species that I observed with lists compiled by others (Snell-Rood et al. *pers. comm.*, G. Johnson, *pers. comm.*).

Table 1: Effort and detections during point counts at 66 stations from 13-19 August 2007 on Rancho Los Fresnos, northern Sonora, Mexico. Number of detections are of individuals, pairs, or flocks.

Date	Route	Start Time	End Time	Number of Stations	Number of Detections	Number of Birds	Number of Species
8/13/2007	Southeast gate to Los Alisos	5:36	7:52	15	201	211	40
8/14/2007	Central	5:33	7:35	12	157	185	26
8/15/2007	Northwest	6:12	8:29	12	182	198	25
8/16/2007	North-Central	5:37	8:45	13	219	227	33
8/18/2007	Around House	6:13	7:19	4	72	72	25
8/19/2007	Northeast corner	5:29	7:08	10	155	164	29
Totals				66	986	1057	60

RESULTS

I established 5 routes along roadways that included 10 to 15 stations each and one route of 4 points that I walked. I detected 986 individuals, pairs, or flocks of 60 species during 330 minutes of point counts at 66 stations (Table 1). On average, I detected 14.9 ± 0.4 (\pm SE) individuals, pairs, or flocks per station (range = 9-23) and 8.8 ± 0.3 species per station (range = 4-17) during each count. I detected an additional 23 species incidentally between 12 August and 19 August, 2007 (Appendix B). Five of the 83 (6%) species that I detected had not been observed previously on the ranch including Wood Duck (*Aix sponsa*), Band-tailed Pigeon (*Patagioenas fasciata*), and Arizona Woodpecker (*Picooides arizonae*) (G. Johnson and E. Snell-Rood, *pers. comm.*). I confirmed breeding of 12 species including Scaled Quail (*Callipepla squamata*; fledged young), Montezuma (*Cyrtonyx montezumae*, fledged young), Botteri's Sparrow (*Aimophila botterii*; nest with eggs, cover photo), and Black-throated Sparrow (*Amphispiza bilineata*; fledged young).

Table 2: Abundance of the 9 most frequently detected species of birds during 66 point counts from 13-19 August 2007 on Rancho Los Fresnos, northern Sonora, Mexico. Estimates of density and population size are for number of territories. Estimates of population size are based on an area of 3,877 ha.

Common Name	Number of Detections	Frequency of Occurrence	Density (no./ha)	CV (%)	Population size			
					Estimate	SE	95% CI Lower bound	95% CI Upper bound
Eastern Meadowlark	154	84.8	0.066	8.94	257	23	215	307
Grasshopper Sparrow	146	77.3	0.84	11.24	3256	366	2609	4065
Botteri's Sparrow	140	92.4	0.47	13.93	1806	252	1374	2374
Blue Grosbeak	76	71.2	0.070	14.12	270	38	205	357
Mourning Dove	72	77.3	0.20	14.01	790	111	600	1041
Rufous-crowned Sparrow	56	40.9	0.19	23.18	739	171	470	1162
Cassin's Kingbird	44	48.5	0.052	23.54	202	48	128	321
Loggerhead Shrike	26	36.4	0.020	19.29	79	15	54	116
Cassin's Sparrow	23	18.2	0.020	34.36	78	27	40	152

