



## **Annual Report on the Lower Colorado River Riparian Bird Surveys, 2008:**

System Monitoring for Riparian Obligate Avian Species (Work Task D6)  
and Avian Use of Restoration Sites (Work Task F2) - Lower Colorado River  
Multi-Species Conservation Program  
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## Abstract

In this report, we summarize the results of our 2008 surveys of riparian obligate bird species along the Lower Colorado River. Surveys in this two-year project have the goals of (1) estimating population sizes of six species covered under the Lower Colorado River Multi-Species Conservation Program (LCR MSCP), the Gilded Flicker (*Colaptes chrysoides*), Gila Woodpecker (*Melanerpes uropygialis*), Vermilion Flycatcher (*Pyrocephalus rubinus*), Arizona Bell's Vireo (*Vireo bellii arizonae*), Sonoran Yellow Warbler (*Dendroica petechia sonorana*), and Summer Tanager (*Piranga rubra*); (2) determining presence and breeding activity of these and other riparian species in LCR MSCP's habitat creation sites; (3) providing a baseline for monitoring riparian obligate birds throughout the LCR MSCP project area and in habitat creation sites; and (4) generating habitat models that describe requirements of the covered species based on field habitat assessments and other available information. The first two goals are addressed in this report, while all other analysis of the two-year survey effort will be reported in 2009. Bird surveys were conducted using a combination of rapid (two visits) and intensive (eight visits) area searches in established plots that, for system-wide surveys, were randomly selected from a grid of the entire project area and, for habitat creation sites, were non-randomly placed to optimize coverage in created habitats. For a double sampling effort, we used 10 randomly selected plots for intensive area searches from the pool of 70 rapid area search plots to allow the calculation of detection ratios for most species found in the system-wide surveys. With detection ratios, an unbiased estimate of population sizes and bird densities can be generated. Because a software program is currently being written to process the data, we postponed these otherwise time-consuming analyses until the program becomes available. Instead, we based our system-wide population size estimates in this report on the detection ratios reported from a previous study in the project area (Bart 2007).

A total of 158 species of birds were detected in all surveys. All LCR MSCP covered species, except the Gilded Flicker, were detected in at least one site. At least some habitat creation sites with more than one year of growth supported breeding populations of four of the six covered species, but all lacked Gila Woodpecker and Gilded Flicker. Pre-development habitat creation sites supported none of the covered species, neither as breeders nor as non-breeders. Insights from this first year of the project on species richness and abundance patterns are discussed in light of adaptive management of both the monitoring and the habitat creation efforts under the Conservation Plan.

## Introduction

This bird inventory and monitoring project is part of the Lower Colorado River Multi-Species Conservation Program (LCR MSCP). The LCR MSCP is “a long-term plan to conserve at least 26 species along the Lower Colorado River from Lake Mead to the Southerly International Boundary with Mexico through implementation of the Habitat Conservation Plan” (BR 2006, p. 4). This report summarizes the methods and results of the 2008 field surveys completed in fulfillment of Work Task D6: *System Monitoring for Riparian Obligate Avian Species* and Work Task F2: *Avian Use of Restoration Sites*.

The system-wide monitoring of the LCR MSCP’s riparian obligate birds emphasizes six species covered under the program (hereafter: covered species), including Gilded Flicker (*Colaptes chrysoides*), Gila Woodpecker (*Melanerpes uropygialis*), Vermilion Flycatcher (*Pyrocephalus rubinus*), Arizona Bell’s Vireo (*Vireo bellii arizonae*), Sonoran Yellow Warbler (*Dendroica petechia sonorana*), and Summer Tanager (*Piranga rubra*). These species exclude only those covered bird species that are monitored by other single-species protocols implemented by the program.

The project area for system-wide bird monitoring includes the Colorado River from Separation Point, upstream of Lake Mead, to the Southerly International Boundary with Mexico and excludes most of the Colorado River Indian Tribes Reservation, except the Ahakhav Preserve. The project area also includes portions of Bill Williams and Virgin rivers, as well as established habitat creation or restoration demonstration sites (hereafter: habitat creation sites) within the historic floodplain of the Colorado River’s mainstem.

The goals of the program addressed in the 2008 season include (1) determining presence and estimating breeding population sizes of covered species on the Lower Colorado River and in habitat creation sites, (2) estimating abundances of other riparian landbirds, (3) and providing a baseline of bird data on pre-development habitat creation sites. The additional project goals of determining habitat selection parameters for the covered species, estimating species’ responses to created habitats, and recommending conservation actions under the adaptive management process outlined in the LCR MSCP Science Strategy (BR 2006) will be addressed in our final report in 2009.

## Methods

### *1. Study Area and Sampling Plan*

The study area spans the mainstem of the Lower Colorado River from Separation Canyon (just upstream of Lake Mead) to the Southerly International Boundary, just south of Yuma (Appendix 1a). The section extending from Separation Canyon to Lake Mead was surveyed in 2007, but was excluded in 2008.

The original sampling plan for system-wide avian surveys (Bart 2007) was developed under Work Task D6, *System Monitoring for Riparian Obligate Avian Species*. The purpose of the plan was to estimate population size, to provide a baseline for monitoring long-term population trends of obligate riparian birds throughout the Lower Colorado River (including randomly selected sites and habitat creation sites) and to define habitat requirements of LCR MSCP covered species.

A complex sampling design was used to create study plots for the monitoring effort. First, the Anderson-Ohmart vegetation classification system was used to define habitat types for stratification (Table 1).

**Table 1.** Codes of dominant vegetation type (according to Anderson-Ohmart system), from Bart (2007).

Code	Description
AG	Agriculture
ATW	Atriplex
AW	Arrowweed
CW	Cottonwood-willow
HM	Honey mesquite
SC	Salt cedar
SH	Salt cedar-honey mesquite
SM	salt cedar-screwbean mesquite
OW	Open water
SOW	Structured open water
BW	Backwater
UD	Undeveloped bare ground
NC	No classification

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Similar habitat types were combined based on their presumed suitability for the six covered bird species, and habitat polygons delineating the following six habitat types were applied to the entire study area (Bart 2007):

- (0) Unsuitable
- (1) Good/Tall: tall CW, mixed CW near to water
- (2) Good/Low: mixed CW; tall HM, SH, SM; mixed HM, SC, SH, SM near to water
- (3) Fair: tall or mixed SC; mixed HM, SC, SH, SM; low CW, HM, SC, SH, SM near to water; AG, ATW, AW, NC, UD near water
- (4) Poor: low CW, HM, SC, SH, SM
- (5) Marsh: all marshes

Plots were assigned to these six habitat types based on the amounts of good, fair, and poor habitat in each plot for the covered species. For further details on plot classifications, see Bart (2007). Finally, plots were stratified by geographic strata (Table 2). In 2007, 160 plots were randomly selected from a total of >15,000 plots system-wide for area search surveys done in 2007 and 2008 (Bart 2007), including:

- A. All plots in the good-tall and good-low strata in geographic strata 3, 4, 5, 6, 8, 10, 11 (see geographic strata in Table 2).
  - B. 44 plots in geographic stratum 7, distributing them across habitats but mainly in the good-tall and good-fair.
  - C. 20 plots in good-tall and good-low strata in geographic stratum 12.
  - D. 10 plots, each in the fair-, poor, and unsuitable strata, distributed evenly across all geographic strata.
  - E. 15 marsh plots, distributing them evenly across all geographic strata.
- No plots in geographic strata 1, 2, 9, and 13.

In 2008, a total of 70 plots were covered in nine of the 13 geographic strata. Table 2 illustrates the distribution of system-wide survey effort among geographic strata in 2008.

**Table 2.** Number of system-wide search plots per geographic stratum surveyed in 2008.

<b>Geographic Strata on the Lower Colorado River (Bart 2007)</b>	<b>Number of System-Wide Area Search Plots Surveyed in 2008</b>
1. Separation Canyon to Lake Mead	0
2. Virgin River	0
3. Lake Mead	10
4. Hoover Dam to Davis Dam	9
5. Davis Dam to Bill Williams (excluding Havasu NWR)	4
6. Havasu NWR (excluding Bill Williams unit)	1
7. Bill Williams unit of the Havasu NWR	19
8. Bill Williams to Cibola excluding the Colorado Reservation	0
9. Colorado River Indian Reservation Preserve.	0
10. Cibola NWR	6
11. Imperial NWR	7
12. Colorado River from the Imperial NWR to Yuma	2
13. Yuma to the southern border of the study area	12
<b>Total</b>	<b>70</b>

All plots in the project area were classified according to this stratification scheme, resulting in the following breakdown of area by stratum for the entire system-wide survey area (Table 3). The area of each stratum was used to calculate estimated population sizes based on the system-wide avian surveys in this report.

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**Table 3.** Breakdown of area in km<sup>2</sup> by stratum of the entire LCR MSCP project area.

Geographic Strata	Habitat Strata						Total
	0	1	2	3	4	5	
1	43.45	14.08	39.77	5.66	9.44	0.34	112.74
2	35.14	3.98	0.61	56.84	24.05	3.34	123.97
3	170.63	0.00	0.00	5.91	123.18	0.43	300.15
4	49.02	1.26	0.00	23.09	16.60	0.00	89.97
5	40.31	2.58	0.13	70.30	52.10	10.63	176.04
6	38.52	1.46	0.08	22.56	14.04	5.99	82.64
7	21.26	5.43	1.03	9.93	35.76	1.67	75.08
8	27.58	0.87	0.00	46.72	30.00	2.16	107.33
9	71.10	0.60	0.13	85.34	54.42	1.11	212.70
10	11.87	0.65	0.27	54.13	25.46	1.49	93.87
11	19.87	2.41	1.07	41.98	27.70	20.85	113.88
12	27.56	11.37	3.86	39.42	17.94	5.40	105.55
13	2.89	10.02	2.52	22.12	5.83	0.22	43.59
<b>Total</b>	<b>559.20</b>	<b>54.70</b>	<b>49.48</b>	<b>484.00</b>	<b>436.52</b>	<b>53.64</b>	<b>1637.52</b>

*A. Plot Selection: System-Wide Surveys*

System-wide avian surveys were conducted using an area search protocol that incorporated double sampling to determine detection ratios for each covered species. A sample of 160 randomly-selected 9 ha plots were surveyed in the first two years of this baseline inventory effort (88 in 2007, and 72 in 2008) using rapid area searches described below. A random sub-sample of these plots (10 in 2008) was surveyed intensively to determine actual numbers of breeding birds present in each plot.

Some of the originally selected sites were inaccessible. Therefore, a list of alternate sites was selected randomly from the population of plots identified in the original stratification process. Plots that were farther than 2.5 km from the nearest road or trail were replaced from the list of alternate plots. Other plots were replaced because private landowners denied access, because they contained wetlands that were too vegetated for a boat but too deep to access in waders, or because conditions were otherwise unsafe for surveyors. In the end, 27 plots from the original list were replaced from the list of alternate sites for these reasons.

The same surveyor conducted both surveys on a plot in most cases. From the 72 plots to be surveyed in 2008, we randomly selected the geographic strata to be covered with two intensive area search sites (Bart 2007). The ten plots for intensive area searches included two on each of the following geographic strata (Table 2): 4 (Lake Mohave); 5 (near Laughlin, NV); 7 (Bill Williams NWR); 10 (near Blythe on the Cibola NWR); and 11 (near Imperial NWR).



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*B. Plot Selection: Habitat Creation Site Surveys*

For habitat creation sites, we used the same field methods for bird surveys as used for the system-wide surveys (rapid and intensive area searches) in 2008. All habitat creation sites were larger than a typical system-wide area search plot, so the sites were subdivided into plots that were small enough to be surveyed in one morning (9 – 20 ha). Rapid area searches were done on 9 habitat creation plots that were either “pre-development”, i.e. prior to implementation of habitat creation activities, or had one year or less growth post-development. Post-development plots with two or more years of growth were surveyed with intensive area searches (17 plots). An overview of habitat creation site locations is provided in Appendix 1b. Table 4 lists all plots, their basic characteristics, and method used for the 2008 surveys.

**Table 4.** List of habitat creation sites and plots, stage of habitat creation activities, and type of bird survey implemented in 2008.

<b>Site and Plot</b>	<b>Restoration Work Phase</b>	<b>Dominant Vegetation</b>	<b>Area Search Type Implemented in 2008</b>
<b><i>Beal Lake Riparian Habitat Creation Project</i></b>			
Beal A	planted 2004	screwbean mesquite	intensive
Beal B	planted 2004	cottonwood-willow	intensive
Beal C	planted 2004	cottonwood-willow	intensive
Beal D	planted 2004	screwbean mesquite	intensive
<b><i>Colorado River Indian Tribe</i></b>			
CRIT 9A	planted 2001	screwbean mesquite	intensive
CRIT 9B	planted 2001	cottonwood-willow	covered species only
CRIT 9C	planted 2002	cottonwood-willow/screwbean mesquite	intensive
CRIT 9D	planted 2003	cottonwood-willow/honey mesquite	intensive
CRIT 9E	planted 2005	cottonwood-willow	covered species only
<b><i>Cibola Valley Conservation and Wildlife Area</i></b>			
CVCA 1A	planted 2006	cottonwood-willow	intensive
CVCA 1B	planted 2006	cottonwood-willow	intensive
CVCA 1C and D	planted 2006	cottonwood-willow	intensive
CVCA 2 (A,B,C)	planted 2008	cottonwood-willow	rapid
CVCA 3A and B	planted 2007	cottonwood-willow	intensive
CVCA 3-2	planted 2007	cottonwood willow/baccaris	intensive

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<b>Site and Plot</b>	<b>Restoration Work Phase</b>	<b>Dominant Vegetation</b>	<b>Area Search Type Implemented in 2008</b>
CVCA 5	pre-development	agricultural	rapid
CVCA 6	pre-development	agricultural	rapid
Crane Roost	pre-development	agricultural	rapid
<b><i>Cibola Nature Trail</i></b>			
NT-north	planted 1999	mesquite-cottonwood-willow	intensive
NT-south	planted 1999	mesquite-cottonwood-willow	intensive
Mass Planting	planted 2005	cottonwood-willow	intensive
<b><i>Palo Verde Ecological Preserve</i></b>			
PVER 2A	planted 2007	cottonwood-willow	intensive
PVER 2B	planted 2007	cottonwood-willow	intensive
PVER 3	planted 2008	cottonwood-willow	rapid
PVER 4	pre-development	agricultural	rapid
PVER 7	pre-development	agricultural	rapid
PVER 8	pre-development	agricultural	rapid
PVER 9	pre-development	agricultural	rapid

**2. Avian Monitoring Methods**

To monitor birds of the Lower Colorado River, both in system-wide and at habitat creation sites, we conducted rapid and intensive area searches. The goal of the rapid area search effort was optimizing the balance between geographic survey coverage and survey effort. The goal of intensive surveys was obtaining a complete and unbiased measure of breeding territories present on the plot. By combining these two approaches, using double-sampling in a subset of system-wide survey plots, the data can be also used to calculate detection ratios of the birds present in the intensive area search plots.

