2009 BIRD CENSUS

RESOLUTION COPPER MINE STUDY AREA

Prepared for:

Resolution Copper Company
102 Magma Heights
Superior, Arizona 85273

Prepared by:

WestLand Resources, Inc.
Engineering and Environmental Consultants
4001 E. Paradise Falls Drive
Tucson, Arizona 85712

SEPTEMBER 2010
Project No. 807.28

TABLE OF CONTENTS

LIST OF TABLES

(Follow text)

LIST OF FIGURES

KEY FINDINGS

BIRD CENSUS

Species Diversity

- Twenty-five new survey points were established during 2009 to cover portions of the Resolution Parcel that were not surveyed during 2008. These points were located in the following habitat types: 15 points in manzanita chaparral, 7 points in scrub oak chaparral, and 3 points in Emory oak woodland.
- Fifty-three bird species were recorded on census plots, and additional 19 species were observed on or near the Study Area.
- Total numbers of species among these habitats were: 24 species in the Emory oak woodlands, 36 species in the scrub oak chaparral, and 47 species in the manzanita chaparral.
- Although absolute numbers of species differed among the three habitat types, these differences may be explained by the different numbers of survey points in each habitat type.

Bird Species Densities

- Total bird densities range from a low of 9.9 birds per hectare in the manzanita chaparral, to 14.2 birds per hectare in the scrub oak chaparral and 14.5 birds per hectare in the Emory oak woodlands

Survey Set Time Segments

- Observations within 3-minute, 2-minute, and 5-minute segments of the total time at each survey point showed the expected pattern of numerous species and individuals observed during the first two time segments (5 minutes total), and relatively few species and individuals added during the final 5 minutes
- From 70-75 % of species and individuals were observed during the first 5 minutes of a count, and the last 5 minutes added 25-30 % of species and individuals. This pattern is consistent across all habitat types and is similar to the patterns observed in 2008. The fact that attenuation of bird species and individuals was not maximized suggests that longer observation periods should be used in future surveys.

1.0 INTRODUCTION

WestLand Resources, Inc. (WestLand) was retained by Resolution Copper Mining, LLC (RCM) to conduct bird surveys in the vicinity of RCM's holdings (collectively referred to as Resolution in this report) near Superior, Arizona. Details of the Study Area are presented in Figure 1. The purpose of these surveys was to establish baseline information about bird populations at Resolution. This report provides an inventory of the birds observed during 2009, various analyses of these data by habitat type, and where appropriate, comparisons to similar data collected in 2008.

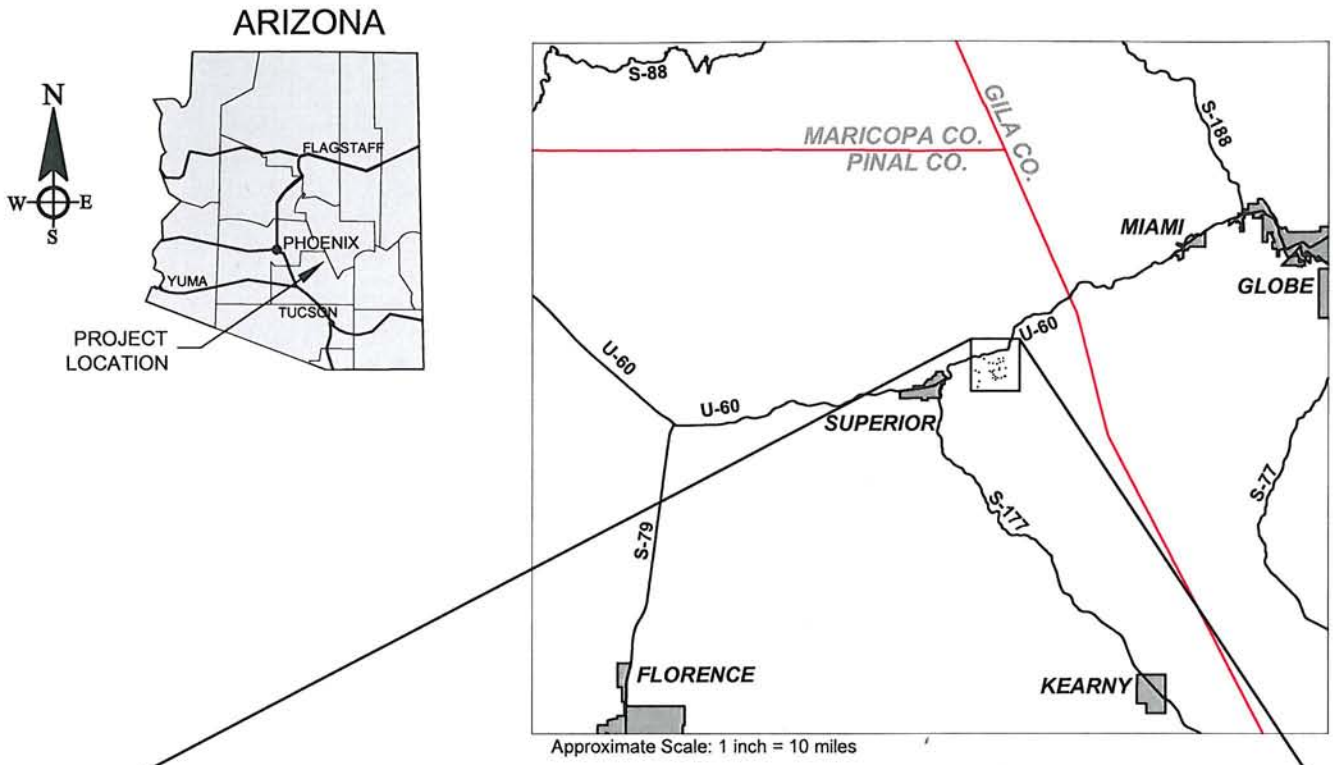
A description of the Study Area and a summary of previous bird surveys conducted in or near the Study Area were provided in the annual report for the 2008 bird surveys.