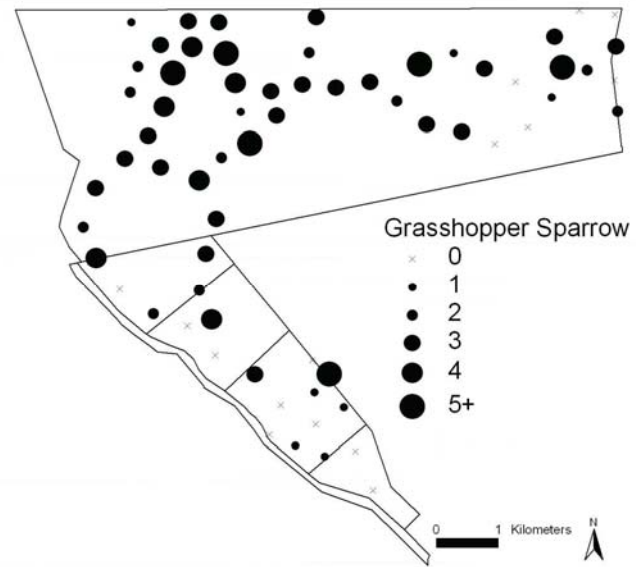
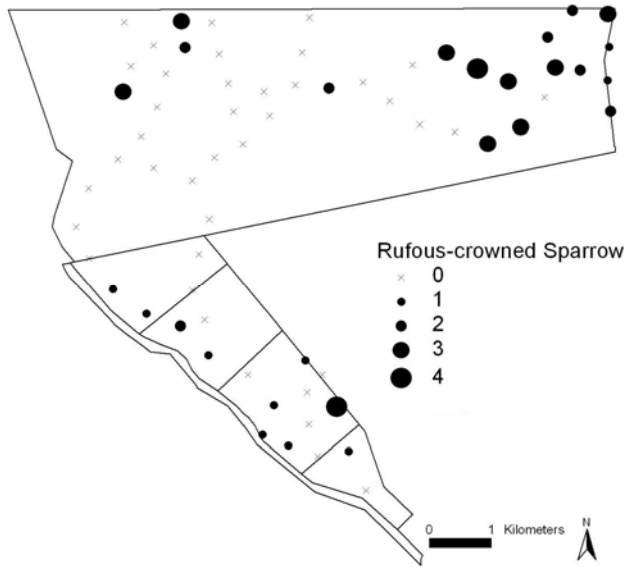
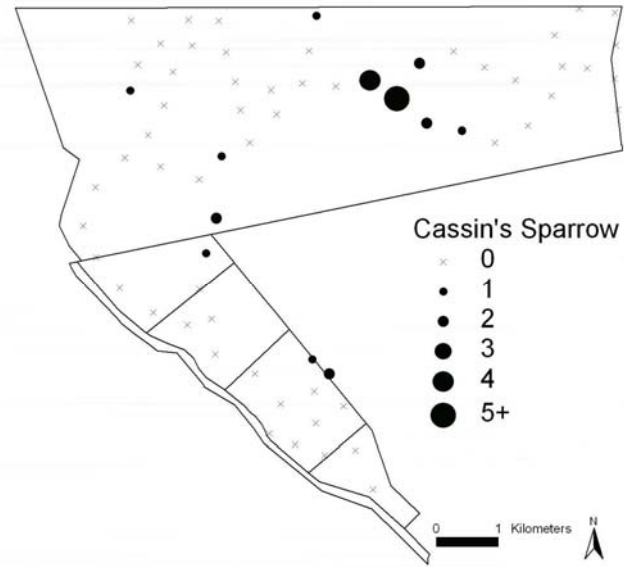
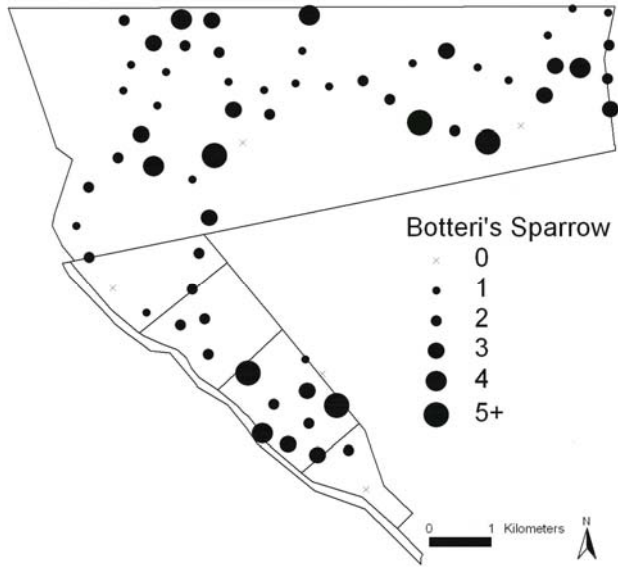


Figure 2: Distribution and abundance of four species of sparrows based on point counts at 65 stations surveyed 13-19 August 2007 on Rancho Los Fresnos, northern Sonora, Mexico. Symbol size is scaled to number of detections.