An area search is a bird survey method that aims to record all birds present during a visit of a defined survey plot. Intensive area searches can be used for the purposes of (1) obtaining an unbiased estimate of bird density, (2) obtaining nesting data, such as information on timing of breeding and nest success, and (3) generating a reliable bird inventory for a high-priority site, for example a habitat restoration or intensive management site (Ralph et al. 1993, Sutherland 1996, Dieni and Jones 2002). Rapid area searches, as defined here, employ the same field methods as intensive area searches, but the reduced number of visits (two, compared with eight in intensive area searches) prevents a similarly-accurate measure of total breeding densities, as some breeding birds may be missed during both visits. The rapid method is therefore primarily used to obtain

large geographic coverage without unduly compromising effectiveness of detecting breeding birds.

To conduct area searches, field surveyors visited the plot with an aerial photo that specified GPS coordinates (in NAD 83) of the plot corners. Using a combination of a hand-held GPS unit and the aerial photo, the surveyor systematically grid-searched the plot walking at a slow enough pace to stop and record all bird sightings at the correct location on the plot. Only one plot could be covered in one morning, and all visits were done by only one surveyor.

All area searches were conducted between 23 April and 30 June, 2008. All surveys began at sunrise and ended no later than noon in order to minimize surveys during high temperatures (> 100°F) and periods of low bird activity. The period of time spent per visit depended on difficulty of terrain, vegetation density, and amount of bird activity, with plots that were easy to hike with low bird densities taking less time (2-3 hours), and plots that had dense vegetation and high bird activity taking more time (up to 6 hours). In all cases, whether the survey was a rapid or an intensive area search, the surveyor's goal was to record all birds present on the plot on each visit, with a minimum of 2 hours spent to determine breeding status and territory location of covered species, or for all birds in the intensive area searches, and to obtain an accurate count and sighting locations of all birds present. The goal of each visit, during both rapid and intensive area searches, was to spend enough time to detect > 90% of all individual birds that were actually present on the plot during the visit.

For this, surveyors passed within no more than 50 m of every point within the plot to assure that all sections of the plot were adequately covered. A critical aspect of an area search is to track individual birds sufficiently to avoid double-counting, but to allow enough time for detecting individuals that return to their territories after an off-territory foraging bout.

All bird sightings and territory boundaries were recorded directly on to an aerial photograph or a hand-drawn plot map, which included the immediate surroundings of the plot. Birds near the edge and just outside the plot were also recorded on the map so as to prevent double-counting. At the end of the survey, birds near the plot border were classified as “in” or “out” of the plot based on the centroid of the polygon that described their activities during the survey, unless a nest or dependent young were found. If a nest or dependent young were found, then the location of the nest or young determined whether it was classified as “in” or “out”. All observed breeding evidence was marked on the map, and breeding status, to the extent that it was known, was recorded explicitly on the data sheet (Appendix 2). **If an adult bird was detected on the same territory in three or more visits during intensive area searches, it was determined a presumed breeder**, and it was thus included in the total number of presumed breeding territories regardless of direct evidence of nesting. The only exceptions to this rule, for the purpose of this study, were repeated sightings of Yellow-billed Cuckoo and Willow Flycatcher, both of which breed later than most other landbirds in the study area, and they are known to also occur as vagrants in the study area. These species are surveyed separately for the

LCR MSCP using single-species survey protocols that were not included in our study. Therefore, all individuals of these species observed in our surveys were classified as presumed non-breeders, unless direct evidence of nesting was observed (Appendix 2).

If a flock was observed, its location was circled on the survey map and number of individuals was recorded on the data sheet. Birds were recorded at the site of first detection as either a pair, male, female, individual of unknown sex/age, fly-over (i.e., a bird flying over but not landing in the plot), or incidental (i.e., a bird seen outside the plot in the general area – same as a casual observation).

#### *A. Rapid Area Searches*

In their implementation, rapid and intensive area searches differed primarily in the amount of data that were recorded for species that are not covered by the LCR MSCP, and the number of visits to the plot. Rapid area searches occurred in two visits spaced by at least four weeks, with the first round of visits to all plots in late April through May, and the second round in June, 2008. If LCR MSCP covered species were found during a rapid area search, surveyors mapped their locations, delineated their territories, and marked locations of the nest or group of dependent young, if found. For all other species, the surveyors focused their efforts on getting a complete count, avoiding double-counts, and determining which individuals were in or out of the plot based on the centroid of the polygon describing their activity. In rapid area searches, territories of covered species were delineated to the best of the surveyor's ability during the two visits. However, in some cases, the breeding status of a bird could not be determined in just two visits, in which case they were classified as presumed non-breeders. Therefore, the conservative measure of covered species breeding territories in rapid area search plots that is presented in this report includes only territories in which positive breeding evidence was found.

#### *B. Intensive Area Searches*

Intensive area searches were conducted on a subset of system-wide rapid area search plots and on post-development habitat creations sites, for which detailed information was needed. Intensive area search plots were visited weekly for a total of eight visits. All territories (covered and non-covered species) were delineated and nest searches conducted for all species to the extent possible, with primary focus on covered species. The knowledge of territory locations from previous visits was used in a cumulative fashion to arrive at a total territory count at the end of the season. For this, the surveyor used the hand-drawn maps from previous visits to the plot to confirm known territory locations and territory boundaries, and to add previously undetected, or poorly delineated, territories with each visit. With the intensive approach, breeding status of individuals could be determined with much greater accuracy than was possible in rapid area searches. At the last visit, the surveyors could determine with significant confidence how many breeding territories were active on the plot during the survey period and which individuals were only visiting the plot, but not breeding.

For breeding evidence, the highest-ranking evidence was recorded, with priority given to evidence that positively confirmed breeding, such as the finding of an active nest or dependent young, or observations of adults carrying nest material, food, or fecal sacs (Appendix 3; for complete methods, see Floyd et al. 2007). “Probable” breeding evidence, such as repeated calling near a particular location, was recorded when breeding could not be otherwise confirmed in order to allow the surveyor to confirm nesting during a later visit. At the end of the season, breeding was either confirmed by direct evidence, or adult birds were also classified as presumed breeders (except Yellow-billed Cuckoo and Willow Flycatcher, see above), if they were observed three or more times in the same territory displaying breeding-related behavior. At the end of the season, the surveyor determined the final locations and layouts of breeding territories within the plot (Appendix 2). For this, all maps drafted during intensive area searches were combined into a final map of territories for a plot using the cumulative data from all visits to determine total number of territories by species.

### ***3. Double-Sampling***

All rapid bird survey techniques may result in biased estimates of birds who are less detectable than others. For instance, densities of birds who have a soft song, vocalize rarely, behave secretively, or show strong seasonal changes in detectability, may be systematically underestimated in a rapid survey technique. Also, birds who are temporarily undetectable, such as those sitting quietly on a nest or having departed the area for long foraging bouts, may be missed entirely. To obtain an estimate of effect size of this bias, intensive and rapid area searches can be used in a double-sampling approach. For this, a surveyor other than the one conducting intensive area searches visits the intensive area search plot to conduct a standard rapid area search without any prior knowledge of the plot and its birds. Using the detections during the rapid area search and the actual number of territories present on the plot, as determined in the intensive area search effort, the detection ratio of each species present can be estimated. Details on how detection ratios are derived can be reviewed in Bart and Earnst (2002) and Bart (2007). During the 2008 season of system-wide bird surveys along the Lower Colorado River, we expended 36% of our total effort on intensive surveys, which exceeds the recommendation of 25-30% of minimum effort spent on intensive surveys for the purpose of double-sampling (Bart and Earnst 2002). Double-sampling was only done on system-wide survey plots, but not on habitat creation sites. There is no known minimum sample size requirement for double-sampling.

### ***4. Data Analyses***

The data presented in this report are summarized, and more detailed analyses were, for the purpose of this progress report, restricted to the calculation of detection ratios and resulting system-wide population size estimates. For all intensive area searches, the data were summarized in two ways, by reporting (1) the total number of confirmed breeding territories based on season-end summaries, and (2) the average number of presumed non-breeding individuals observed per visit. For the latter, all detections of individuals that

were not part of a mated and nesting pair were averaged across all visits, excluding flyovers (which are presumed not to use the plot) and incidental sightings from outside the plot. In this report, flyovers and incidental sightings were only included in species lists, and were excluded from all quantitative analyses. For reporting the results of rapid area searches, we averaged all detections for both visits by species. Territories of covered species detected in system-wide rapid area searches were tallied. These totals represent a conservative estimate of number of territories present, as they were based on only two visits to the plots.

Detection rates can be calculated using the methods of Thompson (1992), edited by Bart and Earnst (2002). A detailed explanation of the formulas is provided in Bart (2007). For this effort, both breeding and non-breeding adults are included when calculating detection ratios. For the purpose of this report, we used the methods published in Earnst and Bart (2002) to calculate the detection ratios for the covered species detected in the system-wide intensive area searches, but we withheld further analyses of the double-sampling data of 2008 as a software program is currently under development to automate the calculation of detection ratios. We expect to be able to analyze the 2008 data with this program in the coming months. For the ten most abundant species detected in 2008, which did not include the covered species, we used the overall detection ratio of 0.93 reported for system-wide surveys on the Lower Colorado River by Bart (2007). Finally, we calculated population size estimates for the covered and ten most abundant species by stratum (Table 3) using this detection ratio. Since not all strata were surveyed in 2008 (see Study Area and System-Wide Sampling Plan, above), the overall population size estimate by species should be considered a minimum population size estimate for the river.

### *5. Habitat Assessments for Covered Species*

Field assessments to describe habitats used by covered species in greater detail than was possible in 2007 were begun as part of the 2008 field season of LCR MSCP system-wide bird monitoring. For habitat assessments, we have a two-year goal of assessing 20 territories per covered species, if possible based on the species' rarity, paired up with 20 non-use sites from the same geographic and habitat stratum (Bart 2007). Much of the natural history and habitat use of the covered species has been described in previous studies and data reviews, (e.g., BR 2008).

According to our 2008 system-wide surveys and Bart (2007), only three of the six covered species may be common enough in the system to allow for this sample size goal: Bell's Vireo, Yellow Warbler, and Gila Woodpecker. There may be a possibility of finding enough Summer Tanager territories over the two-year project to arrive at a reasonable sample size. Vermilion Flycatcher and Glided Flicker, though, are rare enough in the system, that this sample size goal is likely set too high for them, unless areas outside the LCR MSCP project area can be included for habitat analyses.

We used a combination of landscape variable assessment, basic characterization of the vegetation cover types, and a microhabitat description with a point intercept method. This

follows an earlier, rapid habitat assessment protocol implemented by USGS in 2007, for which this more extensive protocol is designed to provide complementary information. We conducted habitat assessments during the breeding season, and we completed additional habitat assessments in the last two weeks of September 2008. In all, we completed a total of 48 assessments for 2008. The 2008 habitat assessment efforts mostly focused on Yellow Warbler and Bell's Vireo. The effort to reach our desired sample sizes for habitat analyses will continue in 2009, with preliminary analyses planned for Yellow Warbler and Bell's Vireo in the winter of 2008/2009. The protocol for habitat assessments can be reviewed in Appendix 4.

## Results

### *1. Overall Species Richness Patterns*

A total of 158 species of birds were detected in all surveys along the Lower Colorado River in 2008 (Appendix 5). All LCR MSCP covered species subject to this monitoring effort, except the Gilded Flicker, were detected in at least one site, and the Clapper Rail, Yellow-billed Cuckoo, and Willow Flycatcher were also recorded (all scientific species names in Appendix 5). A total of 139 species were recorded in system-wide surveys, compared with 104 species in habitat creation site surveys. Species that were unique to habitat creation sites were largely migrant species, such as Rufous Hummingbird and Black-throated Gray Warbler. Species that were unique to system-wide survey plots included (1) migrant species, such as Plumbeous Vireo and Hammond's Flycatcher, (2) species associated with old-growth riparian trees, such as Gila Woodpecker and House Wren, (3) upland species, such as Cactus Wren and Black-throated Sparrow, and (4) water- and marshbirds, such as Sora, Marsh Wren, and a variety of duck species (Appendix 5).

### *2. System-Wide Surveys*

#### *A. Rapid Area Searches*

During system-wide rapid area searches, we recorded 7943 adults of 147 species system-wide (Table 5). The most common of the covered species was Bell's Vireo, the rarest was Vermilion Flycatcher, and Gilded Flickers were absent during all surveys. Other LCR MSCP covered species detected during the rapid surveys included Clapper Rail and Yellow-billed Cuckoo.