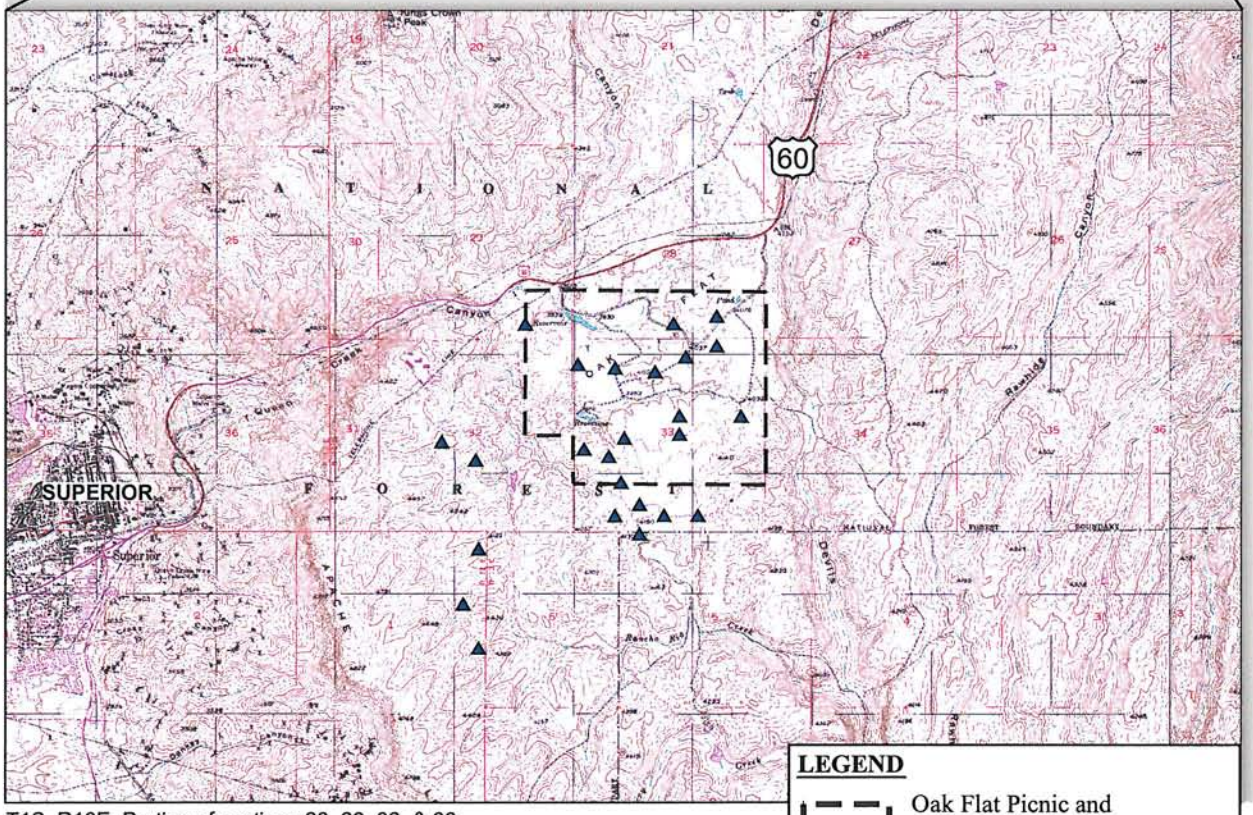
2.0 BIRD CENSUS

2.1 BIRD CENSUS SURVEY METHOD

Twenty–five points were sampled during the 2009 breeding season. Fewer census points were selected in 2009 compared to 2008 and none of the census points were common to both years. This was done to provide a more detailed survey of interior chaparral habitat, which is the most extensive habitat type in the vicinity of Oak Flat and which was sparsely sampled in 2008. Approximate locations of potential survey points were selected using Google Earth and topographic maps of the site. Locations were finalized during our first survey period in May, 2009. All of the new points were in upland areas (Figure 2). GPS coordinates (NAD-27 and NAD-83) for all of the new points are provided in Table 1. Fifteen of the new points were in manzanita chaparral, 7 points were in scrub oak chaparral, and 3 were in Emory oak woodland (Figure 2). No additional data were collected on vegetation during 2009.

The array of points could be surveyed in three days by one team of observers. Each point was counted three times during the breeding survey, with survey dates separated by about two weeks. The first survey period was May 26, 27 and 28; the second period was June 8, 9, and 10; and the final survey period was June 25, 26, 27. To ensure the greatest reliability in our density estimates, we used the same two highly-experienced observers throughout the survey. Both observers worked together to survey each point. Sets of 8-9 points were censused on three consecutive days. The groups of points were chosen because of proximity to each other, but the observers would reverse the order in which points were censused to reduce the potentially confounding effect of time of day.





T1S, R13E, Portion of sections 28, 29, 32, & 33,
T2S, R12E, Portion of section 1, T2S, R13E, Portion of section 5,
Pinal County, Arizona, Superior 7.5' USGS Quadrangle

WestLand Resources Inc.
Engineering and Environmental Consultants
4001 E. Paradise Falls Drive
Tucson, Az 85712 (520) 206-9585