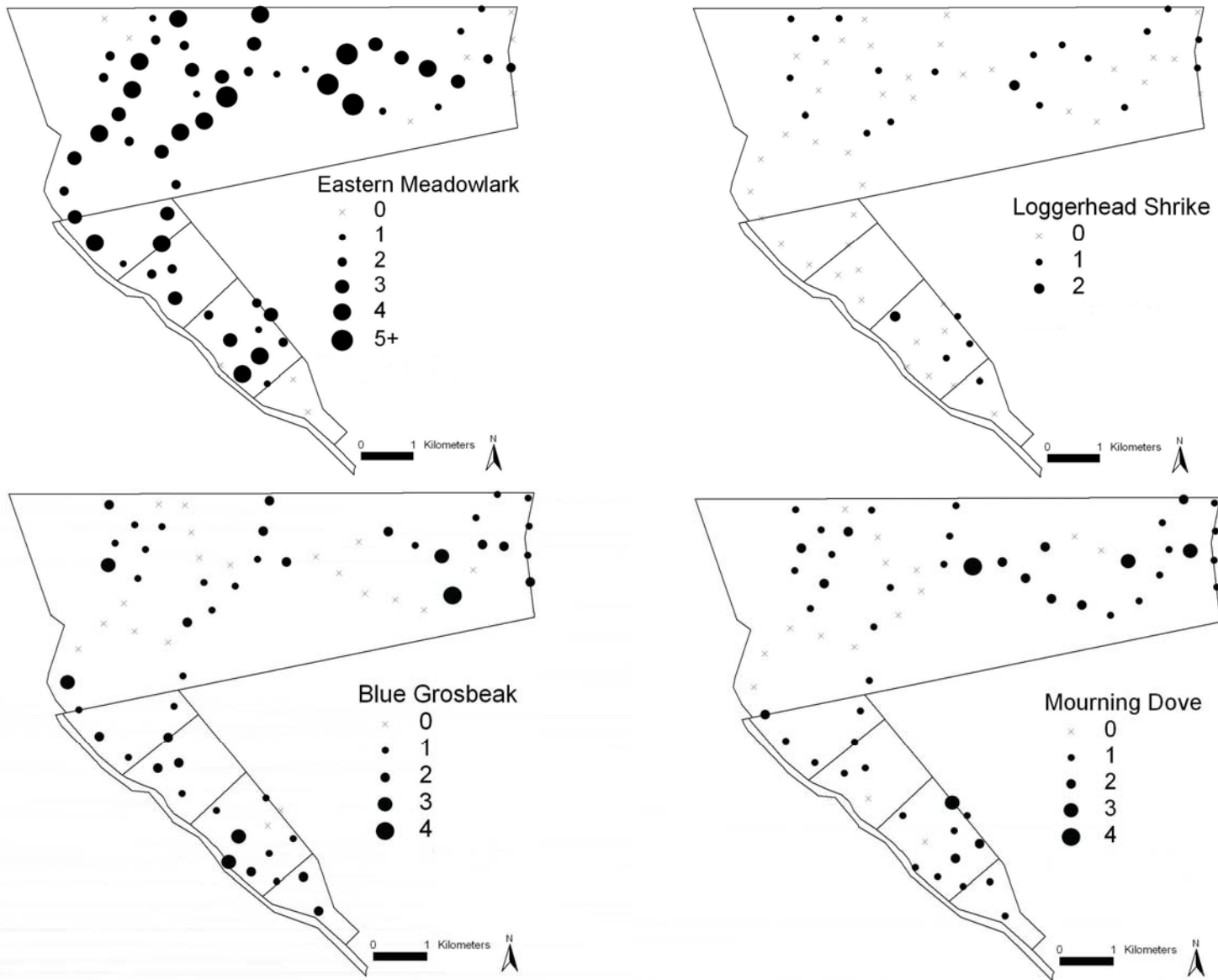


Figure 3: Distribution and abundance of four species of grassland birds based on point-count surveys at 65 stations surveyed 13-19 August 2007 on Rancho Los Fresnos, northern Sonora, Mexico. Symbol size is scaled to number of detections.

Grasshopper Sparrow (*Ammodramus savannarum*) and Botteri's Sparrow were the most abundant species that I detected. I estimate there are 0.84 ± 0.09 Grasshopper Sparrow territories per hectare or 3,256 territories (95% CI = 2,609-4,065) on Rancho Los Fresnos (Table 2). Similarly, I estimate there are 0.47 ± 0.07 Botteri's Sparrow territories per hectare or 1,806 territories (95% CI = 1,374-2,374) overall. Although Botteri's and Grasshopper Sparrow were distributed throughout the ranch, Botteri's Sparrow was most abundant in bottomlands in the southern portion of the ranch whereas Grasshopper Sparrow was most abundant in uplands in the northwestern portion of the ranch (Fig 2). Mourning Dove (*Zenaida macroura*) and Rufous-crowned Sparrow (*Aimophila ruficeps*) were also abundant and had similar population sizes (Table 2). Mourning Dove however, was distributed relatively evenly across the ranch (Fig. 3) whereas Rufous-crowned Sparrow was most abundant on slopes in higher-elevation grasslands in the northeast portion of the ranch (Fig. 2). Eastern Meadowlark (*Sturnella magna*) was the most frequently detected species (154 detections), yet density was 92% lower than that of Grasshopper Sparrow and estimates of population size were much lower (257 territories). Population size of Blue Grosbeak (*Passerina caerulea*) was similar to that of Eastern Meadowlark whereas Loggerhead Shrike (*Lanius ludovicianus*) was less common; all 3 species were distributed relatively evenly across the ranch (Fig. 3).

Of species that I detected too infrequently to estimate density, Scaled Quail, Horned Lark (*Eremophila alpestris*), and Canyon Towhee (*Pipilo fuscus*) occurred at 20% of stations and were relatively common (Table 3). I detected Common Yellowthroat (*Geothlypis trichas*) at 15% of stations and Montezuma Quail at 14%. Both Montezuma and Scaled Quail occurred throughout the ranch whereas Gambel's Quail (*Callipepla gambelii*) occurred only in the south (Fig. 4).