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**Table 5.** System-wide averages of detections, by species, from rapid area searches of 70 plots. Listed in descending order of abundance.

<b>Species</b>	<b>Average</b>
Gambel's Quail	339
Mourning Dove	294.5
Red-winged Blackbird	234
Verdin	230
White-winged Dove	226.5
Black-tailed Gnatcatcher	210.5
Brown-headed Cowbird	158
Song Sparrow	151.5
Yellow-breasted Chat	148.5
Common Yellowthroat	147.5
Great-tailed Grackle	146
Abert's Towhee	134
Lucy's Warbler	113.5
Ash-throated Flycatcher	91.5
Northern Rough-winged Swallow	75.5
House Finch	75
Lesser Nighthawk	74.5
Bell's Vireo*	64.5
Cliff Swallow	63.5
Blue Grosbeak	53.5
Wilson's Warbler	53.5
Black-throated Sparrow	49
Yellow-headed Blackbird	44.5
Ladder-backed Woodpecker	40.5
Yellow Warbler*	40
Phainopepla	38
American Coot	35
Western Kingbird	31
Rock Wren	29.5
Horned Lark	29
Black-chinned Hummingbird	24
Gila Woodpecker	24
Mallard	17
Turkey Vulture	17
Common Raven	16.5
Crissal Thrasher	16
Bullock's Oriole	15.5
Eurasian Collared-Dove	14
House Wren	14
Killdeer	14
Marsh Wren	14
Anna's Hummingbird	13.5
Hummingbird spp.	13.5
Loggerhead Shrike	13
Warbling Vireo	13



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<b>Species</b>	<b>Average</b>
Bewick's Wren	12.5
European Starling	12.5
Brown-crested Flycatcher	11.5
Say's Phoebe	11.5
Black Phoebe	10
MacGillivray's Warbler	9
Greater Roadrunner	8.5
Western Wood-Pewee	8.5
Blue-gray Gnatcatcher	8
Canyon Wren	7.5
Pied-billed Grebe	7.5
Brewer's Sparrow	7
Sparrow spp.	7
Green Heron	6.5
House Sparrow	6.5
Western Flycatcher spp.	6.5
Black-headed Grosbeak	6
Goldfinch spp.	6
Lesser Goldfinch	6
Northern Mockingbird	6
Eared Grebe	5.5
Ruddy Duck	5.5
Summer Tanager*	5.5
Bank Swallow	5
Great Blue Heron	5
White-crowned Sparrow	5
Empidonax spp.	4.5
Western Tanager	4.5
Clark's Grebe	4
Gray Vireo	4
Northern Flicker	4
Black-crowned Night-Heron	3.5
Clapper Rail*	3.5
Flicker spp.	3.5
Hooded Oriole	3.5
Gray Flycatcher	3
Least Bittern	3
Lincoln's Sparrow	3
American Kestrel	2.5
Black-necked Stilt	2.5
Chipping Sparrow	2.5
Common Ground-Dove	2.5
Common Moorhen	2.5
Olive-sided Flycatcher	2.5
Oriole spp.	2.5
Snowy Egret	2.5
Willow Flycatcher	2.5
Townsend's Warbler	2.5
Yellow-rumped Warbler	2.5

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<b>Species</b>	<b>Average</b>
Great Egret	2
Orange-crowned Warbler	2
Violet-green Swallow	2
American Robin	1.5
Bendire's Thrasher	1.5
Cactus Wren	1.5
Dove spp.	1.5
Great Horned Owl	1.5
Northern Shoveler	1.5
Peregrine Falcon	1.5
Swainson's Thrush	1.5
Tanager spp.	1.5
Thrasher spp.	1.5
Vermilion Flycatcher*	1.5
White-breasted Nuthatch	1.5
American Goldfinch	1
Barn Swallow	1
Double-crested Cormorant	1
Gnatcatcher spp.	1
Nashville Warbler	1
Pacific-slope Flycatcher	1
Red-tailed Hawk	1
Sora	1
Virginia Rail	1
Yellow-billed Cuckoo*	1
Black-throated Gray Warbler	0.5
Cordilleran Flycatcher	0.5
Green-tailed Towhee	0.5
Hammond's Flycatcher	0.5
Hermit Thrush	0.5
Indigo Bunting	0.5
Lark Sparrow	0.5
Lazuli Bunting	0.5
Le Conte's Thrasher	0.5
Northern Harrier	0.5
Osprey	0.5
Plumbeous Vireo	0.5
Sharp-shinned Hawk	0.5
Solitary Vireo spp.	0.5
Swallow spp.	0.5
Tree Swallow	0.5
Wren spp.	0.5

\*LCR MSCP covered species

Of the covered species detected during system-wide rapid area searches, the Bell's Vireo was most commonly found as a breeder (Table 6). Vermilion Flycatcher and Summer Tanager were the rarest breeders, and Gilded Flicker was absent.

**Table 6.** Total number of territories of LCR MSCP covered species detected during system-wide rapid area searches in 2008.

<b>Species</b>	<b>Total</b>
Bell's Vireo	39
Yellow Warbler	17
Gila Woodpecker	5
Vermilion Flycatcher	1
Summer Tanager	1

*B. Intensive Area Searches*

During system-wide intensive area searches, we recorded 362 adults of 45 species. We found four of the covered species breeding in the system-wide intensive area search plots (Table 7). When dividing the survey period into two halves (Period 1: late April through May, Period 2: June), seasonal effects were obvious in number of non-breeding individuals detected for covered species. The total number of presumed breeding adults was similar throughout the season in all covered species, but the number of non-breeding adult Yellow Warblers in Period 1 was almost triple that of Period 2 (Table 8).

**Table 7.** Total number of territories by species detected during system-wide intensive area searches, 2008. Listed in descending order of abundance.

<b>Species</b>	<b>Number of Territories</b>
Yellow-breasted Chat	61
Song Sparrow	54
Yellow Warbler*	29
Common Yellowthroat	24
Bell's Vireo*	21
White-winged Dove	17
Black-tailed Gnatcatcher	16
Lucy's Warbler	16
Verdin	16
Abert's Towhee	14
Gambel's Quail	14
Mourning Dove	14
Ash-throated Flycatcher	7
Gila Woodpecker*	6
Lesser Nighthawk	6
Ladder-backed Woodpecker	5
Brown-headed Cowbird	4
Great-tailed Grackle	3
Summer Tanager*	3
Bewick's Wren	2

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<b>Species</b>	<b>Number of Territories</b>
Brown-crested Flycatcher	2
Eurasian Collared Dove	2
House Finch	2
Killdeer	2
Phainopepla	2
Tree Swallow	2
American Kestrel	1
Black-chinned Hummingbird	1
Blue Grosbeak	1
Canyon Wren	1
Cliff Swallow	1
Common Raven	1
Crissal Thrasher	1
Eared Grebe	1
Hooded Oriole	1
House Sparrow	1
Loggerhead Shrike	1
Mallard	1
Red-winged Blackbird	1
Say's Phoebe	1
Spotted Sandpiper	1
Warbling Vireo	1
Western Flycatcher spp.	1
Yellow-headed Blackbird	1

\* LCR MSCP covered species

**Table 8.** Total number of adults detected in Period 1 and Period 2 on system-wide intensive area search plots, including both rapid and intensive area searches, in 2008.

<b>System-wide Intensive Surveys</b>	<b>Period 1</b>	<b>Period 2</b>
<b>Bell's Vireo</b>		
Intensive surveys (presumed breeders)	20	20
Intensive surveys (non-breeders)	4	2
<b>Yellow Warbler</b>		
Intensive surveys (presumed breeders)	27	24
Intensive surveys (non-breeders)	23	8
<b>Gila Woodpecker</b>		
Intensive surveys (presumed breeders)	6	6
Intensive surveys (non-breeders)	4	4
<b>Summer Tanager</b>		
Intensive surveys (presumed breeders)	3	2
Intensive surveys (non-breeders)	3	5

*C. System-Wide Population Size Estimates*

When applying the detection ratio of 0.93 to the covered species and calculating population size estimates for the strata surveyed in 2008, we estimate a minimum population size of more than 6,800 Bell’s Vireos, more than 5,100 Yellow Warblers, more than 1,700 Gila Woodpeckers, and more than 1,100 Summer Tanagers system-wide (Table 9). However, the selection of survey sites was part of a larger pool of randomly-selected plots (160 plots for both 2007 and 2008), and the portion of this pool surveyed in 2008 was likely a non-random portion of the sample. Therefore, because the data from the plots surveyed in 2007 were not available at the time of this report, the population size estimates reported here should be viewed with caution. The remaining two covered species, Vermilion Flycatcher and Gilded Flicker, were too rare (or absent, in the latter case) to be subjected to detection ratio calculations.

While Bell’s Vireo had the highest estimated population size system-wide, Yellow Warbler occurred in more strata than Bell’s Vireo (8 and 6, respectively, of a total of 25 strata surveyed). Summer Tanager occurred in the lowest number of strata (4), and Gila Woodpecker occurred in 5. The number of strata occupied by the species suggests how widespread the species is system-wide; however, several strata were not surveyed in 2008 (Table 9). Therefore, to determine how widespread a species is system-wide, ideally, all data from the first three years of this inventory should be pooled.

**Table 9.** Estimated minimum population sizes of covered species, by stratum, based on system-wide surveys completed in 2008. Strata combinations are listed as geographic stratum first, habitat stratum second, separated by a period. For details on strata definitions, see methods. Dashes indicate strata that were not surveyed in 2008. Strata combinations that are not listed were empty (no habitat in that geographic stratum).

<b>Stratum: Geographic.Habitat</b>	<b>Bell's Vireo</b>	<b>Yellow Warbler</b>	<b>Gila Wood- pecker</b>	<b>Summer Tanager</b>
1.0	-	-	-	-
1.1	-	-	-	-
1.2	-	-	-	-
1.3	-	-	-	-
1.4	-	-	-	-
1.5	-	-	-	-
2.0	-	-	-	-
2.1	-	-	-	-
2.2	-	-	-	-
2.3	-	-	-	-
2.4	-	-	-	-
2.5	-	-	-	-
3.0	0	0	0	0
3.3	0	0	0	0
3.4	0	736	0	0

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Stratum: Geographic.Habitat	Bell's Vireo	Yellow Warbler	Gila Wood- pecker	Summer Tanager
3.5	-	-	-	-
4.0	0	143	0	0
4.1	184	133	0	0
4.3	-	-	-	-
4.4	139	52	0	0
5.0	0	0	0	0
5.1	-	-	-	-
5.2	-	-	-	-
5.3	0	0	0	0
5.4	-	-	-	-
5.5	0	21	0	0
6.0	-	-	-	-
6.1	-	-	-	-
6.3	-	-	-	-
6.4	-	-	-	-
6.5	-	-	-	-
7.0	0	0	0	0
7.1	1507	803	436	156
7.2	-	-	-	-
7.3	116	0	5	0
7.4	4154	3031	1227	532
7.5	0	0	0	0
8.0	-	-	-	-
8.1	-	-	-	-
8.3	-	-	-	-
8.4	-	-	-	-
8.5	-	-	-	-
9.0	-	-	-	-
9.1	-	-	-	-
9.2	-	-	-	-
9.3	-	-	-	-
9.4	-	-	-	-
9.5	-	-	-	-
10.0	-	-	-	-
10.1	0	0	0	0
10.2	-	-	-	-
10.3	0	0	0	0
10.4	0	0	0	0
10.5	-	-	-	-
11.0	0	0	0	0
11.1	-	-	-	-
11.2	0	0	4	0
11.3	760	215	0	430
11.4	0	0	0	0
11.5	0	0	0	80
12.0	0	0	0	0
12.1	0	0	49	0

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Stratum: Geographic.Habitat	Bell's Vireo	Yellow Warbler	Gila Wood- pecker	Summer Tanager
12.2	0	0	31	0
12.3	0	0	0	0
12.4	0	0	0	0
12.5	-	-	-	-
13.0	-	-	-	-
13.1	-	-	-	-
13.2	-	-	-	-
13.3	-	-	-	-
13.4	-	-	-	-
13.5	-	-	-	-
<b>Total</b>	<b>6859</b>	<b>5134</b>	<b>1752</b>	<b>1197</b>

For the ten most abundant species system-wide, we calculated population size estimates using the same methods as for covered species (Table 10). Based on the 2008 data, the most common species were Mourning Dove and Red-winged Blackbird with > 60,000 individuals estimated to be present system-wide during the breeding season. Compared with the covered species, the ten most abundant species were also widespread through the project area, with most of them being present in > 12 of the 25 strata surveyed in 2008.

**Table 10.** Estimated minimum population sizes of the ten most abundant species along the Lower Colorado River, by stratum, based on system-wide surveys completed in 2008. Dashes indicate strata that were not surveyed in 2008. For details on strata definitions, see methods.