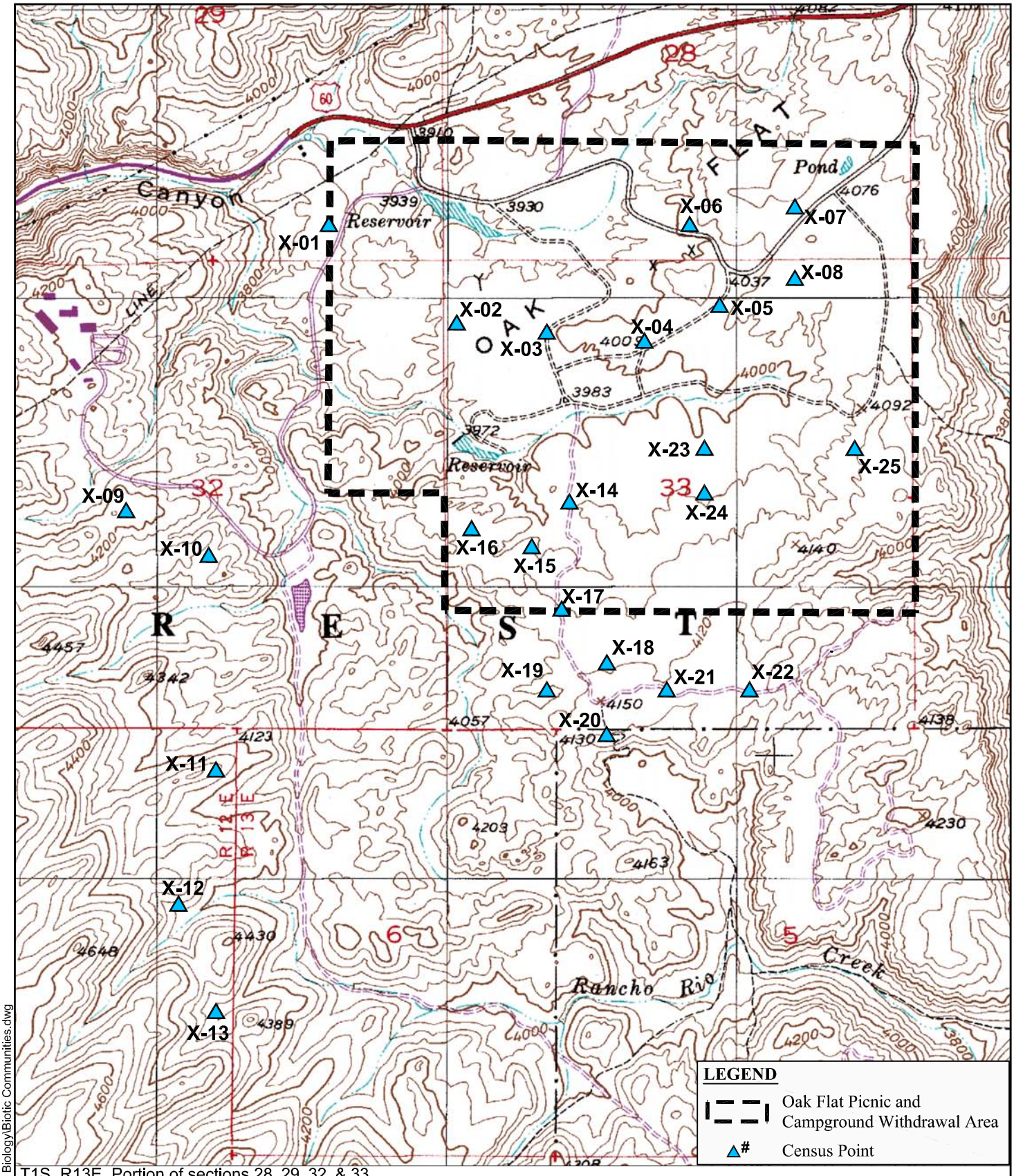
0 .5 mi 1 mi

N
W E
S

RESOLUTION COPPER MINNING
Baseline Studies

2009 Bird Survey Area
Vicinity Map
Figure 1

DWG FullPath: M:\projects\807.28\Baseline Biology\Vicinity.dwg



T1S, R13E, Portion of sections 28, 29, 32, & 33,
T2S, R12E, Portion of section 1, T2S, R13E, Portion of section 5,
Pinal County, Arizona, Superior 7.5' USGS Quadrangle

WestLand Resources Inc.
Engineering and Environmental Consultants
4001 E. Paradise Falls Drive
Tucson, Az 85712 (520) 206-9585

0' 750' 1500'
SCALE 1" = 1500'

N
W E
S

RESOLUTION COPPER MINNING
Baseline Studies

Location of Bird Surveys
During 2009 Breeding Season
Figure 2

M:\projects\807.28\Baseline Biology\Biotic Communities.dwg

The variable circular-plot method (VCPM) was used for estimating bird populations (Verner 1985, Gibbons et al. 1996). This procedure was also utilized as in 2008. From the chosen central point of each location 5-meter increments of radius out to 30 meters from the central point, and 10-meter increments from 30 to 100 meters were approximated visually. Birds observed at distances greater than 100 meters from the survey point were recorded but were generally beyond calculated detection limits for density estimates. Birds at distances greater than 200 meters were not recorded. Survey points were at least 200 meters apart to minimize the possibility of repeat counting of individual birds. Because the activity level of birds may decrease during the middle part of the day, census times were restricted to the first five hours after sunrise. This restriction is more critical in summer than in winter. For each point birds were counted for a 10-minute period during each cycle of surveying and their approximate distances from the center point were recorded. In order to better understand the rates of detection of birds at each census point, we noted the number of individual birds detected during a first 3-minute period, a second 2-minute period, and a third 5-minute period. We analyzed the data in a manner similar to Dettmers et al. (1999).

The VCPM can be used to estimate densities for a wide variety of bird species. Because different species are detectable at different distances from the observer and the ability of the observer to detect particular species differs among biotic communities, detection distances are determined for each species in each biotic community and the observations from all points and the species observed at those points within that biotic community are combined. The detection distance is normally the distance at which the incremental density of a species in the next greater radial range is less than half of the incremental density in the lower range. Incremental densities are calculated by dividing the number of observations within a concentric ring by the area of that ring. For example, the incremental area of the ring between 30 and 40 meters from the central point would be the area of a 40-meter radius circle minus the area of a 30-meter radius circle.

Because incremental areas increase geometrically with the distance from the central point, minor errors in distance estimates for birds close to the point can bias the density estimate (Verner 1985). Similar biases can result if birds are attracted to or repelled from the observer (Gibbons et al. 1996). However, the accuracy of detection limits and densities will improve with a greater number of observations. Another potential bias in this method may occur if uncommon birds happen to be observed close to the point. With too few observations to determine a reliable detection limit, very high densities for uncommon species based on one or two close observations may be calculated. To reduce the effects of this potential bias, a minimum detection limit of 20 meters was assumed for uncommon species observed close to the census point.

Once a detection limit has been determined for a species in a biotic community, a density estimate may be calculated based on pooled data from all points within that biotic community. The total number of individuals observed is divided by the area of a circle with a radius of the detection limit. This result is then divided by the total number of counts within that biotic community during the survey. The total number of counts for a biotic community is equal to the number of census points within that biotic community multiplied by the number of times each point was censused (25 points x 3 dates = 75).