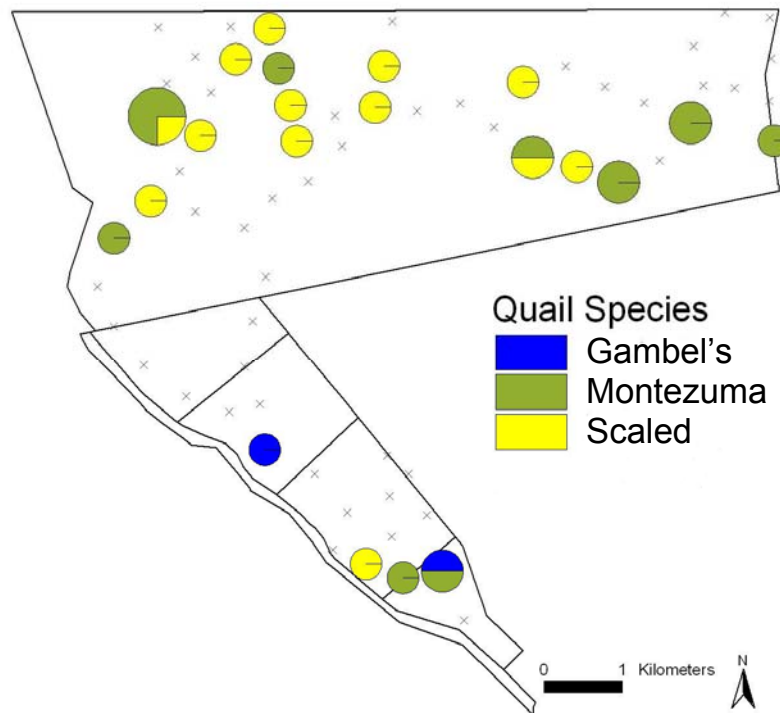


Figure 4: Distribution and abundance of three species of quail detected during point counts at 65 stations 13-19 August 2007 on Rancho Los Fresnos, northern Sonora, Mexico. Circle size indicates number of detections (1, 2, or 4 individuals) at each station. Colors indicate proportion of detections by species. "X" indicates stations where quail were not detected.

Table 3: Number of observations, frequency of occurrence, and mean detection distance for 60 species detected during 66, 5 min. point counts from 13-19 August 2007 on Rancho Los Fresnos, northern Sonora, Mexico.

Scientific Name	Common Name	Number of Observations	Frequency of Occurrence	Distance	
				Mean	SE
<i>Sturnella magna lillianae</i>	Eastern Meadowlark	154	84.8	175.3	5.5
<i>Ammodramus savannarum</i>	Grasshopper Sparrow	146	77.3	57.2	2.3
<i>Aimophila botterii</i>	Botteri's Sparrow	140	92.4	103.7	4.1
<i>Passerina caerulea</i>	Blue Grosbeak	76	71.2	163.0	7.5
<i>Zenaida macroura</i>	Mourning Dove	72	77.3	100.7	4.4
<i>Aimophila ruficeps</i>	Rufous-crowned Sparrow	56	40.9	89.6	4.6
<i>Tyrannus vociferans</i>	Cassin's Kingbird	44	48.5	178.6	13.2
<i>Lanius ludovicianus</i>	Loggerhead Shrike	26	36.4	193.6	12.5
<i>Aimophila cassinii</i>	Cassin's Sparrow	23	18.2	169.8	12.1
<i>Geothlypis trichas</i>	Common Yellowthroat	16	15.2	146.1	20.8
<i>Eremophila alpestris</i>	Horned Lark	16	19.7	86.2	8.2
<i>Pipilo fuscus</i>	Canyon Towhee	15	19.7	103.9	10.6
<i>Cyrtonyx montezumae</i>	Montezuma Quail	13	13.6	124.7	10.4
<i>Callipepla squamata</i>	Scaled Quail	13	19.7	130.2	7.8
<i>Melanerpes formicivorus</i>	Acorn Woodpecker	9	10.6	123.9	24.3
<i>Thryomanes bewickii</i>	Bewick's Wren	9	10.6	89.6	13.8
<i>Colaptes auratus</i>	Northern Flicker	9	10.6	154.7	16.8
<i>Tyrannus verticalis</i>	Western Kingbird	9	12.1	104.3	20.4
<i>Falco sparverius</i>	American Kestrel	8	12.1	186.0	27.3
<i>Pheucticus melanocephalus</i>	Black-headed Grosbeak	8	10.6	116.3	18.8
<i>Mimus polyglottos</i>	Northern Mockingbird	8	12.1	165.6	26.7
<i>Melanerpes uropygialis</i>	Gila woodpecker	6	7.6	107.5	30.2
<i>Aphelocoma ultramarina</i>	Mexican Jay	6	7.6	243.3	29.9
<i>Buteo jamaicensis</i>	Red-tailed Hawk	6	7.6	276.2	44.4
<i>Sitta carolinensis</i>	White-breasted Nuthatch	6	9.1	129.3	18.1
<i>Campylorhynchus brunneicapillus</i>	Cactus Wren	5	6.1	142.2	40.7
<i>Corvus corax</i>	Common Raven	5	7.6	248.0	34.7
<i>Amphispiza bilineata</i>	Black-throated Sparrow	4	4.5	53.8	6.6
<i>Spizella passerina</i>	Chipping Sparrow	4	6.1	36.0	8.3
<i>Toxostoma curvirostre</i>	Curve-billed Thrasher	4	6.1	137.5	21.7
<i>Asturina nitida maxima</i>	Gray Hawk	4	6.1	195.0	67.5
<i>Carpodacus mexicanus</i>	House Finch	4	6.1	42.0	7.6
<i>Picoides scalaris</i>	Ladder-backed Woodpecker	4	6.1	145.0	44.8
<i>Chondestes grammacus</i>	Lark Sparrow	4	6.1	78.8	34.8
<i>Buteo swainsoni</i>	Swainson's Hawk	4	6.1	297.5	77.4
<i>Zenaida asiatica</i>	White-winged Dove	4	4.5	250.0	17.8
<i>Dendroica petechia</i>	Yellow Warbler	4	4.5	126.0	29.7
<i>Archilochus alexandri</i>	Black-chinned Hummingbird	3	4.5	18.7	6.7
<i>Carduelis psaltria</i>	Lesser Goldfinch	3	4.5	90.0	55.1
<i>Circus cyaneus</i>	Northern Harrier	3	4.5	182.7	101.2
<i>Selasphorus rufus</i>	Rufous Hummingbird	3	4.5	69.7	17.8
<i>Aimophila carpalis</i>	Rufous-winged Sparrow	3	3.0	120.0	15.3
<i>Piranga rubra</i>	Summer Tanager	3	3.0	53.3	12.0
<i>Hirundo rustica</i>	Barn Swallow	2	3.0	100.0	40.0
<i>Sayornis nigricans</i>	Black Phoebe	2	3.0	50.0	10.0
<i>Psaltriparus minimus</i>	Bushtit	2	3.0	42.5	7.5
<i>Callipepla gambelii</i>	Gambel's Quail	2	3.0	195.0	55.0
<i>Geococcyx californianus</i>	Greater Roadrunner	2	3.0	135.0	25.0
<i>Calamospiza melanocorys</i>	Lark Bunting	2	3.0	44.5	3.5
<i>Sayornis saya</i>	Say's Phoebe	2	3.0	129.5	40.5
<i>Calypte anna</i>	Anna's Hummingbird	1	1.5	4.0	
<i>Picoides arizonae</i>	Arizona Woodpecker	1	1.5	120.0	
<i>Baeolophus wollweberi</i>	Bridled Titmouse	1	1.5	45.0	
<i>Chordeiles minor</i>	Common Nighthawk	1	1.5	180.0	
<i>Charadrius vociferus</i>	Killdeer	1	1.5	285.0	
<i>Salpinctes obsoletus</i>	Rock Wren	1	1.5	65.0	
<i>Icterus parisorum</i>	Scott's Oriole	1	1.5	230.0	
<i>Cathartes aura</i>	Turkey Vulture	1	1.5	95.0	
<i>Pyrocephalus rubinus</i>	Vermilion Flycatcher	1	1.5	152.0	
<i>Contopus sordidulus</i>	Western Wood-pewee	1	1.5	35.0	
All Species		986		128.5	8.9