Strata (Geo- graphic. Habitat)	Brown-headed Cowbird	Black-tailed Gnatcatcher	Common Yellowthroat	Gambel's Quail	Great-tailed Grackle	Mourning Dove	Red-winged Blackbird	Song Sparrow	White-winged Dove	Yellow-breasted Chat
1.0	-	-	-	-	-	-	-	-	-	-
1.1	-	-	-	-	-	-	-	-	-	-
1.2	-	-	-	-	-	-	-	-	-	-
1.3	-	-	-	-	-	-	-	-	-	-
1.4	-	-	-	-	-	-	-	-	-	-
1.5	-	-	-	-	-	-	-	-	-	-
2.0	-	-	-	-	-	-	-	-	-	-
2.1	-	-	-	-	-	-	-	-	-	-
2.2	-	-	-	-	-	-	-	-	-	-
2.3	-	-	-	-	-	-	-	-	-	-
2.4	-	-	-	-	-	-	-	-	-	-
2.5	-	-	-	-	-	-	-	-	-	-
3.0	0	6120	0	1019	0	14277	0	0	0	0
3.3	19	0	0	71	0	498	0	0	0	0

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Strata (Geo- graphic Habitat)	Brown-headed Cowbird	Black-tailed Gnatcatcher	Common Yellowthroat	Gambel's Quail	Great-tailed Grackle	Mourning Dove	Red-winged Blackbird	Song Sparrow	White-winged Dove	Yellow-breasted Chat
3.4	0	0	466	2403	0	3139	466	0	0	0
3.5	-	-	-	-	-	-	-	-	-	-
4.0	0	701	0	143	0	2284	430	0	351	0
4.1	269	358	30	97	478	161	52	31	52	21
4.3	-	-	-	-	-	-	-	-	-	-
4.4	0	1456	121	0	1162	277	208	0	0	69
5.0	2294	0	765	4588	0	0	3058	382	0	0
5.1	-	-	-	-	-	-	-	-	-	-
5.2	-	-	-	-	-	-	-	-	-	-
5.3	5761	6790	0	8359	4099	4302	451	225	0	0
5.4	-	-	-	-	-	-	-	-	-	-
5.5	43	21	54	0	301	0	21	32	0	0
6.0	-	-	-	-	-	-	-	-	-	-
6.1	-	-	-	-	-	-	-	-	-	-
6.3	-	-	-	-	-	-	-	-	-	-
6.4	-	-	-	-	-	-	-	-	-	-
6.5	-	-	-	-	-	-	-	-	-	-
7.0	-	-	-	-	-	-	-	-	-	-
7.1	843	405	2015	454	0	1338	0	4714	158	3394
7.2	-	-	-	-	-	-	-	-	-	-
7.3	712	119	178	868	964	949	340	475	443	274
7.4	2345	1600	4581	5713	0	12589	1386	4680	5112	4849
7.5	9	0	121	0	26	0	181	17	0	26
8.0	-	-	-	-	-	-	-	-	-	-
8.1	-	-	-	-	-	-	-	-	-	-
8.3	-	-	-	-	-	-	-	-	-	-
8.4	-	-	-	-	-	-	-	-	-	-
8.5	-	-	-	-	-	-	-	-	-	-
9.0	-	-	-	-	-	-	-	-	-	-
9.1	-	-	-	-	-	-	-	-	-	-
9.2	-	-	-	-	-	-	-	-	-	-
9.3	-	-	-	-	-	-	-	-	-	-
9.4	-	-	-	-	-	-	-	-	-	-
9.5	-	-	-	-	-	-	-	-	-	-
10.0	-	-	-	-	-	-	-	-	-	-
10.1	19	0	14	0	0	0	0	34	38	53
10.2	-	-	-	-	-	-	-	-	-	-
10.3	2655	808	1950	647	6427	6884	40556	323	5072	784
10.4	-	-	-	-	-	-	-	-	-	-
10.5	-	-	-	-	-	-	-	-	-	-
11.0	359	239	120	1078	958	1078	0	0	599	120
11.1	-	-	-	-	-	-	-	-	-	-
11.2	0	39	0	15	0	15	0	0	8	0



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Strata (Geo- graphic, Habitat)	Brown-headed Cowbird	Black-tailed Gnatcatcher	Common Yellowthroat	Gambel's Quail	Great-tailed Grackle	Mourning Dove	Red-winged Blackbird	Song Sparrow	White-winged Dove	Yellow-breasted Chat
11.3	3061	2712	10734	3110	1510	9209	1920	3959	11231	6096
11.4	0	0	0	0	0	0	0	0	172	0
11.5	1037	479	3670	0	1197	1117	0	4308	718	1915
12.0	59	236	0	236	0	118	59	0	236	0
12.1	2727	449	1769	512	731	3442	3988	370	2810	308
12.2	0	0	15	0	0	15	0	0	46	0
12.3	1909	0	983	0	492	4613	3934	246	5869	0
12.4	0	0	321	107	1605	750	4502	0	1659	0
12.5	-	-	-	-	-	-	-	-	-	-
13.0	-	-	-	-	-	-	-	-	-	-
13.1	-	-	-	-	-	-	-	-	-	-
13.2	-	-	-	-	-	-	-	-	-	-
13.3	-	-	-	-	-	-	-	-	-	-
13.4	-	-	-	-	-	-	-	-	-	-
13.5	-	-	-	-	-	-	-	-	-	-
<b>Total</b>	<b>24121</b>	<b>22533</b>	<b>27908</b>	<b>29421</b>	<b>19950</b>	<b>67056</b>	<b>61553</b>	<b>19797</b>	<b>34574</b>	<b>17909</b>

### 3. Habitat Creation Sites

During intensive area searches on 17 plots in habitat creation sites, we recorded 231 breeding territories of 32 species. Four of our six covered species, Bell's Vireo, Yellow Warbler, Summer Tanager, and Vermilion Flycatcher, were recorded as presumed or confirmed breeders in post-development habitat creation sites (Table 11). Gila Woodpecker and Gilded Flickers were not recorded in the habitat creation sites. The number of territories detected in intensive area searches on habitat creation sites are listed by species in Table 11, and the number of non-breeding individuals detected in intensive area searches on habitat creation sites are listed, by species, in Table 12.

We found no covered species in the nine rapid area search plots on habitat creation sites, which were done on pre-development and first-season planting sites. On these plots, we recorded 1267 individuals of 51 species. The average numbers of detections in rapid area searches on habitat creation sites are listed, by species, in Table 13.

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**Table 11.** Total number of territories, by species, detected in intensive area searches on habitat creation plots in 2008. Listed in alphabetical order. Parentheses indicate species that were detected at least three times in same area, but breeding was not confirmed.

<b>Species</b>	<b>Number of Territories</b>
Abert's Towhee	28
Anna's Hummingbird	1
Bell's Vireo*	4
Black-chinned Hummingbird	1
Black-tailed Gnatcatcher	2
Blue Grosbeak	37
Brown-headed Cowbird	7
Bullock's Oriole	10
Common Yellowthroat	12
Crissal Thrasher	1
Gambel's Quail	6
Greater Roadrunner	1
House Finch	8
Lucy's Warbler	5
Mallard	1
Mourning Dove	27
Northern Harrier	1
Northern Mockingbird	1
Phainopepla	1
Say's Phoebe	1
Song Sparrow	25
(Willow Flycatcher)**	3
Summer Tanager*	1
Verdin	10
Vermilion Flycatcher*	2
Warbling Vireo	2
Western Kingbird	7
White-tailed Kite	2
White-winged Dove	5
Yellow Warbler*	9
(Yellow-billed Cuckoo*)**	1
Yellow-breasted Chat	7
<b>Total</b>	<b>231</b>

\* LCR MSCP covered species

\*\* breeding not confirmed

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**Table 12.** Average number of non-breeding individuals recorded in intensive area searches on habitat creation plots. Listed in descending order of abundance.

<b>Species</b>	<b>Total</b>	<b>Average</b>
Red-winged Blackbird	731	5.4
Mourning Dove	285	2.1
Brown-headed Cowbird	279	2.1
Wilson's Warbler	242	1.8
White-winged Dove	215	1.6
House Finch	191	1.4
Great-tailed Grackle	188	1.4
Abert's Towhee	102	0.8
Gambel's Quail	101	0.8
Empidonax spp.	98	0.7
Pacific-slope Flycatcher	97	0.7
Western Kingbird	97	0.7
European Starling	77	0.6
Hummingbird spp.	70	0.5
Western Wood-Pewee	64	0.5
Verdin	62	0.5
Black-chinned Hummingbird	60	0.4
Ash-throated Flycatcher	56	0.4
Lucy's Warbler	49	0.4
Blue Grosbeak	44	0.3
Warbling Vireo	38	0.3
Cliff Swallow	36	0.3
Willow Flycatcher	32	0.2
Yellow Warbler**	24	0.2
Townsend's Warbler	21	0.2
Common Yellowthroat	19	0.1
Bullock's Oriole	18	0.1
Western Tanager	17	0.1
Anna's Hummingbird	16	0.1
Western Flycatcher spp.	16	0.1
Yellow-breasted Chat	16	0.1
Phainopepla	15	0.1
Killdeer	14	0.1
Northern Rough-winged Swallow	14	0.1
Song Sparrow	14	0.1
Black-tailed Gnatcatcher	12	0.1
Ladder-backed Woodpecker	11	0.1
Tree Swallow	10	0.1
Greater Roadrunner	9	0.1
Yellow-headed Blackbird	9	0.1
Vermilion Flycatcher**	8	0.1
American Kestrel	7	0.1
Brewer's Blackbird	7	0.1

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<b>Species</b>	<b>Total</b>	<b>Average</b>
Olive-sided Flycatcher	6	0.0
White-crowned Sparrow	6	0.0
Bell's Vireo**	5	0.0
Black-headed Grosbeak	5	0.0
Dickcissel	5	0.0
Great Egret	5	0.0
MacGillivray's Warbler	5	0.0
Black Phoebe	4	0.0
Northern Mockingbird	4	0.0
Say's Phoebe	4	0.0
Warbler spp.	4	0.0
Bewick's Wren	3	0.0
Crissal Thrasher	3	0.0
Forster's Tern	3	0.0
Horned Lark	3	0.0
Rufous Hummingbird	3	0.0
Brown-crested Flycatcher	2	0.0
Great Horned Owl	2	0.0
Green Heron	2	0.0
Inca Dove	2	0.0
Lesser Nighthawk	2	0.0
Raptor spp.	2	0.0
Scott's Oriole	2	0.0
Sparrow spp.	2	0.0
Summer Tanager**	2	0.0
Western Meadowlark	2	0.0
White-tailed Kite	2	0.0
Yellow-rumped Warbler	2	0.0
American Bittern	1	0.0
Barn Swallow	1	0.0
Belted Kingfisher	1	0.0
Burrowing Owl	1	0.0
Cassin's Vireo	1	0.0
Common Nighthawk	1	0.0
Great Blue Heron	1	0.0
Hooded Oriole	1	0.0
House Wren	1	0.0
Lazuli Bunting	1	0.0
Loggerhead Shrike	1	0.0
Mallard	1	0.0
Northern Harrier	1	0.0
Tanager spp.	1	0.0
Turkey Vulture	1	0.0
Violet-green Swallow	1	0.0

\*\* LCR MSCP covered species

**Table 13.** Average number of detections, by species, during rapid area searches on habitat creation plots in 2008. Listed in descending order of abundance.

<b>Species</b>	<b>Average</b>
Red-winged Blackbird	341
Mourning Dove	42.5
House Finch	35.5
Yellow-headed Blackbird	33
Brown-headed Cowbird	23.5
Abert's Towhee	21.5
Horned Lark	18.5
Gambel's Quail	17
Cliff Swallow	13
White-winged Dove	12
Blue Grosbeak	7.5
Western Kingbird	6.5
Western Meadowlark	6
Common Yellowthroat	5.5
Great-tailed Grackle	5.5
Killdeer	3.5
Northern Rough-winged Swallow	3.5
Sparrow spp.	3.5
American Pipit	3
Warbling Vireo	3
Hummingbird spp.	2.5
Northern Harrier	2.5
Lucy's Warbler	2
Ash-throated Flycatcher	1.5
Common Ground-Dove	1.5
Song Sparrow	1.5
Wilson's Warbler	1.5
Bank Swallow	1
Black-necked Stilt	1
Black-tailed Gnatcatcher	1
Common Raven	1
Lark Sparrow	1
Long-billed Curlew	1
Say's Phoebe	1
Verdin	1
Yellow-breasted Chat	1
American Kestrel	0.5
Anna's Hummingbird	0.5
Bullock's Oriole	0.5
Burrowing Owl	0.5
Cattle Egret	0.5
Empidonax spp.	0.5
Great Blue Heron	0.5

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<b>Species</b>	<b>Average</b>
Greater Roadrunner	0.5
Lesser Nighthawk	0.5
Olive-sided Flycatcher	0.5
Pacific-slope Flycatcher	0.5
Phainopepla	0.5
Willow Flycatcher	0.5
Townsend's Warbler	0.5
Vireo spp.	0.5

\* LCR MSCP covered species

**Beal Lake Riparian Habitat Creation Site**

In the Beal Lake Riparian Habitat Creation site, intensive area searches in four plots resulted in 57 confirmed breeding territories and 500 sightings of non-breeding individuals (Tables 14 and 15). Bell’s Vireos were found breeding in Beal B, C, and D, Yellow Warblers in Beal B and C, and a Yellow-billed Cuckoo was repeatedly detected in Beal C (Table 14).

**Table 14.** Number of territories by species detected in Beal Lake intensive area search plots in 2008. Listed in alphabetical order. Parentheses indicate covered species that were present at least in three area searches, but that are presumed non-breeders.

Species	Number of Territories				Total Beal
	Beal A	Beal B	Beal C	Beal D	
Abert's Towhee	1	2	3	2	8
Bell's Vireo*		1	1	1	3
Black-chinned Hummingbird			1		1
Black-tailed Gnatcatcher		2			2
Blue Grosbeak		3	5	1	9
Brown-headed Cowbird		1			1
Bullock's Oriole			1		1
Crissal Thrasher			1		1
Gambel's Quail	1	1		1	3
Greater Roadrunner				1	1
Lucy's Warbler	1			1	2
Mourning Dove		3			3
Song Sparrow	2	2	2		6
Verdin	1	1	2	2	6
Western Kingbird				1	1
White-winged Dove		1			1
Yellow Warbler*		1	1		2
(Yellow-billed Cuckoo*)			1		1
Yellow-breasted Chat	3	2			5
<b>Total</b>	<b>9</b>	<b>20</b>	<b>18</b>	<b>10</b>	<b>57</b>

\* LCR MSCP covered species

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**Table 15.** Average number of non-breeding individuals, by species, detected in intensive area searches at Beal Lake habitat creation plots in 2008. Listed in descending order of abundance.