2.2 BIRD CENSUS RESULTS AND DISCUSSION

Bird Species Diversity

During the 2009 breeding survey, 53 bird species were recorded with distance estimates (Table 2). Nineteen other species (Table 3) were observed in the Resolution vicinity but were not recorded at any points during the breeding survey. The species names and their sequence in these tables follow the taxonomy of the American Ornithologists Union (AOU 2009). The data from all survey points in specific biotic communities were combined to determine detection limits for each species in each biotic community. As in the 2008 surveys, most breeding survey density estimates are based on relatively few observations. Only 32 of 112 breeding density estimates (28.6 %) are based on ten or more observations within a biotic community type. This means that estimated densities can either under or over estimate actual densities. These densities are best viewed as an approximation of relative density of the different bird species observed during the study.

The numbers of species observed in the different biotic communities ranged from a low of 24 species in the Emory oak sites to a high of 47 species in the manzanita sites. The sites in scrub oak chaparral were intermediate with 36 species. Unidentified hummingbirds were not counted as a separate species because they were almost certain to be either black-chinned or Annas' hummingbirds. The average number of species per habitat in 2009 was 35.7.

The total number of bird species observed in each biotic community increased with new observations in each of the three survey sets. The total number of species is the simplest measure of species diversity. These results are illustrated graphically in Figure 3. The general pattern for each community is a large number of species observed during the first survey period, with relatively fewer new species added in subsequent survey periods. Roughly two-thirds of the species were observed during the first breeding survey set in each habitat type. The last survey period added about 10 % of the species in the Emory oak and scrub oak communities, but it added about 20 % in the manzanita chaparral. Thus, the number of species per habitat was attenuating, but these results suggest that additional, relatively uncommon species could be added with additional survey effort.

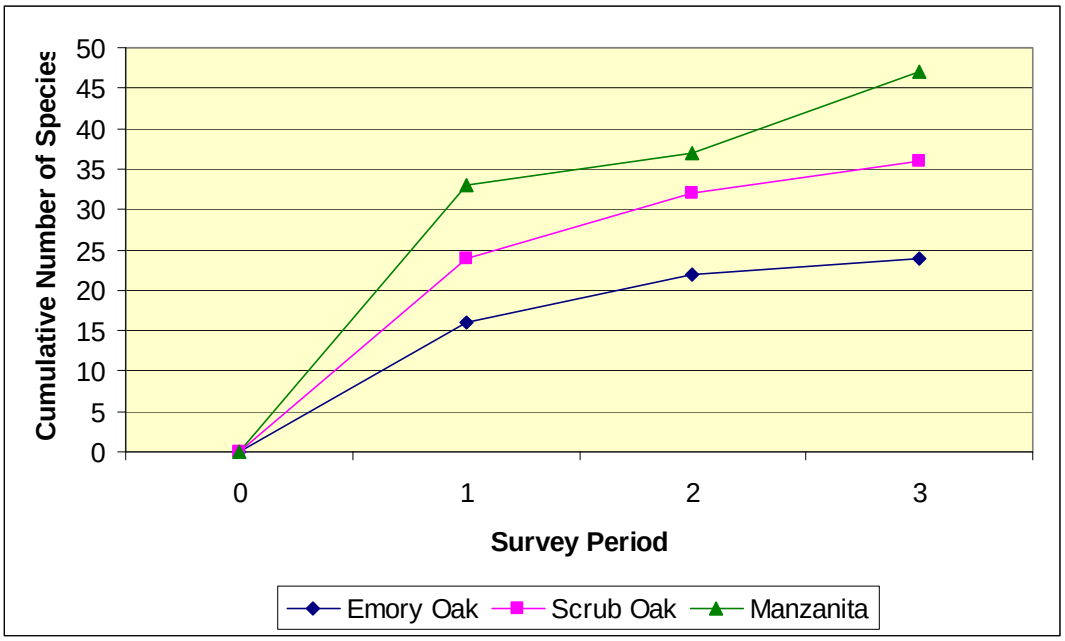


Figure 3. Cumulative numbers of species observed in the habitat types covered during the 2009 breeding season.

The total number of species in each habitat appears to be dependent on the number of survey points. When the data from Figure 3 are plotted based on the number of census points within a habitat, all values appear to fall on or near a smooth curve, as shown in Figure 4. The curve does not reach an asymptote, which would suggest saturation of sampling effort and would indicate a maximum number of species. Again these data suggest that additional sampling effect would detect uncommon species.

Bird Species Densities

The detection limits described above were used to calculate densities for each species in each biotic community. These densities provide for reasonable comparisons among biotic communities. Detection limits and densities that are based on very few observations are only approximate. Because many bird species are infrequently observed, only 32 out of 107 density estimates (29.9%) are based on 10 or more observations within a biotic community (Table 2). Not surprisingly, the Emory oak community, which had the fewest points and the least census time, had the fewest species with reliable detection limits. In contrast, both the scrub oak and the manzanita communities had reliable estimates for about 30 % of the observed species (Table 2).

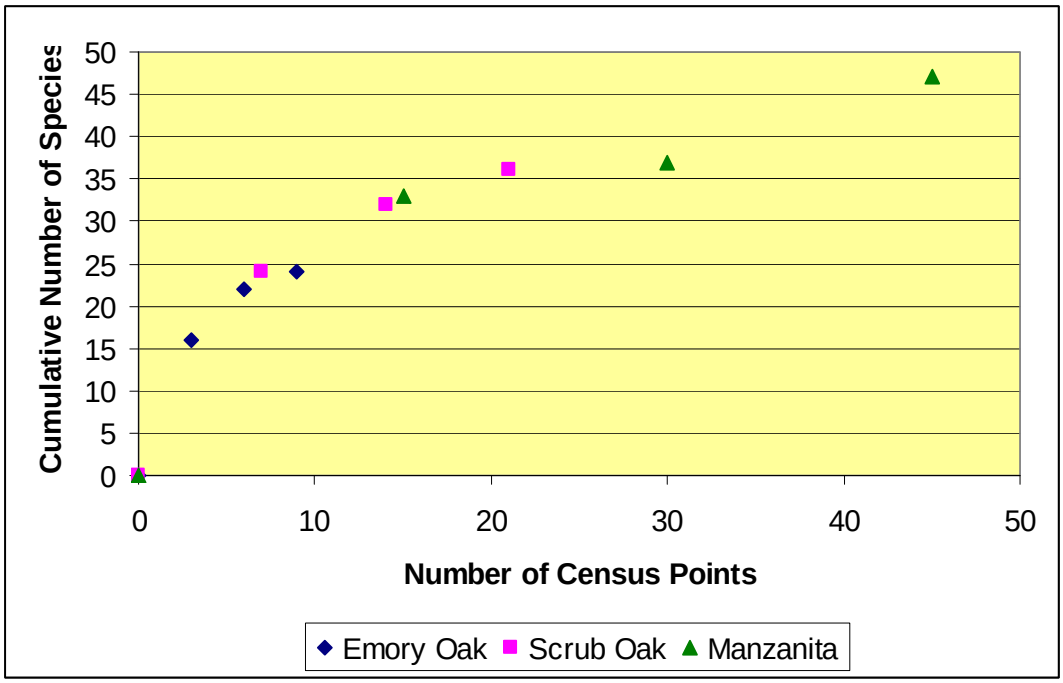


Figure 4. Cumulative numbers of species observed in the habitat types covered during the 2009 breeding season, based on number of censuses in each habitat type.