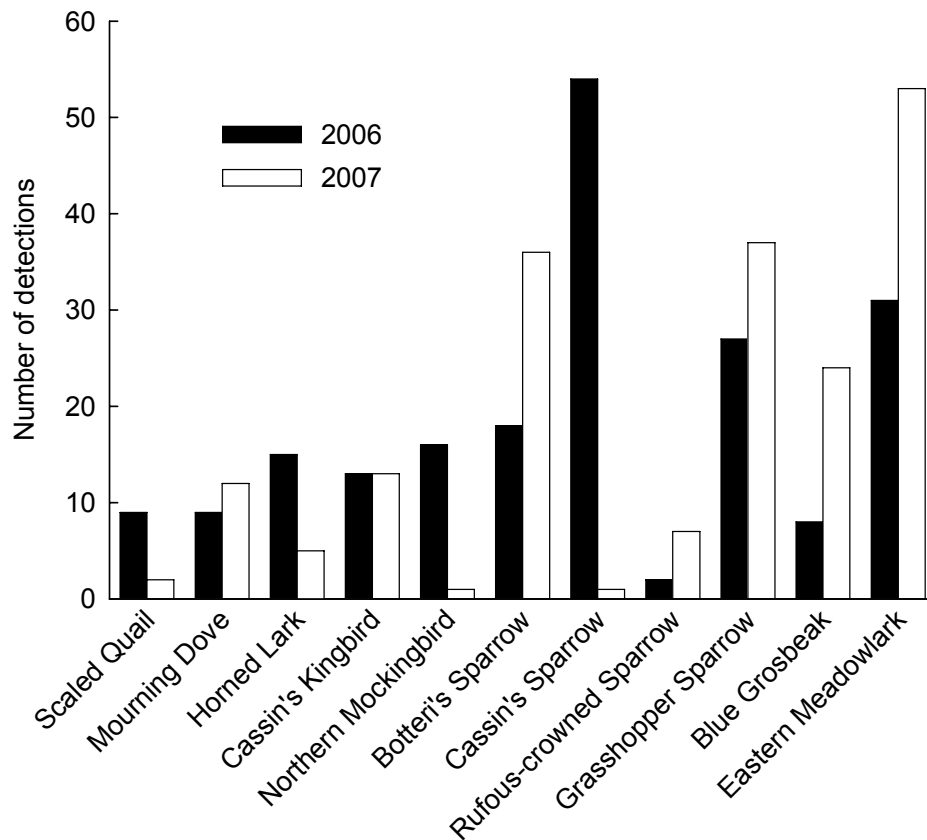


Figure 5: Number of detections of 11 species of birds at the same 19 point-count stations during the first week of July 2006 and the second week of August 2007 on Rancho Los Fresnos, northern Sonora, Mexico. Differences may not suggest annual changes in population size due to timing of surveys and other factors.

Notably, I detected only 23 Cassin's Sparrows (*Aimophila cassini*) during counts in 2007 and estimate that only 78 territories were present; most individuals were in flat grasslands in the center of the ranch (Fig. 2). In comparison, during early July 2006, I detected 54 Cassin's Sparrows at 19 points in the southern portion of the ranch (points 1-19; Appendix A) where I detected only 2 individuals in mid August 2007. Similarly, I detected more Scaled Quail, Horned Lark, and Northern Mockingbirds (*Mimus polyglottos*) in 2006 than in 2007, but detected more Botteri's Sparrow, Rufous-crowned Sparrow, Blue Grosbeak and Eastern Meadowlark in 2007 (Fig. 5). Differences between years may not indicate changes in population size due to differences in the timing of surveys between years.