Species	Beal A	Beal B	Beal C	Beal D	BEAL Total Detections	BEAL Average
Great-tailed Grackle	2.3	5.0	7.9	0.3	123	3.1
Mourning Dove	4.0	1.8	1.6	1.0	67	1.7
Gambel's Quail	4.0	0.3	1.3	0.3	46	1.2
Red-winged Blackbird	1.3	0.0	2.4	1.3	39	1.0
Lucy's Warbler	0.0	1.0	3.6	0.0	37	0.9
Brown-headed Cowbird	0.5	0.6	0.4	0.1	13	0.3
Wilson's Warbler	0.1	1.0	0.1	0.3	12	0.3
House Finch	0.1	0.6	0.6	0.0	11	0.3
Cliff Swallow	0.3	1.0	0.0	0.0	10	0.3
Tree Swallow	0.0	0.0	1.3	0.0	10	0.3
Black-tailed Gnatcatcher	0.3	0.0	0.5	0.4	9	0.2
Verdin	0.0	0.6	0.5	0.0	9	0.2
Western Kingbird	0.1	0.5	0.5	0.0	9	0.2
Yellow Warbler**	0.6	0.0	0.3	0.3	9	0.2
Ash-throated Flycatcher	0.1	0.1	0.6	0.1	8	0.2
Common Yellowthroat	0.0	0.0	0.8	0.0	6	0.2
Willow Flycatcher	0.0	0.3	0.4	0.1	6	0.2
Abert's Towhee	0.5	0.0	0.1	0.0	5	0.1
Pacific-slope Flycatcher	0.1	0.1	0.4	0.0	5	0.1
Bullock's Oriole	0.0	0.5	0.0	0.0	4	0.1
Greater Roadrunner	0.3	0.0	0.3	0.0	4	0.1
Ladder-backed Woodpecker	0.0	0.3	0.3	0.0	4	0.1
White-winged Dove	0.1	0.0	0.4	0.0	4	0.1
Bell's Vireo**	0.4	0.0	0.0	0.0	3	0.1
Bewick's Wren	0.1	0.1	0.0	0.1	3	0.1
Blue Grosbeak	0.3	0.0	0.0	0.1	3	0.1
Forster's Tern	0.4	0.0	0.0	0.0	3	0.1
Northern Rough-winged Swallow	0.0	0.0	0.4	0.0	3	0.1
Song Sparrow	0.0	0.4	0.0	0.0	3	0.1
American Kestrel	0.0	0.1	0.0	0.1	2	0.1
Brown-crested Flycatcher	0.0	0.0	0.3	0.0	2	0.1
Crissal Thrasher	0.0	0.3	0.0	0.0	2	0.1
Empidonax spp.	0.1	0.1	0.0	0.0	2	0.1
Great Egret	0.3	0.0	0.0	0.0	2	0.1
Northern Mockingbird	0.0	0.3	0.0	0.0	2	0.1
Say's Phoebe	0.1	0.0	0.0	0.1	2	0.1
Western Wood-Pewee	0.0	0.3	0.0	0.0	2	0.1
Anna's Hummingbird	0.1	0.0	0.0	0.0	1	0.0
Barn Swallow	0.0	0.0	0.1	0.0	1	0.0
Black-chinned Hummingbird	0.0	0.1	0.0	0.0	1	0.0
Great Blue Heron	0.0	0.0	0.1	0.0	1	0.0
Killdeer	0.0	0.0	0.1	0.0	1	0.0
Lazuli Bunting	0.0	0.0	0.1	0.0	1	0.0



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<b>Species</b>	<b>Beal A</b>	<b>Beal B</b>	<b>Beal C</b>	<b>Beal D</b>	<b>BEAL Total Detections</b>	<b>BEAL Average</b>
Lesser Nighthawk	0.0	0.0	0.1	0.0	1	0.0
Loggerhead Shrike	0.0	0.0	0.1	0.0	1	0.0
Summer Tanager**	0.0	0.0	0.1	0.0	1	0.0
Townsend's Warbler	0.0	0.0	0.1	0.0	1	0.0
Turkey Vulture	0.0	0.0	0.1	0.0	1	0.0
Violet-green Swallow	0.0	0.0	0.0	0.1	1	0.0
Warbling Vireo	0.0	0.0	0.1	0.0	1	0.0
Western-type Flycatcher	0.0	0.0	0.1	0.0	1	0.0
White-crowned Sparrow	0.0	0.0	0.0	0.1	1	0.0
Yellow-breasted Chat	0.0	0.1	0.0	0.0	1	0.0
<b>Total</b>					<b>500</b>	<b>12.5</b>

\*\*LCR MSCP covered species

**Colorado River Indian Tribe (CRIT 9)**

Three intensive area searches in the Colorado River Indian Tribe habitat creation site (CRIT 9) resulted in 47 confirmed breeding territories and 477 detections of non-breeding individuals (Tables 16 and 17). Vermilion Flycatchers were found using mesquite woodlands in CRIT 9 A and Summer Tanagers were using cottonwood-willow habitat in CRIT 9 C.

**Table 16.** Number of breeding territories by species found in Colorado River Indian Tribe (CRIT 9) intensive area search plots in 2008. Listed in alphabetical order.

Species	Number of Territories			Total CRIT 9
	CRIT 9 A	CRIT 9 C	CRIT 9 D	
Abert's Towhee	3	2	2	7
Blue Grosbeak			1	1
Brown-headed Cowbird	4	1	1	6
Bullock's Oriole			1	1
Gambel's Quail	2			2
House Finch	1	1		2
Lucy's Warbler	1		2	3
Mourning Dove	10		5	15
Northern Mockingbird	1			1
Say's Phoebe	1			1
Summer Tanager*		1		1
Verdin	2		1	3
Vermilion Flycatcher*	2			2
White-winged Dove		1		1
<b>Total</b>	<b>27</b>	<b>6</b>	<b>13</b>	<b>47</b>

\* LCR MSCP covered species

**Table 17.** Average number of non-breeding individuals, by species, detected in intensive area searches at Colorado River Indian Tribe (CRIT 9) habitat creation plots in 2008. Listed in descending order of abundance.

Species	CRIT 9 A	CRIT 9 C	CRIT 9 D	CRIT 9 Total Detections	CRIT 9 Average
Mourning Dove	5.5	2.6	3.4	86	2.9
House Finch	2.1	3.1	2.9	59	2.0
White-winged Dove	0.6	1.1	4.1	42	1.5

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Species	CRIT 9 A	CRIT 9 C	CRIT 9 D	CRIT 9 Total Detections	CRIT 9 Average
Wilson's Warbler	1.1	2.6	1.9	40	1.4
Great-tailed Grackle	2.5	0.7	0.3	27	0.9
Gambel's Quail	0.0	0.4	3.1	25	0.9
Ash-throated Flycatcher	0.3	0.7	1.6	18	0.6
Red-winged Blackbird	1.9	0.0	0.0	15	0.5
Western-type Flycatcher	0.0	1.6	0.6	15	0.5
Verdin	0.0	0.6	1.4	14	0.5
Cliff Swallow	0.5	1.1	0.1	13	0.4
Abert's Towhee	0.0	0.6	1.1	12	0.4
Pacific-slope Flycatcher	1.0	0.1	0.3	11	0.4
Bullock's Oriole	0.4	0.6	0.4	10	0.3
Lucy's Warbler	0.0	0.9	0.6	10	0.4
Hummingbird spp.	0.0	1.1	0.1	9	0.3
Willow Flycatcher	0.0	0.1	1.0	8	0.3
Vermilion Flycatcher**	0.0	1.1	0.0	8	0.3
Western Wood-Pewee	0.8	0.3	0.0	8	0.3
Western Tanager	0.4	0.6	0.0	7	0.2
Western Kingbird	0.0	0.9	0.0	6	0.2
Northern Rough-winged Swallow	0.6	0.0	0.0	5	0.2
Warbling Vireo	0.4	0.0	0.1	4	0.1
Yellow-breasted Chat	0.5	0.0	0.0	4	0.1
Black Phoebe	0.0	0.4	0.0	3	0.1
Black-chinned Hummingbird	0.4	0.0	0.0	3	0.1
Great Egret	0.0	0.4	0.0	3	0.1
Ladder-backed Woodpecker	0.1	0.0	0.3	3	0.1
Brown-headed Cowbird	0.3	0.0	0.0	2	0.1
Townsend's Warbler	0.1	0.1	0.0	2	0.1
Anna's Hummingbird	0.0	0.0	0.1	1	0.0
Black-tailed Gnatcatcher	0.1	0.0	0.0	1	0.0
Common Nighthawk	0.0	0.0	0.1	1	0.0
Empidonax spp.	0.0	0.0	0.1	1	0.0
Greater Roadrunner	0.0	0.1	0.0	1	0.0
House Wren	0.0	0.0	0.1	1	0.0
Lesser Nighthawk	0.1	0.0	0.0	1	0.0
MacGillivray's Warbler	0.0	0.0	0.1	1	0.0
Northern Harrier	0.1	0.0	0.0	1	0.0
Say's Phoebe	0.0	0.0	0.1	1	0.0
Tanager spp.	0.0	0.1	0.0	1	0.0
<b>Total</b>				<b>477</b>	<b>16.3</b>

\* observed as a flyover or incidental \*\*LCR MSCP covered species

**Cibola Valley Conservation Area (CVCA)**

Five intensive area searches in the Cibola Valley Conservation Area (CVCA) sites resulted in 62 confirmed breeding territories and a total of 1182 detections of non-breeding individuals (Tables 18 and 19). Only one covered species was found breeding at CVCA, the Yellow Warbler, and Summer Tanager and Willow Flycatcher were detected as presumed non-breeders at this site.

Only 18 species were detected in the three rapid area searches on the pre-development habitat creation plots of CVCA (Table 20). No covered species were detected in the rapid area searches.

**Table 18.** Number of territories by species detected in Cibola Valley Conservation Area (CVCA) intensive area search plots in 2008. Listed in alphabetical order. Parentheses indicate covered species that were present at least in three area searches, but that are presumed non-breeders.

Species	Number of Territories					Total CVCA
	CVCA-1A	CVCA-1B	CVCA-1CD	CVCA3-2	CVCA-3AB	
Abert's Towhee	1	1	3	2	2	9
Blue Grosbeak	4	2	5	3	3	17
Bullock's Oriole	1	1	1			3
Common Yellowthroat	1	1				2
Gambel's Quail			1			1
House Finch	1	1	2			4
Mourning Dove	1		1	1		3
Song Sparrow	3	6	4	1		14
(Willow Flycatcher)**		2				2
Warbling Vireo			1			1
Western Kingbird	1					1
White-winged Dove	1			1		2
Yellow Warbler*		1	2			3
<b>Total</b>	<b>14</b>	<b>15</b>	<b>20</b>	<b>8</b>	<b>5</b>	<b>62</b>

\* LCR MSCP covered species

\*\* breeding not confirmed

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**Table 19.** Average number of non-breeding individuals, by species, detected in intensive area searches at Cibola Valley Conservation Area (CVCA) habitat creation plots in 2008. Listed in descending order of abundance.

Species	CVCA-1A	CVCA-1B	CVCA-1CD	CVCA 3-2	CVCA-3AB	CVCA Total Detections	CVCA Average
Red-winged Blackbird	18.1	10.0	7.0	7.9	4.1	377	7.9
Brown-headed Cowbird	5.5	1.3	1.4	8.0	1.1	138	2.9
Wilson's Warbler	7.1	1.9	1.9	1.6	0.9	107	2.2
White-winged Dove	3.1	0.3	0.8	3.9	0.3	66	1.4
Mourning Dove	2.8	0.3	1.1	2.5	1.5	65	1.4
European Starling	6.3	0.0	0.0	0.0	0.0	50	1.0
Empidonax spp.	3.1	0.0	0.0	3.0	0.0	49	1.0
Pacific-slope Flycatcher	2.8	0.5	0.6	0.6	0.1	37	0.8
Blue Grosbeak	0.4	1.1	0.9	0.3	0.8	27	0.6
House Finch	1.4	0.0	1.5	0.0	0.0	23	0.5
Abert's Towhee	1.5	0.8	0.0	0.3	0.1	21	0.4
Hummingbird spp.	1.3	0.1	0.0	1.1	0.1	21	0.4
Western Wood-Pewee	0.9	0.3	0.4	1.1	0.0	21	0.4
Ash-throated Flycatcher	0.6	0.0	0.8	1.0	0.0	19	0.4
Verdin	1.9	0.0	0.0	0.5	0.0	19	0.4
Gambel's Quail	0.1	0.0	0.0	2.0	0.0	17	0.4
Western Kingbird	0.4	1.0	0.4	0.0	0.0	14	0.3
Black-chinned Hummingbird	0.3	0.0	0.6	0.6	0.1	13	0.3
Warbling Vireo	0.1	0.8	0.3	0.1	0.3	12	0.3
Willow Flycatcher	1.0	0.0	0.1	0.0	0.1	10	0.2
Common Yellowthroat	0.3	0.0	0.3	0.1	0.4	8	0.2
Townsend's Warbler	0.4	0.0	0.0	0.6	0.0	8	0.2
Song Sparrow	0.0	0.0	0.5	0.1	0.3	7	0.1
Yellow Warbler**	0.1	0.6	0.0	0.0	0.0	6	0.1
Dickcissel	0.3	0.0	0.4	0.0	0.0	5	0.1
White-crowned Sparrow	0.5	0.0	0.0	0.0	0.1	5	0.1
Yellow-breasted Chat	0.3	0.0	0.1	0.1	0.0	4	0.1
Greater Roadrunner	0.1	0.1	0.0	0.1	0.0	3	0.1
Horned Lark	0.0	0.0	0.0	0.4	0.0	3	0.1
Olive-sided Flycatcher	0.0	0.1	0.1	0.1	0.0	3	0.1
Warbler spp.	0.4	0.0	0.0	0.0	0.0	3	0.1
Bullock's Oriole	0.1	0.0	0.0	0.1	0.0	2	0.0
Great-tailed Grackle	0.0	0.3	0.0	0.0	0.0	2	0.0
Lucy's Warbler	0.0	0.0	0.3	0.0	0.0	2	0.0
Northern Rough-winged Swallow	0.0	0.0	0.3	0.0	0.0	2	0.0
Yellow-headed Blackbird	0.0	0.1	0.0	0.1	0.0	2	0.0
Yellow-rumped Warbler	0.3	0.0	0.0	0.0	0.0	2	0.0
American Kestrel	0.0	0.0	0.0	0.1	0.0	1	0.0
Burrowing Owl	0.0	0.0	0.0	0.1	0.0	1	0.0
Great Horned Owl	0.0	0.0	0.1	0.0	0.0	1	0.0
Inca Dove	0.0	0.0	0.0	0.0	0.1	1	0.0

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Species	CVCA-1A	CVCA-1B	CVCA-1CD	CVCA3-2	CVCA-3AB	CVCA Total Detections	CVCA Average
Ladder-backed Woodpecker	0.0	0.1	0.0	0.0	0.0	1	0.0
Raptor spp.	0.0	0.0	0.0	0.1	0.0	1	0.0
Summer Tanager**	0.0	0.1	0.0	0.0	0.0	1	0.0
Western Meadowlark	0.1	0.0	0.0	0.0	0.0	1	0.0
Western Tanager	0.1	0.0	0.0	0.0	0.0	1	0.0
<b>Total</b>						<b>1182</b>	<b>24.6</b>

\* observed as a flyover or incidental \*\*LCR MSCP covered species

**Table 20.** Average number of individuals detected, by species, on rapid area search plots at Cibola Valley Conservation Area (CVCA) in 2008. Listed in descending order of abundance.