Total breeding survey bird densities in these communities range from a low of about 9.9 birds per hectare in the manzanita community to highs of 14.2 and 14.5 birds per hectare in the scrub oak and Emory oak communities, respectively. A weighted average of all survey points gives a density of 11.6 birds per hectare during the breeding survey.

Time Interval Analysis of Survey Sets

We attempted to determine the efficiency of the sampling protocol by analyzing the accumulation of species observed in sites during subsets of the 10 minute observation period at each sample point. The survey data were also analyzed based on observations within different time segments in each survey set. Observations were recorded separately for the first 3 minutes, the next 2 minutes, and the final 5 minutes of the total 10-minute survey at each point. Surveyors hypothesized that most species and individuals would be seen during the 3-minute and 2-minute intervals, and that fewer new species and individuals would be added during the final 5-minute interval.

The data collected during the 2009 breeding season generally support this hypothesis, and the results are very similar for all three habitat types. Time interval analyses for species and individuals are presented in Figures 5 and 6, respectively. These figures show that about half of the species and individuals are observed during the first 3 minutes of a census, and about two-thirds are observed during the first 5 minutes. This trend was identical for each of the habitats and did not seem to be affected by number of sample points per habitat. These graphs do not reach an asymptote which indicates that additional time censusing each point would likely result in more species and individuals being recorded.

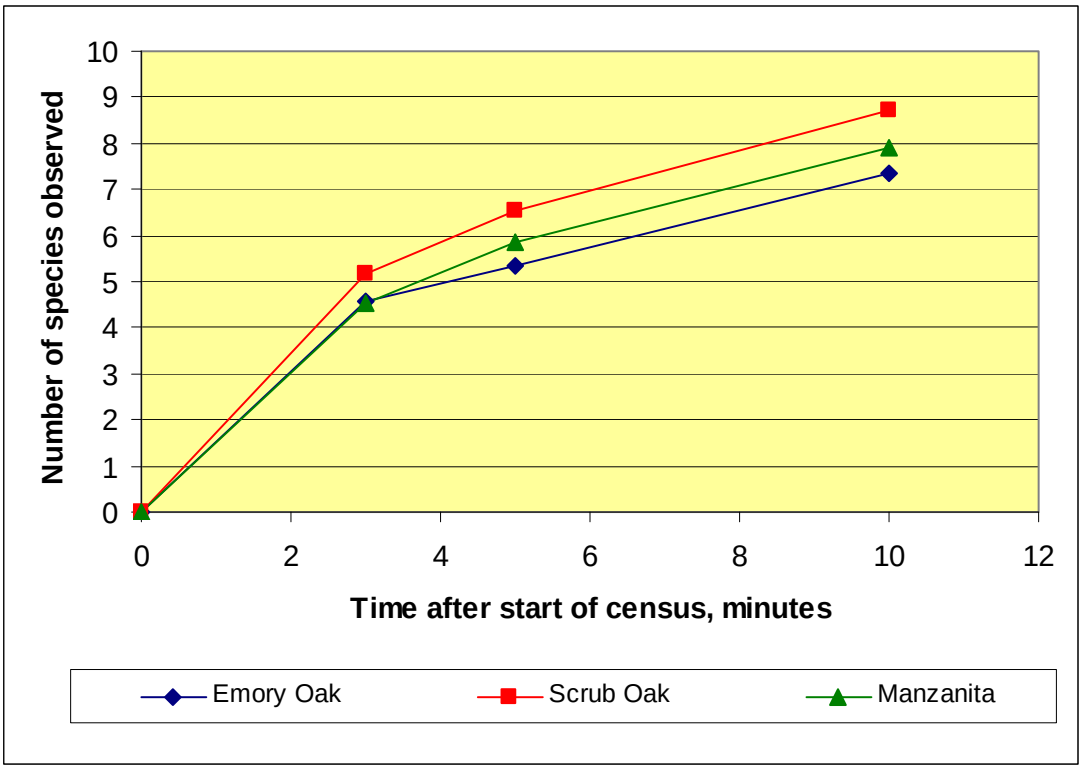


Figure 5. Cumulative numbers of species based on time segments after the beginning of a census count at a point, averaged over all points in a habitat type.

Effects of Time of Day

Our survey protocol includes the implicit assumption that bird activity will decrease in the middle part of the day, leading to a potential bias in density data. This expected decrease in activity is likely because of high daytime temperatures during the summer. To test this assumption, we analyzed the numbers of species and individuals recorded during each 10-minute survey period, based on the time after sunrise that the survey period started. The data were grouped into half-hour time intervals beginning with the time of sunrise, and the bird counts were averaged during those time intervals. Using time-after-sunrise eliminates any potential bias from increasing day lengths later in the season.

Results of this analysis, based on 75 survey periods are shown numerically in Table 5. Figures 7 and 8 show these data graphically for species and individuals, respectively. Correlation coefficients (r) for the species and individuals are 0.263 and 0.443, respectively. Neither of these correlations is statistically significant, indicating that there is no trend for bird species or numbers to decrease during our census periods. This indicates a lack of bias in censuses occurring earlier or later in the morning and further suggests that longer census times in the mornings would be possible in the future.