DISCUSSION

Rancho Los Fresnos supports relatively large populations of breeding grassland birds despite its small size. Based on counts at 66 stations during August 2007, I estimate that >3,000 Grasshopper Sparrows and approximately 2,000 Botteri's Sparrows breed on the ranch. Estimates of population size for other species of grassland birds were <1,000 but are still significant given the larger territory sizes of these species. Grassland conditions in much of the region surrounding Rancho Los

Fresnos and in many other areas of northern Sonora, has lower horizontal and vertical cover of grass than that found on the ranch. This is likely because of much higher grazing intensity in grasslands surrounding the ranch and because Rancho Los Fresnos is at a relatively high elevation and has only low-intensity grazing. Compared to densities of grassland birds on Rancho Los Fresnos, my incidental observations outside the ranch and throughout the surrounding region (Flesch, *in press*), suggest that densities of many species of grassland birds are much higher inside the ranch. This contrast was especially notable for species such as Botteri's Sparrow that require dense and tall stands of grass that are rare in Sonora. Compared to more arid semidesert grasslands in western Sonora, prospects for conserving and restoring high-quality grasslands are much greater at higher elevations in the upper San Pedro and upper Santa Cruz watersheds. Further, compared to desert grasslands of the Chihuahuan Desert region to the east, tall-grass dominated Plains grasslands on Rancho Los Fresnos support some breeding species, such as Grasshopper and Botteri's Sparrow, that do not breed in the Chihuahuan region.

Few estimates of density and population size are available for breeding grassland birds in semidesert or Plains grasslands in the southwestern U.S. and estimates that I provide are the only available in Sonora (with the possible exception of Masked Bobwhite). Compared to known estimates, density of Botteri's Sparrow on Rancho Los Fresnos is slightly lower than the highest estimates on the Audubon Research Ranch in nearby Arizona where maximum densities occur in mature stands of sacaton grass (*Sporobolus wrightii*) (Webb 1985, Jones and Bock 2005). Had I stratified estimates by vegetation type, estimates of density in sacaton grasslands on Rancho Los Fresnos would likely have been similar. Notably, estimates of density of Grasshopper Sparrow on Rancho Los Fresnos are among the highest observed anywhere in North America (Strong 1988, Vickery 1996). The only other study of the Arizona Grasshopper Sparrow (*Ammodramus savannarum ammoregus*), which is the subspecies that breeds only in southern Arizona and northern Sonora, estimated somewhat similar densities in the Sonoita Plains and San Rafael Valley in adjacent Arizona, yet estimation techniques varied (Strong 1988). High densities of Arizona Grasshopper Sparrow on Rancho Los Fresnos are significant because it is a species of significant conservation concern (Arizona Game and Fish Department 1996) and because populations in the region surrounding Rancho Los Fresnos are the only breeding populations of this subspecies in northern Mexico (Howell and Webb 1995). Rancho Los Fresnos also supports large populations of several other species of grassland birds that seem to have declined in the surrounding region and that are of significant conservation concern such as Scaled Quail and Eastern Meadowlark. Ongoing efforts to restore upland and bottomland (e.g. sacaton) grasslands on the ranch will likely augment the size of these populations in the future. A greater understanding of the effects of prescribed fire on populations of grassland birds should help guide management by providing guidelines on appropriate frequency, intensity, and scale of prescribed fire.

Although I was able to estimate density of nine species of grassland birds on Rancho Los Fresnos, sample sizes that I obtained after single counts at 66 stations were insufficient to estimate abundance for fairly common and uncommon species (Table 2). Further, number of detections varied widely for some species when counts at the same stations in early July 2006 were compared to those from mid August 2007. Differences in counts between years suggest that detection probability varies widely across the breeding season and that some species sing at varying frequencies early (July) versus late (August) in the breeding season, which for grassland birds in this region typically begins with the onset of the summer monsoon in late June or early July. Although to some extent, difference between years could be due to changes in population size, my results suggest that counts in mid August were too late to effectively survey Scaled Quail, and perhaps Northern Mockingbird and Horned Lark because most individuals may not have been actively vocalizing. In comparison, Cassin's Sparrows were likely much less numerous in 2007 than in 2006 and may be more likely to vary in abundance from year to year due to factors on their spring and early summer ranges in the Great Plains of the central U.S. Due to limited area and lack of sufficient road access in some portions of the ranch, potential to efficiently augment the number of counting

stations is limited. Given these challenges, I suggest surveying each station two times per year, once in early to mid July and once in early to mid August depending on timing of the monsoon. Counting stations twice per season will augment the number of species for which density can be estimated with reasonable precision. I recommend obtaining a minimum of 50 detections and a coefficient of variation in density of $\leq 20\%$ to reliably estimate and monitor changes in density over time (Powell et al. 2007). Monitoring populations of grassland birds and other wildlife on Rancho Los Fresnos is important for evaluating the influence of management on the ranch and for guiding future land acquisitions, conservation, and restoration programs in the region.