Species	CVCA 5	CVCA 6	CVCA 2	CVCA Average
Red-winged Blackbird	40.5	5.5	29	25.0
House Finch	0	0	16.5	5.5
Mourning Dove	9	1	3.5	4.5
Brown-headed Cowbird	3.5	0	7.5	3.7
Horned Lark	1.5	0	7	2.8
White-winged Dove	0	0	8	2.7
Sparrow spp.	3.5	0	0	1.2
Abert's Towhee	0	0	2.5	0.8
Hummingbird spp.	0	0	2	0.7
Western Kingbird	0	0	2	0.7
Bank Swallow	1	0	0	0.3
Black-necked Stilt	0	0	1	0.3
Western Meadowlark	0	0	1	0.3
American Kestrel	0	0	0.5	0.2
Anna's Hummingbird	0.5	0	0	0.2
Lesser Nighthawk	0	0	0.5	0.2
Black-tailed Gnatcatcher	0	0	0.5	0.2
Killdeer	0.5	0	0	0.2
Great-tailed Grackle	0	0	0.5	0.2
Blue Grosbeak	0	0	0.5	0.2
<b>Total</b>	<b>60</b>	<b>6.5</b>	<b>82.5</b>	<b>49.7</b>

**Cibola Nature Trail Site**

Three intensive area searches at the Cibola Nature Trail site resulted in 47 confirmed breeding territories and a total of 984 detections of non-breeding individuals (Tables 21 and 22). Yellow Warblers were presumed to be breeding in both Nature Trail plots, and Willow Flycatcher was repeatedly detected in the southern Nature Trail plot (NT-S). Of the other covered species, only Bell’s Vireo was detected as a non-breeder in the northern Nature Trail plot (NT-N). During the rapid area searches at the Crane Roost site, 24 species including the Willow Flycatcher were detected (Table 23).

**Table 21.** Number of breeding territories by species found in the Cibola Nature Trail intensive area search plots in 2008. Listed in alphabetical order. Parentheses indicate covered species that were present at least in three area searches, but that are presumed non-breeders.

Species	Number of Territories			Total Nature Trail
	NT-N	NT-S	CVMP	
Abert's Towhee	3	1		4
Anna's Hummingbird	1			1
Blue Grosbeak	1	3	1	5
Bullock's Oriole	2	2	1	5
Common Yellowthroat	1	2	3	6
House Finch	1			1
Mourning Dove	2	2	2	6
Phainopepla		1		1
Song Sparrow		1	2	3
(Willow Flycatcher)		1		1
Verdin	1			1
Warbling Vireo	1			1
Western Kingbird	2	3		5
White-winged Dove		1		1
Yellow Warbler*	2	2		4
Yellow-breasted Chat	2			2
<b>Total</b>	<b>19</b>	<b>19</b>	<b>9</b>	<b>47</b>

\* LCR MSCP covered species

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**Table 22.** Average number of non-breeding individuals, by species, detected in intensive area searches at Cibola Nature Trail habitat creation plots in 2008. Listed in descending order of abundance.

Species	CVMP	NT-N	NT-S	Cibola Total Detections	Cibola Average
White-winged Dove	4.3	0.9	7.8	103	4.3
House Finch	2.9	0.3	8.9	96	4.0
Wilson's Warbler	3.3	1.9	4.9	80	3.3
Brown-headed Cowbird	2.1	0.5	6.8	75	3.1
Mourning Dove	1.9	1.3	4.8	63	2.6
Western Kingbird	1.6	0.3	5.9	62	2.6
Abert's Towhee	1.8	1.3	3.3	50	2.1
Empidonax spp.	3.1	0.4	2.3	46	1.9
Pacific-slope Flycatcher	1.9	1.3	2.4	44	1.8
Great-tailed Grackle	1.6	0.8	2.1	36	1.5
Black-chinned Hummingbird	1.4	0.5	2.4	34	1.4
Western Wood-Pewee	1.3	0.8	2.1	33	1.4
Hummingbird spp.	1.0	0.1	2.6	30	1.3
European Starling	0.0	0.0	3.4	27	1.1
Warbling Vireo	0.0	0.9	1.8	21	0.9
Verdin	0.4	0.0	2.1	20	0.8
Phainopepla	0.0	0.4	1.5	15	0.6
Anna's Hummingbird	0.6	0.3	0.8	13	0.5
Blue Grosbeak	0.3	0.0	1.4	13	0.5
Killdeer	0.1	0.8	0.8	13	0.5
Townsend's Warbler	0.5	0.3	0.5	10	0.4
Gambel's Quail	0.0	0.5	0.6	9	0.4
Western Tanager	0.0	0.9	0.3	9	0.4
Ash-throated Flycatcher	0.3	0.4	0.4	8	0.3
Willow Flycatcher	0.3	0.5	0.3	8	0.3
Yellow-breasted Chat	0.0	0.3	0.6	7	0.3
American Kestrel	0.0	0.4	0.1	4	0.2
Common Yellowthroat	0.3	0.3	0.0	4	0.2
MacGillivray's Warbler	0.1	0.3	0.1	4	0.2
Red-winged Blackbird	0.4	0.1	0.0	4	0.2
Yellow Warbler**	0.0	0.0	0.5	4	0.2
Ladder-backed Woodpecker	0.1	0.1	0.1	3	0.1
Olive-sided Flycatcher	0.0	0.1	0.3	3	0.1
Rufous Hummingbird	0.0	0.0	0.4	3	0.1
Black-headed Grosbeak	0.0	0.0	0.3	2	0.1
Black-tailed Gnatcatcher	0.0	0.0	0.3	2	0.1
Brewer's Blackbird	0.0	0.0	0.3	2	0.1
Scott's Oriole	0.3	0.0	0.0	2	0.1
Song Sparrow	0.1	0.1	0.0	2	0.1
Sparrow spp.	0.0	0.0	0.3	2	0.1
American Bittern	0.0	0.1	0.0	1	0.0
Bell's Vireo**	0.0	0.1	0.0	1	0.0



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Species	CVMP	NT-N	NT-S	Cibola Total Detections	Cibola Average
Belted Kingfisher	0.0	0.1	0.0	1	0.0
Black Phoebe	0.0	0.1	0.0	1	0.0
Bullock's Oriole	0.1	0.0	0.0	1	0.0
Cassin's Vireo	0.0	0.0	0.1	1	0.0
Crissal Thrasher	0.0	0.1	0.0	1	0.0
Great Horned Owl	0.0	0.1	0.0	1	0.0
Green Heron	0.1	0.0	0.0	1	0.0
Hooded Oriole	0.0	0.1	0.0	1	0.0
Inca Dove	0.0	0.0	0.1	1	0.0
Northern Mockingbird	0.0	0.1	0.0	1	0.0
Northern Rough-winged Swallow	0.0	0.0	0.1	1	0.0
Raptor spp.	0.0	0.0	0.1	1	0.0
Say's Phoebe	0.0	0.0	0.1	1	0.0
Warbler spp.	0.1	0.0	0.0	1	0.0
Western Meadowlark	0.1	0.0	0.0	1	0.0
Yellow-headed Blackbird	0.1	0.0	0.0	1	0.0
<b>Total</b>				<b>984</b>	<b>41.0</b>

\* observed as a flyover or incidental \*\*LCR MSCP covered species

**Table 23.** Average number of individuals detected, by species, on the rapid area search plot at the Cibola Crane Roost site in 2008. Listed in descending order of abundance.

Species	Crane Roost
Abert's Towhee	7.5
Mourning Dove	7
Gambel's Quail	6
Brown-headed Cowbird	4
Warbling Vireo	3
Common Yellowthroat	2.5
Blue Grosbeak	2.5
Red-winged Blackbird	2.5
Western Meadowlark	2
Song Sparrow	1.5
Wilson's Warbler	1.5
Yellow-breasted Chat	1
Ash-throated Flycatcher	1
Lucy's Warbler	1
Western Kingbird	1
White-winged Dove	1
Bullock's Oriole	0.5
Empidonax spp.	0.5
Olive-sided Flycatcher	0.5
Pacific-slope Flycatcher	0.5

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<b>Species</b>	<b>Crane Roost</b>
Phainopepla	0.5
Willow Flycatcher	0.5
Vireo spp.	0.5
Black-tailed Gnatcatcher	0.5
Verdin	0.5
House Finch	0.5
<b>Total</b>	<b>50</b>

**Palo Verde Ecological Reserve (PVER)**

In two intensive area search plots at the Palo Verde Ecological Reserve, 17 breeding territories were confirmed and a total of 450 non-breeding individuals detected (Tables 24 and 25). Only one covered species, the Bell’s Vireo, was confirmed as a breeder and Yellow Warbler was detected as a non-breeder. The PVER sites had some surprising species as confirmed breeders: A Mallard nest was found on the PVER2-A plot, which is near a wetland, but wetlands were not present on the plot itself. A Northern Harrier nest was active on the plot, with both parents vigorously defending the nest, carrying food to the nest, and begging calls detected at the nest site. Finally, a White-tailed Kite pair attempted to nest twice (carrying nest material and occupying a nest site), once in each of the two plots during the 2008 survey season. Successful breeding was not confirmed for this species, but two nesting attempts clearly took place. In the five rapid area searches at the Palo Verde Ecological Reserve, 32 species that included no covered species were detected (Table 26).

**Table 24.** Number of territories by species detected in PVER intensive area search plots in 2008. Listed in alphabetical order.

Species	Number of Territories		Total PVER
	PVER2-A	PVER-2B	
Bell's Vireo*	1		1
Blue Grosbeak	2	3	5
Common Yellowthroat	2	2	4
House Finch	1		1
Mallard	1		1
Northern Harrier		1	1
Song Sparrow		2	2
White-tailed Kite**	1	1	2**
<b>Total</b>	<b>8</b>	<b>9</b>	<b>17</b>

\* LCR MSCP covered species

\*\* same pair attempted to nest in each plot during 2008

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**Table 25.** Average number of non-breeding individuals, by species, detected in intensive area searches at PVER habitat creation plots in 2008. Listed in descending order of abundance.

Species	PVER-2A	PVER-2B	PVER Total Detections	PVER Average
Red-winged Blackbird	29.3	7.8	296	18.5
Brown-headed Cowbird	4.4	2.0	51	3.2
Abert's Towhee	1.3	0.5	14	0.9
Cliff Swallow	1.6	0.0	13	0.8
Hummingbird spp.	1.1	0.1	10	0.6
Black-chinned Hummingbird	0.4	0.8	9	0.6
Western Kingbird	0.1	0.6	6	0.4
Yellow-headed Blackbird	0.8	0.0	6	0.4
Brewer's Blackbird	0.6	0.0	5	0.3
Yellow Warbler**	0.6	0.0	5	0.3
Gambel's Quail	0.5	0.0	4	0.3
Mourning Dove	0.3	0.3	4	0.3
Ash-throated Flycatcher	0.1	0.3	3	0.2
Black-headed Grosbeak	0.4	0.0	3	0.2
Northern Rough-winged Swallow	0.4	0.0	3	0.2
Wilson's Warbler	0.3	0.1	3	0.2
House Finch	0.3	0.0	2	0.1
Song Sparrow	0.1	0.1	2	0.1
White-tailed Kite	0.3	0.0	2	0.1
Anna's Hummingbird	0.0	0.1	1	0.1
Bell's Vireo**	0.0	0.1	1	0.1
Blue Grosbeak	0.1	0.0	1	0.1
Bullock's Oriole	0.1	0.0	1	0.1
Common Yellowthroat	0.1	0.0	1	0.1
Greater Roadrunner	0.1	0.0	1	0.1
Green Heron	0.1	0.0	1	0.1
Mallard	0.1	0.0	1	0.1
Northern Mockingbird	0.1	0.0	1	0.1
<b>Total</b>			<b>450</b>	<b>28.1</b>

\*\*LCR MSCP covered species

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**Table 26.** Average number of individuals detected, by species, on rapid area search plots at Palo Verde Ecological Reserve (PVER) in 2008. Listed in descending order of abundance.