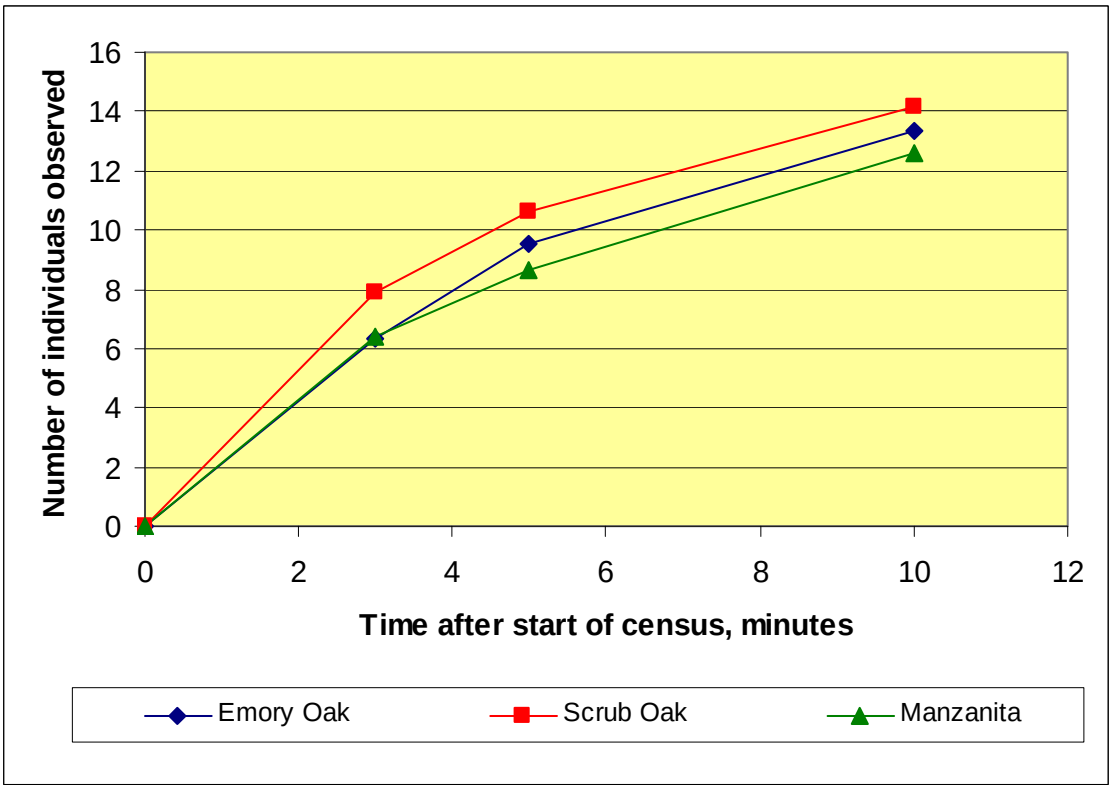


Figure 6. Cumulative numbers of individuals based on time segments after the beginning of a census count at a point, averaged over all points in a habitat type.

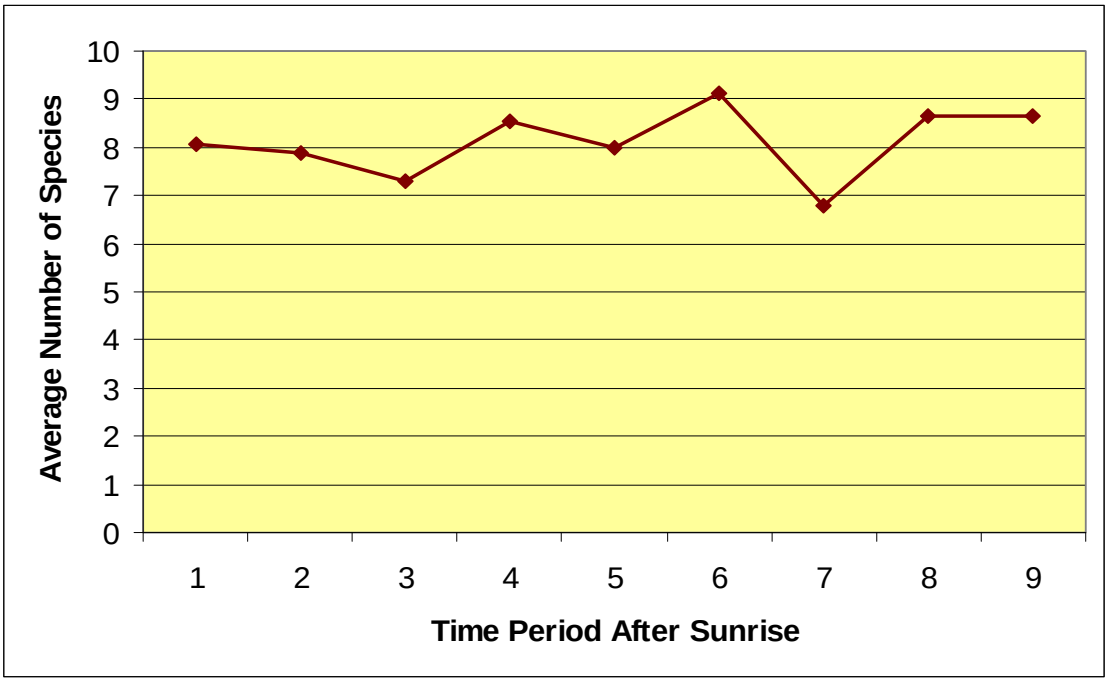


Figure 7. Time of day effect on numbers of species observed. Each time period represents a 30 minute interval.