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Appendix A: UTM coordinates of point count stations (Zone 12S, NAD 27 Mexico)

Station Number	UTM Easting (m)	UTM Northing (m)	Route Name	Number of Observations
1	557784	3465267	Central	14
2	557371	3464776	Central	14
3	556944	3464326	Central	11
4	556494	3464119	Central	18
5	556142	3463746	Southeast gate to Los Alisos	9
6	555526	3463948	Southeast gate to Los Alisos	11
7	554956	3464090	Southeast gate to Los Alisos	11
8	554492	3463622	Southeast gate to Los Alisos	10
9	554291	3463002	Southeast gate to Los Alisos	11
10	554498	3462500	Southeast gate to Los Alisos	17
11	554874	3462012	Southeast gate to Los Alisos	11
12	555409	3461612	Southeast gate to Los Alisos	14
13	555952	3461422	Southeast gate to Los Alisos	17
14	556394	3460947	Southeast gate to Los Alisos	18
15	557029	3460637	Southeast gate to Los Alisos	16
16	557439	3460154	Southeast gate to Los Alisos	14
17	558000	3459845	Southeast gate to Los Alisos	11
18	558633	3459421	Southeast gate to Los Alisos	17
19	558915	3458795	Southeast gate to Los Alisos	14
20	556335	3461514	Central	12
21	556142	3461991	Central	14
22	556247	3462572	Central	14
23	556414	3463133	Central	15
24	557282	3465159	Central	9
25	556796	3464843	Central	9
26	557978	3460355	Central	10
27	557945	3460865	Central	17
28	555328	3464451	Northwest	14
29	555582	3464914	Northwest	17
30	555721	3465449	Northwest	16
31	555163	3465562	Northwest	14
32	555036	3465156	Northwest	22
33	556027	3465870	Northwest	18
34	556452	3466259	Northwest	16
35	555972	3466283	Northwest	15
36	555526	3465898	Northwest	14
37	555053	3466268	Northwest	14
38	556568	3465760	Northwest	11
39	556718	3465294	Northwest	11
40	558007	3466345	North-Central	16
41	557897	3465787	North-Central	12
42	558318	3465217	North-Central	15
43	558860	3465305	North-Central	12
44	559293	3465013	North-Central	22

45	559770	3464638	North-Central	23
46	560328	3464522	North-Central	14
47	560855	3464326	North-Central	22
48	561380	3464590	North-Central	15
49	561761	3465070	North-Central	17
50	561184	3465317	North-Central	18
51	560687	3465521	North-Central	13
52	560196	3465776	Northeast corner	18
53	559650	3465585	Northeast corner	17
54	557257	3459686	North-Central	20
55	561932	3465538	Northeast corner	15
56	561804	3466034	Northeast corner	16
57	562204	3466464	Northeast corner	14
58	562770	3466391	Northeast corner	14
59	562784	3465875	Northeast corner	14
60	562764	3465345	Northeast corner	13
61	562814	3464848	Northeast corner	15
63	557670	3459511	Around House	19
64	558137	3459337	Around House	19
65	558442	3460121	Around House	19
66	558212	3460639	Around House	15
67	562329	3465508	Northeast corner	19

Appendix B: Bird species ($n = 83$) detected on and around Rancho Los Fresnos, upper San Pedro River Valley, northern Sonora Mexico between 12 and 19 August 2007. Abundance is indicated either by a code (A-abundant, C-common, F-fairly common, U-uncommon, R-rare) or by a number indicating the maximum number observed per day. M indicates male, P indicates pair, T indicates territory. Asterisk indicate species that had not been detected on the ranch based on records described by Snell-Rool et al. 2007 and Johnson (pers. comm.).