<b>Species</b>	<b>PVER-P3</b>	<b>PVER 4</b>	<b>PVER 7</b>	<b>PVER 8</b>	<b>PVER 9</b>	<b>PVER Average</b>
Red-winged Blackbird	12.5	2	63	84	102	52.7
Yellow-headed Blackbird	17.5	0	2	3.5	10	6.6
Mourning Dove	0.5	2	3	7.5	9	4.4
House Finch	0	0	0	4.5	14	3.7
Cliff Swallow	0	0	4	8	1	2.6
Abert's Towhee	2.5	0	2	2	5	2.3
Gambel's Quail	2.5	0	0	0	8.5	2.2
Horned Lark	0	1	6	3	0	2
Brown-headed Cowbird	2	1	1	1	3.5	1.7
Great-tailed Grackle	0	0	0	2	3	1
Blue Grosbeak	1	0	1.5	0.5	1.5	0.9
Northern Rough-winged Swallow	0	0	1	2.5	0	0.7
Western Kingbird	0	0	2	0.5	1	0.7
American Pipit	0	0	3	0	0	0.6
Killdeer	0	0	1	2	0	0.6
Common Yellowthroat	0	1.5	0.5	0	1	0.6
Western Meadowlark	0	1.5	1.5	0	0	0.6
White-winged Dove	0.5	0	2	0.5	0	0.6
Northern Harrier	0	0.5	0.5	0.5	1	0.5
Common Ground-Dove	0	0	0	1.5	0	0.3
Common Raven	0	0.5	0	0.5	0	0.2
Lark Sparrow	0	0	0	0	1	0.2
Long-billed Curlew	0	0	0	1	0	0.2
Say's Phoebe	0	0	1	0	0	0.2
Lucy's Warbler	0	0	0	0	1	0.2
Burrowing Owl	0	0.5	0	0	0	0.1
Cattle Egret	0	0	0	0.5	0	0.1
Great Blue Heron	0	0	0.5	0	0	0.1
Greater Roadrunner	0	0	0	0.5	0	0.1
Townsend's Warbler	0	0	0	0	0.5	0.1
Verdin	0	0	0.5	0	0	0.1
Ash-throated Flycatcher	0	0	0	0.5	0	0.1
Hummingbird spp.	0	0.5	0	0	0	0.1
<b>Total</b>	<b>39</b>	<b>11</b>	<b>96</b>	<b>127</b>	<b>163</b>	<b>87.1</b>

## Discussion

### *Species Richness Patterns*

When reviewing the species lists (Appendix 5), several important patterns emerge. First, the Gilded Flicker was not detected in any 2007 or 2008 surveys throughout the LCR MSCP project area (Bart 2007), neither during standard surveys nor in casual observations. Second, of the covered species, the Bell's Vireo, Yellow Warbler, and Gila Woodpecker are fairly regularly found throughout the project area, while the Summer Tanager can be locally uncommon and appears to have a spotty distribution within the study area. Vermilion Flycatcher is both uncommon and appears to have a spotty distribution.

Three general patterns appear clear from the species lists of the habitat creation sites compared with system-wide plots: (1) there were fewer upland species in habitat creation sites, which is not surprising, as only riparian vegetation cover types are targeted for habitat creation; (2) waterbirds and marshbirds are currently uncommon in habitat creation sites, likely because marshy habitats are not a primary target in the habitat creation efforts for the covered bird species; and (3) species that are associated with old-growth riparian trees are less prevalent in habitat creation sites than system-wide. The latter effect is likely due to the relative early seral stages of riparian woodlands in the habitat creation sites, most of which are less than ten years old. Several bird species of old-growth riparian woodlands are associated only with trees large enough to produce cavities and abundant woody debris. As the habitat creation areas mature, more of these species are expected to colonize the sites.

### *System-Wide Surveys*

Our system-wide surveys showed that the Lower Colorado River corridor was occupied by a large variety of both breeding birds and migrants. While overall abundances were greatest in generalist species, such as Brown-headed Cowbird, Gambel's Quail, and Great-tailed Grackle, the most abundant breeders included mostly riparian specialist species, such as Yellow-breasted Chat, Song Sparrow, and Yellow Warbler. The data further indicate that there is a substantial seasonal effect in at least some species, particularly in species that migrate through the project area to northern breeding grounds, but also have significant presence as local breeders, such as Yellow Warbler. In future analyses, we plan to look at these effects more closely after collecting more data in 2009. Also, additional analyses will be necessary to determine detection ratios from the 2008 data, pending a software program that is being written for this purpose, as well as to revise bird population size estimates based on the results of these analyses and the results of the 2007 surveys. The 2008 system-wide survey plots were from a larger sample of randomly-selected survey plots that also included all plots surveyed in 2007. The selection of plots surveyed in each of the two years was not random, so it is likely that the 2008 alone represent a non-random sample of the overall populations.

The most common and widespread covered species were Bell's Vireo, Yellow Warbler, and Gila Woodpecker. Summer Tanager and Vermilion Flycatcher were present in few enough locations, both in the 2007 and 2008 surveys, that they may require additional efforts to determine the most effective monitoring methods of their populations.

### *Habitat Creation Sites*

The post-development habitat creation sites (> 1 year of growth) supported breeding populations of four of the six covered species, with only Gila Woodpecker and Gilded Flicker not having been detected. In addition, Yellow-billed Cuckoo and Willow Flycatcher were detected repeatedly during the survey season in at least one post-development habitat creation site. However, breeding of these two species was not confirmed as both species are known to wander in the project area and to breed later than most other landbirds. In comparison with data from pre-development and freshly planted habitat creation sites, these data suggest that the habitat creation effort in fact caused the presence of these covered bird species in the sites. The Gila Woodpecker was not detected, most likely because the post-development sites were still too young to produce trees large enough for woodpecker cavities. This species is common enough in the project area that it will likely colonize the sites as soon as the trees are large enough to support them. The Gilded Flicker, on the other hand, has not been detected in the LCR MSCP project area in both 2007 and 2008, and may therefore be less likely to colonize the habitat creation sites quickly. Old-growth riparian canopy trees are relatively uncommon in the current landscape of the Lower Colorado River, and monitoring of the habitat creation sites will be particularly useful to determine whether riparian populations of bird species associated with old-growth can be restored, particularly the Gilded Flicker and Elf Owl (*Micrathene whitneyi*).

### *Considerations for Future Bird Monitoring Work on the Lower Colorado River*

Several aspects of the presented study need further analyses, field work, and planning, including (1) pooling data collected in 2007 to develop combined population size estimates based on the full sample of 160 plots selected at random at the beginning of the system-wide monitoring effort; (2) completing the software that calculates detection ratios and population size estimates based on the data collected in this project; (3) completing habitat assessments for the covered species; and (4) completing habitat models for those covered species, for which sufficient sample sizes are available.

In the field season of 2009, we plan on a similar effort as in the 2008 field season, with some suggested changes to the sampling plan. The results of the 2008 data collection indicate that several species complete their breeding cycle prior to the end of June, and that they vacate the survey plots at some time in late June. We therefore recommend advancing the bird survey season by two weeks, with a start date of April 15, and ending on June 15. This will allow us to better estimate breeding densities of early breeders, but will have the disadvantage of covering more of the wave of migrants coming through the Lower Colorado River corridor in spring. The latter is probably an unavoidable complication, since we are concerned that overall population estimates are significantly

influenced when counts from the late season, when some birds have left their breeding grounds, are included in averages.

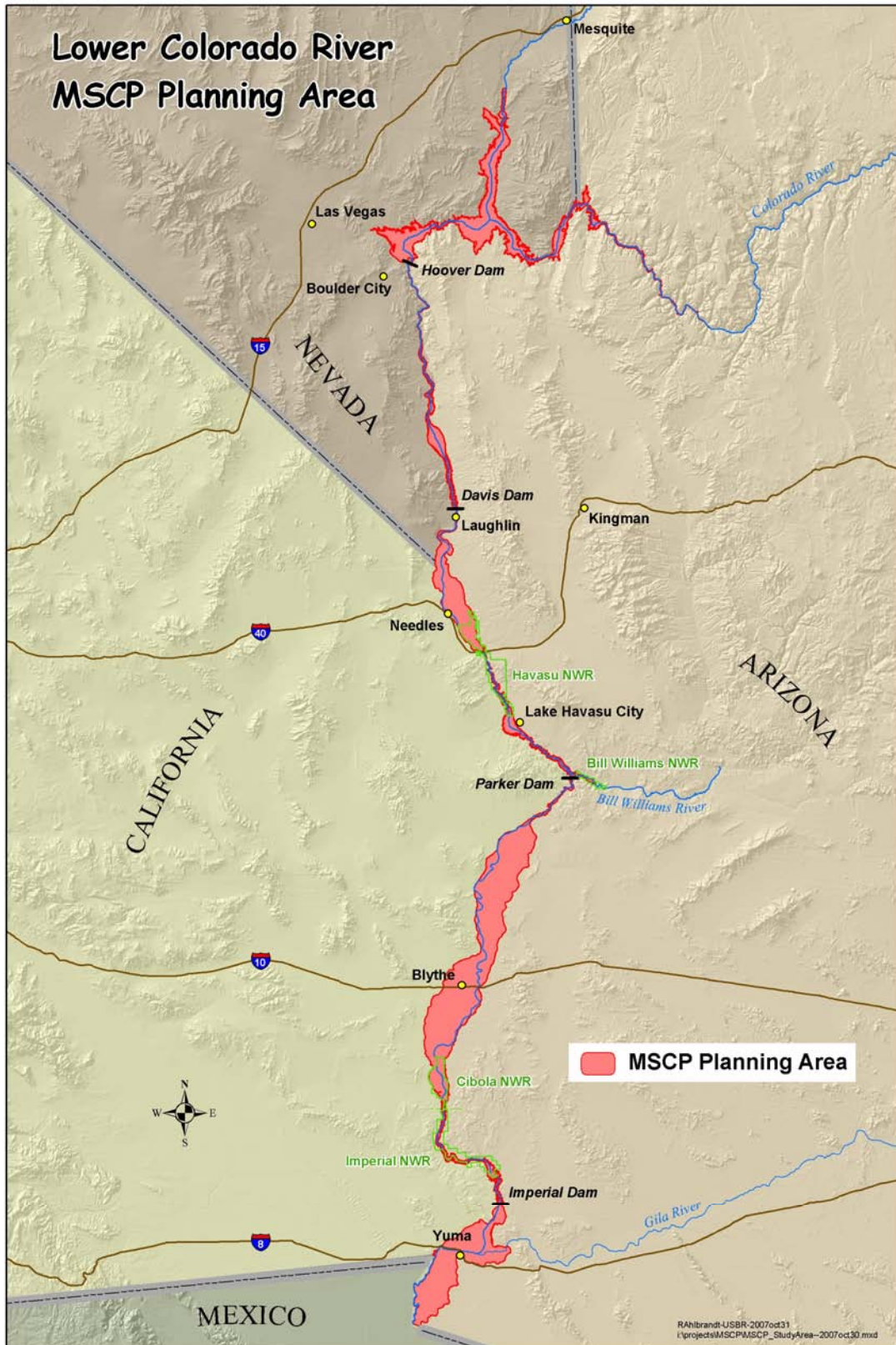
Further into the future, the sampling plan should be reviewed for additional refinements. For instance, detection ratios for the covered species (and possibly other riparian associated species) may be examined to evaluate the extent of a double sampling effort necessary for future monitoring. If the detection ratios are not significantly different from year to year, there may be no need to expend as large a portion of the survey effort (36% in 2008) on collecting intensive area search data, but instead increase geographic coverage of rapid area searches. Also, a review of monitoring plans for habitat creation sites may be necessary as habitat creation efforts expand over larger areas, making complete coverage more difficult. Finally, the habitat creation site data may be analyzed as a full data set that includes previous monitoring efforts led by the Bureau of Reclamation, in order to determine effect sizes of habitat creation on covered species, and to inform habitat creation strategies through an adaptive management approach.