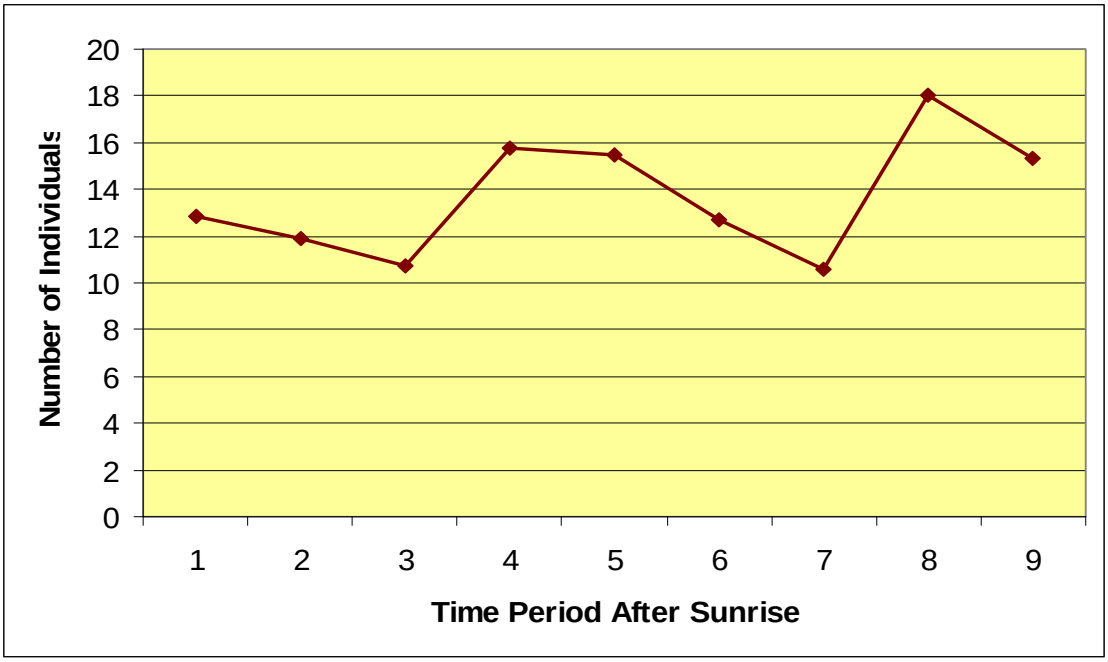


Figure 8. Time of day effect on numbers of individual birds observed. Each time period represents a 30 minute interval.

2.3 BIRD CENSUS SUMMARY AND CONCLUSIONS

The 2009 breeding season survey using the VCPM has been successfully completed at the Study Area. These surveys covered 25 points distributed among three different habitat types. Fifty-three (53) bird species were recorded at these survey points, and another 19 species were observed elsewhere on the Resolution site. Forty-seven species were recorded in the manzanita habitat, 36 species were recorded in the scrub oak habitat, and 24 species were recorded in the Emory oak habitat. These differences in species diversity are likely to be the result of different numbers of census points in these habitat types and not to intrinsic differences in suitability of these for birds in general. Overall bird densities ranged from 9.9 birds per hectare in the manzanita community to 14.5 birds per hectare in the Emory oak community. The weighted average of all survey points is 11.6 birds per hectare.

The 10-minute sample period was broken into 3-minute, 2-minute, and 5-minute segments for data collection. Each of the habitats showed similar patterns, with about half of the species and individuals recorded in the first 3 minutes, and about two-thirds of species and individuals were recorded in the first 5 minutes. The rates at which new species and individuals are observed at a point decreased with time but suggest that some rarer species would be discovered if census times per site were extended.

The survey results were sorted by starting time and broken into groups based on half-hour intervals after sunrise. The results of this analysis showed that time of day had no effect on the numbers of species and individuals observed.

This project has successfully extended our survey of breeding birds to the most common habitat types at the Resolution site and has added more species of birds to the list of birds recorded in 2008. While this survey was effective in detecting common and uncommon species at the sample sites, our analysis has suggested that additional species may be detected with further sampling.

3.0 REFERENCES

American Ornithologists' Union (AOU). 2009. Check-list of North American Birds. Available at internet site: http://www.aou.org/checklist/north/index.php.

Dettmers, R., D. A. Buehler, J. G. Bartlett, and N. A. Klaus. 1999. Influence of point count length and repeated visits on habitat model performance. Journal of Wildlife Management 63(3): 815-823.

Gibbons, D. W., D. Hill, and W. J. Sutherland. 1996. Birds. Pp. 227-259 *in* Sutherland, W. J., ed. Ecological Census Techniques. Cambridge University Press, Cambridge, UK.

Verner, J. 1985. Assessment of counting techniques. Pp. 247-302 *in* Johnson, R. F., ed. Current Ornithology, Vol. 2. Plenum Press, New York.

Table 1. New points selected for bird surveys during the 2009 breeding season.

2009 Bird Survey Points	UTM, NAD-27[1]		UTM, NAD-83[2]		Habitat Type
	Easting	Northing	Easting	Northing	
X-01	494574	3685258	494511	3685456	Emory Oak Woodland
X-02	495038	3684912	494975	3685110	Manzanita Chaparral
X-03	495345	3684880	495282	3685078	Scrub Oak Chaparral
X-04	495682	3684853	495619	3685051	Manzanita Chaparral
X-05	495967	3684943	495904	3685141	Scrub Oak Chaparral
X-06	495866	3685249	495803	3685447	Manzanita Chaparral
X-07	496182	3685299	496119	3685497	Manzanita Chaparral
X-08	496225	3685085	496162	3685283	Manzanita Chaparral
X-09	493850	3684249	493787	3684447	Manzanita Chaparral
X-10	494049	3684083	493986	3684281	Manzanita Chaparral
X-11	494315	3683290	494252	3683488	Manzanita Chaparral
X-12	494072	3682845	494009	3683043	Scrub Oak Chaparral
X-13	494238	3682545	494175	3682743	Scrub Oak Chaparral
X-14	495418	3684360	495355	3684558	Manzanita Chaparral
X-15	495278	3684129	495215	3684327	Manzanita Chaparral
X-16	495055	3684155	494992	3684353	Manzanita Chaparral
X-17	495331	3683960	495268	3684158	Manzanita Chaparral
X-18	495556	3683738	495493	3683936	Scrub Oak Chaparral
X-19	495373	3683615	495310	3683813	Emory Oak Woodland
X-20	495534	3683479	495471	3683677	Scrub Oak Chaparral
X-21	495758	3683635	495695	3683833	Manzanita Chaparral
X-22	496065	3683647	496002	3683845	Manzanita Chaparral
X-23	495893	3684477	495830	3684675	Emory Oak Woodland
X-24	495917	3684272	495854	3684470	Manzanita Chaparral
X-25	496466	3684481	496403	3684679	Scrub Oak Chaparral

[1]- Universal Transverse Mercator/North American Datum 1927
[2]- Universal Transverse Mercator/North American Datum 1983

Emory Oak – *Quercus emoryi*

Scrub Oak – *Quercus turbinella*

Manzanita – *Arctostaphylos pungens*

Table 2. Densities of bird species observed in habitats on the Resolution Parcel during the breeding season, 2009. Densities expressed as individuals/hectare.