Scientific Name	Common Name	Abundance	Comments and breeding status
<i>Aix sponsa</i>	Wood Duck*	1 M	likely early migrant
<i>Anas platyrhynchos</i>	Mallard	C	paired
<i>Aythya americana</i>	Redhead	5	migrant
<i>Callipepla squamata</i>	Scaled Quail	F	fledged young
<i>Callipepla gambelii</i>	Gambel's Quail	U	paired
<i>Cyrtonyx montezumae</i>	Montezuma Quail	C	fledged young, calling throughout ranch
<i>Podilymbus podiceps</i>	Pied-billed Grebe	1 P	courtship display, calling
<i>Phalacrocorax auritus</i>	Double-crested Cormorant	2	2 immatures
<i>Ardea herodias</i>	Great Blue Heron	U	unknown
<i>Butorides virescens</i>	Green Heron	1	unknown
<i>Nycticorax nycticorax</i>	Black-crowned Night-Heron	1	immature
<i>Cathartes aura</i>	Turkey Vulture	F	no suitable nesting habitat
<i>Elanus leucurus</i>	White-tailed Kite	1	soaring adult
<i>Circus cyaneus</i>	Northern Harrier	4	early migrants
<i>Accipiter cooperii</i>	Cooper's Hawk	1	adult
<i>Asturina nitida</i>	Gray Hawk	3 T	2 with fledged young
<i>Buteo swainsoni</i>	Swainson's Hawk	2	1 immature, 1 adult in 2006 nest tree
<i>Buteo jamaicensis</i>	Red-tailed Hawk	4	adult with young of year
<i>Falco sparverius</i>	American Kestrel	3	territorial calling
<i>Fulica americana</i>	American Coot	1	unknown
<i>Charadrius vociferus</i>	Killdeer	24	large flock of 20
<i>Actitis macularius</i>	Spotted Sandpiper	1	migrant
<i>Patagioenas fasciata</i>	Band-tailed Pigeon*	1	in atypical but potential breeding habitat
<i>Zenaida asiatica</i>	White-winged Dove	3	calling
<i>Zenaida macroura</i>	Mourning Dove	C	calling
<i>Columbina passerina</i>	Common Ground-Dove	1	calling at house
<i>Geococcyx californianus</i>	Greater Roadrunner	5	calling
<i>Tyto alba</i>	Barn Owl	1	calling at house
<i>Bubo virginianus</i>	Great Horned Owl	1	calling at house
<i>Chordeiles minor</i>	Common Nighthawk	10	calling
<i>Phalaenoptilus nuttallii</i>	Common Poorwill	2	flushed from slope
<i>Archilochus alexandri</i>	Black-chinned Hummingbird	8	courtship display, singing
<i>Selasphorus rufus</i>	Rufous Hummingbird	6	migrant
<i>Melanerpes formicivorus</i>	Acorn Woodpecker	15	
<i>Melanerpes uropygialis</i>	Gila Woodpecker	4	
<i>Picoides scalaris</i>	Ladder-backed Woodpecker	2	
<i>Picoides arizonae</i>	Arizona woodpecker*	2	in oaks near northeast corner of reserve
<i>Colaptes auratus</i>	Northern Flicker	8	
<i>Contopus sordidulus</i>	Western Wood-Pewee	3	calling

<i>Sayornis nigricans</i>	Black Phoebe	2	used nest
<i>Sayornis saya</i>	Say's Phoebe	2	pair at house
<i>Pyrocephalus rubinus</i>	Vermilion Flycatcher	2	both males
<i>Tyrannus vociferans</i>	Cassin's Kingbird	C	
<i>Tyrannus verticalis</i>	Western Kingbird	C	
<i>Lanius ludovicianus</i>	Loggerhead Shrike	F	
<i>Aphelocoma ultramarina</i>	Mexican Jay	15	
<i>Corvus sp.</i>	Raven	6	
<i>Eremophila alpestris</i>	Horned Lark	35	flocks and few single birds still singing
<i>Tachycineta bicolor</i>	Tree Swallow	5	
<i>Tachycineta thalassina</i>	Violet-green Swallow	12	
<i>Stelgidopteryx serripennis</i>	Northern Rough-winged Swallow	2	
<i>Hirundo rustica</i>	Barn Swallow	25	
<i>Baeolophus wollweberi</i>	Bridled Titmouse	3	
<i>Sitta carolinensis</i>	White-breasted Nuthatch	7	
<i>Salpinctes obsoletus</i>	Rock Wren	1	singing
<i>Thryomanes bewickii</i>	Bewick's Wren	14	singing but only in oaks at higher elevations
<i>Mimus polyglottos</i>	Northern Mockingbird	6	singing
<i>Toxostoma curvirostre</i>	Curve-billed Thrasher	2	
<i>Phainopepla nitens</i>	Phainopepla	1	
<i>Dendroica petechia</i>	Yellow Warbler	8	singing
<i>Geothlypis trichas</i>	Common Yellowthroat	18	singing in tall forbs mainly in cienega
<i>Piranga rubra</i>	Summer Tanager	3	
<i>Piranga ludoviciana</i>	Western Tanager	1	migrant
<i>Pipilo fuscus</i>	Canyon Towhee	8	paired, singing
<i>Aimophila cassinii</i>	Cassin's Sparrow	12	carrying food, notably sparse this season
<i>Aimophila botterii</i>	Botteri's Sparrow	C	nest with 3 eggs, more abundant this season
<i>Aimophila ruficeps</i>	Rufous-crowned Sparrow	F	fledged young
<i>Spizella passerina</i>	Chipping Sparrow	4	migrant
<i>Chondestes grammacus</i>	Lark Sparrow	8	carrying food, singing
<i>Amphispiza bilineata</i>	Black-throated Sparrow*	6	fledged young, only in cliffrose scrub in NE
<i>Calamospiza melanocorys</i>	Lark Bunting*	16	flocks
<i>Ammodramus savannarum</i>	Grasshopper Sparrow	C	carrying food, very common
<i>Melospiza melodia</i>	Song Sparrow	4	singing
<i>Pheucticus melanocephalus</i>	Black-headed Grosbeak	2	calling, likely migrants
<i>Passerina caerulea</i>	Blue Grosbeak	C	carrying food
<i>Passerina amoena</i>	Lazuli Bunting	1	migrant
<i>Agelaius phoeniceus</i>	Red-winged Blackbird	3	
<i>Sturnella magna lillianae</i>	Eastern Meadowlark	C	carrying food
<i>Molothrus ater</i>	Brown-headed Cowbird	2	
<i>Icterus parisorum</i>	Scott's Oriole	1	singing
<i>Carpodacus mexicanus</i>	House Finch	6	
<i>Carduelis psaltria</i>	Lesser Goldfinch	2	
<i>Passer domesticus</i>	House Sparrow	1	at house