Scientific Name	Common Name	Habitats		
		Emory Oak Woodland	Scrub Oak Chaparral	Manzanita Chaparral
Phalacrocorax auratus	Double-crested Cormorant			0.004
Ardea herodias	Great Blue Heron			0.019
Cathartes aura	Turkey Vulture	0.094	0.015	0.007
Buteo albonotatus	Zone-tailed Hawk			0.002
Buteo jamaicensis	Red-tailed Hawk	0.039	0.015	0.004
Falco sparverius	American Kestrel			0.044
Callipepla gambelii	Gambel's Quail	0.141	0.182	0.384
Zenaida asiatica	White-winged Dove	0.289	0.030	0.044
Zenaida macroura	Mourning Dove	0.035	0.071	0.020
Geococcyx californianus	Greater Roadrunner			0.079
Aeronautes saxatalis	White-throated Swift			0.011
Archilochus alexandri	Black-chinned Hummingbird		0.379	0.531
Calypte anna	Anna's Hummingbird		1.517	0.453
	Hummingbird sp.		0.379	1.415
Picoides scalaris	Ladder-backed Woodpecker	0.144	0.056	0.022
Empidonax wrightii	Gray Flycatcher			0.028
Empidonax sp.	*Empidonax* flycatcher		0.168	
Myiarchus cinerascens	Ash-throated Flycatcher	0.718	0.521	0.491
Vireo vicinior	Gray Vireo	0.982	0.464	0.454
Vireo plumbeus	Plumbeous Vireo	0.786	0.047	0.043
Vireo huttoni	Hutton's Vireo			0.177
Aphelocoma californica	Western Scrub-Jay		0.084	0.035
Corvus corax	Common Raven	0.491	0.019	0.028
Tachycineta thalassina	Violet-green Swallow			0.021
Baeolophus ridgwayi	Juniper Titmouse			0.442
Auriparus flaviceps	Verdin	0.424	0.758	0.113
Psaltriparus minimus	Bushtit	5.502	1.137	1.651
Campylorhynchus brunneicapillus	Cactus Wren		0.166	
Salpinctes obsoletus	Rock Wren	0.166	0.545	0.233
Catherpes mexicanus	Canyon Wren	0.166	0.243	0.183
Thryomanes bewickii	Bewick's Wren	1.179	0.568	0.511
Polioptila melanura	Black-tailed Gnatcatcher		0.379	0.028
Mimus polyglottos	Northern Mockingbird	0.283	0.062	0.057
Toxostoma crissale	Crissal Thrasher	0.055	0.168	0.055
Phainopepla nitens	Phainopepla		0.047	0.044
Vermivora luciae	Lucy's Warbler			0.177
Oporornis tolmiei	MacGillivray's Warbler			0.044
Piranga ludoviciana	Western Tanager			0.020
Pipilo chlorurus	Green-tailed Towhee		0.061	0.028
Pipilo maculatus	Spotted Towhee	0.884	0.557	0.431
Pipilo fuscus	Canyon Towhee		0.364	0.130
Aimophila ruficeps	Rufous-crowned Sparrow	0.885	0.547	0.079
Spizella atrogularis	Black-chinned Sparrow	0.442	2.527	0.685
Amphispiza bilineata	Black-throated Sparrow	0.566	0.663	0.287
Pheucticus	Black-headed Grosbeak	0.044	0.061	0.017

Scientific Name	Common Name	Habitats		
		Emory Oak Woodland	**Scrub Oak Chaparral**	**Manzanita Chaparral**
melanocephalus				
Passerina caerulea	Blue Grosbeak	0.141		
Molothrus aeneus	Bronzed Cowbird		0.379	0.177
Molothrus ater	Brown-headed Cowbird			0.029
Icterus cucullatus	Hooded Oriole		0.047	
Icterus parisorum	Scott's Oriole	0.055	0.124	0.078
Carpodacus mexicanus	House Finch		0.853	0.014
Carduelis psaltria	Lesser Goldfinch		0.015	0.035
Total Density		**14.511**	**14.218**	**9.864**
Total Species		**24**	**36**	**47**
Estimates based on 10 or more individuals		**5**	**12**	**15**

Table 3. Bird species observed elsewhere on the Resolution Parcel during the breeding season, 2009, but not recorded at any of the survey points.

Scientific Name	Common Name
Accipiter cooperii	Cooper's Hawk
Buteogallus anthracinus	Common Black Hawk
Falco peregrinus	Peregrine Falcon
Streptopellia decaocto	Eurasian Collared Dove
Bubo virginianus	Great Horned Owl
Contopus sordidulus	Western Wood-Pewee
Sayornis nigricans	Black Phoebe
Myiarchus tyrannulus	Brown-crested Flycatcher
Tyrannus vociferans	Cassin's Kingbird
Vireo bellii	Bell's Vireo
Vireo gilvus	Warbling Vireo
Stelgidopteryx serripennis	Northern Rough-winged Swallow
Baeolophus wollweberi	Bridled Titmouse
Vermivora virginiae	Virginia's Warbler
Dendroica petechia	Yellow Warbler
Piranga rubra	Summer Tanager
Pipilo aberti	Abert's Towhee
Chondestes grammacus	Lark Sparrow
Cardinalis cardinalis	Northern Cardinal

Table 4. Year to year comparison of results for 2008 and 2009 breeding seasons.

Community	Variable	2009	2008
Emory Oak Woodland	Number of Census Points	3	8
	Number of Species	24	44
	Total Density	14.5	15.9
Scrub Oak Chaparral	Number of Census Points	7	5
	Number of Species	36	28
	Total Density	14.2	9.7
Manzanita Chaparral	Number of Census Points	15	5
	Number of Species	47	36
	Total Density	9.9	34.6

Table 5. Average numbers of species and individuals based on time after sunrise.

Time Interval	Time After Sunrise (min)	Number of Survey Periods Per Time Interval	Average Number of Bird Species	Average Number of Individuals
1	0-29	13	8.1	12.9
2	30-59	9	7.9	11.9
3	60-89	10	7.3	10.7
4	90-119	9	8.6	15.8
5	120-149	9	8.0	15.4
6	150-179	9	9.1	12.7
7	180-209	9	6.8	10.6
8	210-239	3	8.7	18.0
9	240-269	3	8.7	15.3
	TOTAL	**75**		