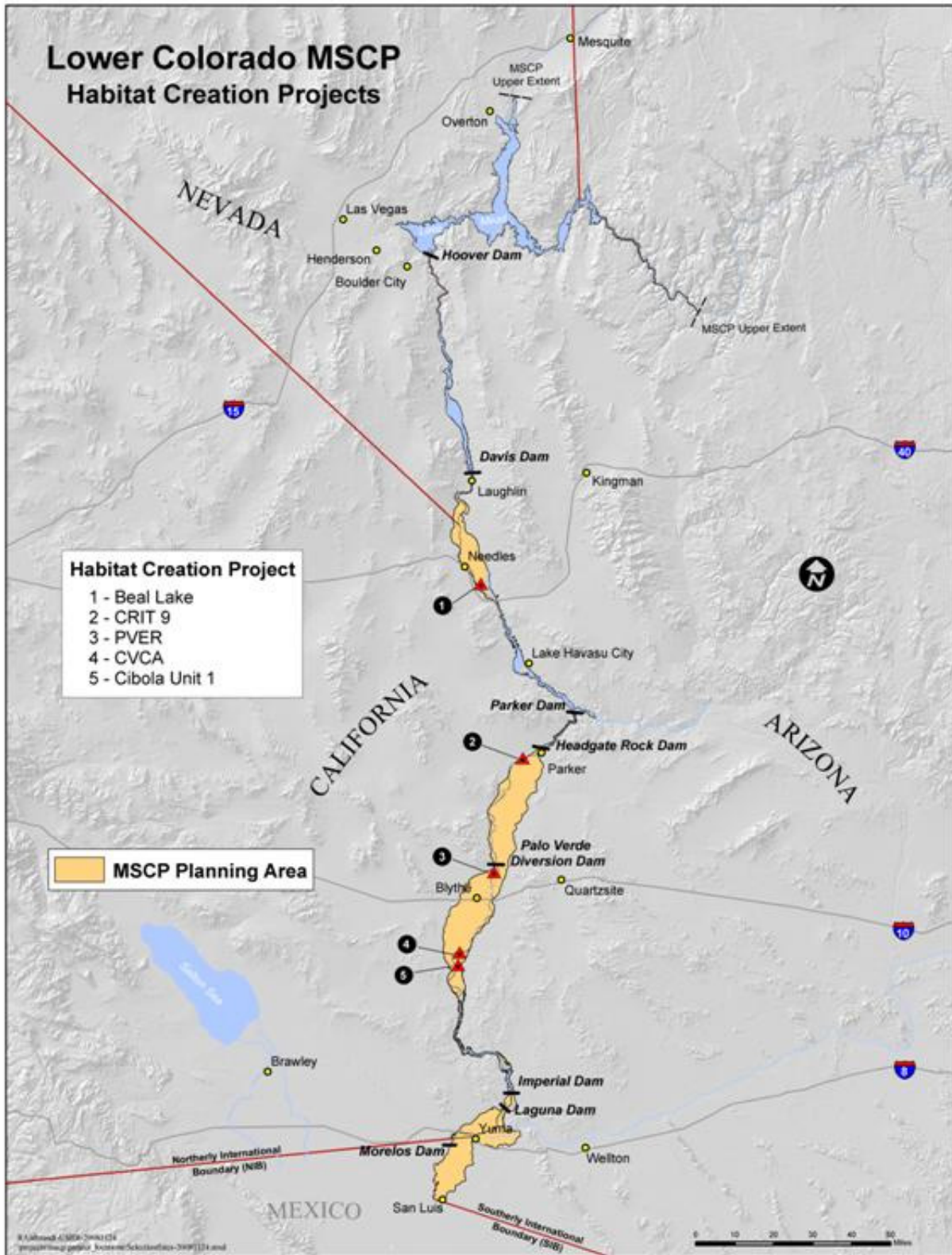
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**Appendix 1a.** Map of the LCR-MSCP study area for system-wide bird surveys (in pink). Map provided by the Bureau of Reclamation, Lower Colorado River Region.



**Appendix 1b.** Overview of habitat creation sites of the LCR MSCP in 2008. Map provided by the Bureau of Reclamation, Lower Colorado River Region.





**Lower Colorado River Riparian Bird Surveys  
Intensive Surveys Summary Table -2008 (Fill out after each intensive survey.)**

**Plot** \_\_\_\_\_

**Surveyor** \_\_\_\_\_

**Page** \_\_\_ **of** \_\_\_

		<b>Date 1:</b>	<b>Time In:</b>	<b>Date 2:</b>	<b>Time In:</b>	<b>Date 3:</b>	<b>Time In:</b>	<b>Date 4:</b>	<b>Time In:</b>
		<b>Sky Code:</b> <b>Wind:</b>	<b>Time Out:</b>	<b>Sky Code:</b> <b>Wind:</b>	<b>Time Out:</b>	<b>Sky Code:</b> <b>Wind:</b>	<b>Time Out:</b>	<b>Sky Code:</b> <b>Wind:</b>	<b>Time Out:</b>
<b>Species Code</b>	<b>Full Species Name</b>	<b># of individuals /sex</b>	<b>Breeding Activity</b>	<b># of individuals /sex</b>	<b>Breeding Activity</b>	<b># of individuals /sex</b>	<b>Breeding Activity</b>	<b># of individuals /sex</b>	<b>Breeding Activity</b>



**Appendix 3.** Positive breeding evidence and other behavior codes recorded during an area search used in system-wide and habitat creations sites on the Lower Colorado River in 2008.

### **Confirmed and Probable Breeding**

- 1.) Adults **carrying nest material** were assumed to be building a nest. Recorded using code “mat”.
- 2.) Adults **carrying food** were assumed to be traveling to a nest with nestlings or recently fledged young. If the nest site was in a thicket, its approximate location was delineated. Recorded using code “food”.
- 3.) **Nests** were recorded when found active. No old nests from previous nesting attempts were included as confirmed breeding evidence. Recorded using code \*.
- 4.) **Paired adults**, seen repeatedly in consecutive visits, were used as probable breeding evidence. They were used primarily as indications of possible nest sites and territory locations to be determined in multiple visits.
- 5.) **Nest guarding, mate guarding, and territorial displays** were used as probable breeding evidence. They were used primarily as indications of possible nest sites and territory locations to be determined in multiple visits.

### **Other Codes Used in Area Searches**

**Singing birds:** Recorded by circling the species code on the location of the detected individual.

**Counter-singing:** Recorded with a dashed line between the two birds on the map with their species codes circled.

**Two or more locations of the same bird:** Locations recorded with a solid line between the locations on the map.

**Appendix 4.** Habitat assessment protocol for the Lower Colorado River Avian Surveys.

This habitat assessment protocol was designed to provide a rapid assessment of dominant vegetation to determine habitat-bird associations for the LCR MSCP covered species using data collected from the Lower Colorado River. The results of these assessments will be analyzed in 2009 together with bird survey data to correlate vegetation structure and floristics with presence of the six covered species in order to assist in the adaptive management process of the LCR MSCP.

**Plot Selection for Habitat Assessments**

Habitat assessment sites were conducted within breeding territories of covered species as well as in non-use sites randomly selected from the same, or nearest, similar stratum. Surveyors located covered species when conducting rapid and intensive area searches. We estimated that we will need to assess approximately 20 use and 20 non-use sites for each of the six covered species for an adequate sample size to do multivariate statistical modeling. Habitat surveys may be done using territory data from 2007 in addition to those collected in 2008 and 2009. Additional searches may be required to detect a sufficient number of territories for rare species (e.g., Vermilion Flycatcher).

Habitat assessments for pairwise comparisons of use and non-use sites followed the geographic stratification of the bird sampling plan. Habitat assessments for use sites were located at nest sites, or at territory centers if no nest was located. Territories for habitat assessments were randomly selected from the territories available in each geographic stratum for each species. For each of the assessed territories, a non-use site in the same stratum was randomly selected from plots in which the species was absent. If it was present in all plots of the stratum, the nearest similar stratum was used for a random selection of plots to be used as non-use sites.

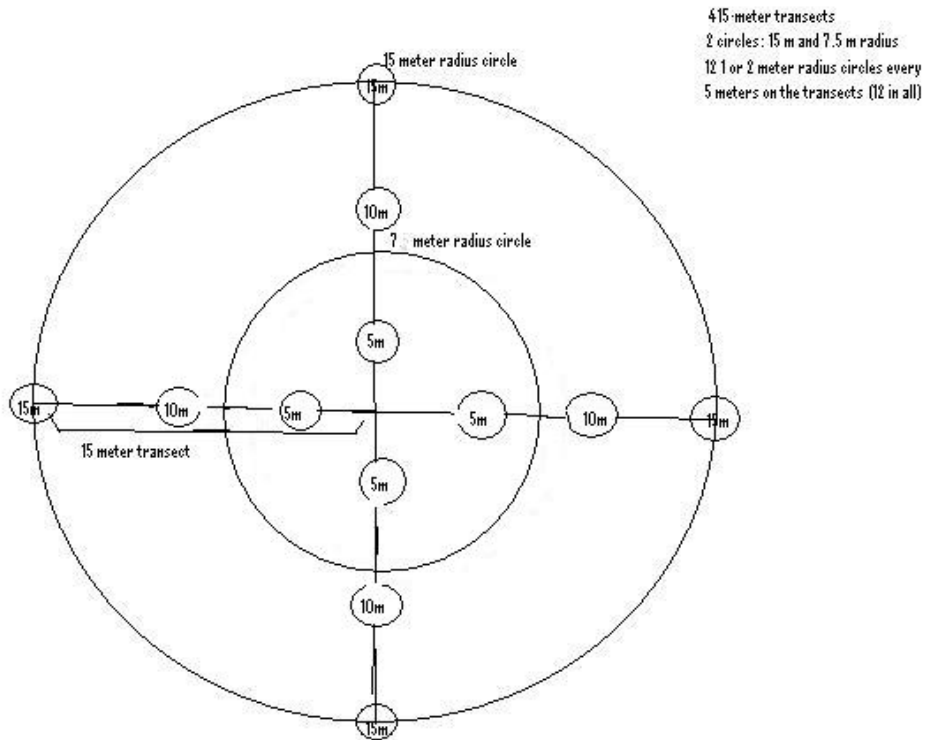
**Data Collection Overview**

The Lower Colorado River Project habitat assessments consisted of the following parts:

- (1) photographs of the site;
- (2) a series of categorical landscape variables;
- (3) cover and foliage height diversity via point-intercept and a 5 m pole with marked heights;
- (4) tree density and size (including snags);
- (5) shrub density;
- (6) canopy closure; and
- (7) soil moisture

During the area searches, UTM's (NAD83) for nest locations and territory centers of the covered species were recorded and habitat assessed after fledging had occurred. Each habitat assessment included four 15 m vegetation transects, with the first oriented in a random direction, and the remainder oriented at 90 degrees from the first (Figure 1).

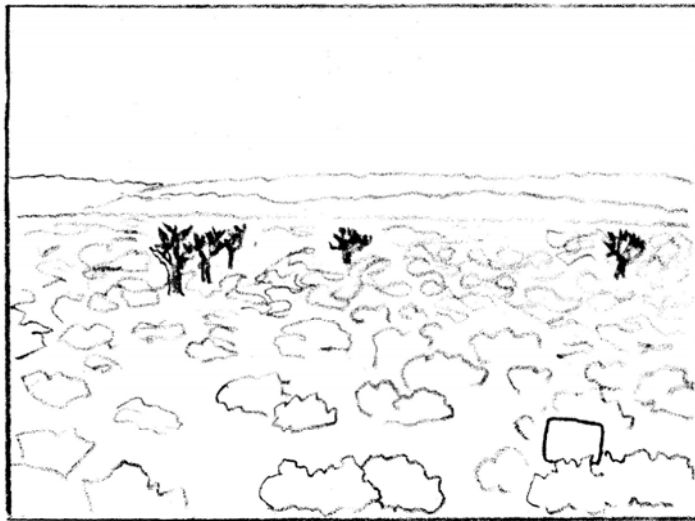




**Figure 1.** Habitat assessment vegetation transect set up.

### Photograph of Site

We took photographs from point center in the direction of a representative transect. We used a dry-erase board to write the Plot Name, Species, Point Type (e.g., Nest, Territory, or Non-Use), azimuth of transect, and date, and to be placed it in the foreground of the photo (Figure 2).



**Figure 2.** Illustrated example of a habitat assessment photograph.

### **Categorical Landscape Variables**

The following questions described categorical landscape variables recorded at each point, using yes/no answers:

Are there charcoaled stems within the 100 m radius plot?

Are there cliffs 30 ft or taller within 1000 m of the point?

Are there natural/modified-natural water sources in the territory (if applicable)?

100 m of the plot center?

1000 m of the plot center?

What proportion of the 50 m radius circle around the plot center consists

of standing water?

Characterize the water in the closest distance category above as either

standing or moving.

Is there a dry wash > 5 ft wide within the territory (if applicable)?

100 m of the plot center?

1000 m of the plot center?

Are there trees greater than 12 cm dbh within the territory (if applicable)?

100 m of the plot center?

1000 m of the plot center?

Are there snags greater than 12 cm dbh within the territory (if applicable)?

100 m of the plot center?

1000 m of the plot center?

Are there branches greater than 12 cm diameter within the territory (if applicable)?

100 m of the plot center?

1000 m of the plot center?

Is there upland habitat within the territory (if applicable)?

100 m of the plot center?

1000 m of the plot center?

Are there anthills within the territory (if applicable)?

100 m of the plot center?

1000 m of the plot center?

Is there mistletoe within the territory (if applicable)?

100 m of the plot center?

1000 m of the plot center?

### **Cover and Foliage Height Diversity**

For each vegetation transect, we placed an extendable pole vertically at each meter along the measuring tape except for the center point (1, 2, ..., 15). Vegetation hits were recorded for the following height intervals: 0, 1-15, 15-50, 50-100, 100-150, 150-200, 200-300, 300-400, 400-500, >500 cm (see also vegetation codes at the end of appendix). All dominant plants were identified to species or genus. Where possible, we identified other woody plants to species as well. Non-woody plants were identified to class (e.g., forb, grass, sedge). Vegetation classification codes used in habitat assessments are listed at the end of this appendix.

### **Tree and Snag Density and Size**

To provide consistency with other bird studies of the LCR MSCP, we based our definition of trees and shrubs on the definitions used for Southwestern Willow Flycatcher habitat assessments (McLeod et al. 2007): trees included all woody plants with a diameter at breast height (DBH) greater than 8 cm, while all woody plants with DBH of 8 cm or less were classified as shrubs.

Tree and snag densities were measured using a circular plot centered on the center point of the habitat assessment site. The circle size was determined by tree density within the circle. A 15 m-radius circular plot was used unless there were more than 25 trees within the plot, in which case a 7 m-radius plot was used to determine density. A 15 m-radius circle was used to estimate snag density. We tallied all the trees and snags by height and diameter class. To be counted, the trees had to be rooted within the circle, and for boundary individuals, at least half of the trunk had to be rooted within the circle.

### **Shrub Density**

At 5 m intervals along each vegetation transect (i.e., at 5, 10, 15 m), we assessed shrub density using circular plots. The plot radius used depended on the density of shrub stems at the location: we used 2 m radius plots to tally shrub stems unless we estimated there were more than 25 stems in the 2 m radius, in which case, we used 1 m radius plots. We tallied all shrub stems within each circular plot and identified dominant plants at least to genus. We did not mix 1 m and 2 m circles within the same habitat assessment plot to streamline data analyses procedures.

### **Canopy Closure**

We used a spherical densitometer to approximate canopy closure. We took densitometer readings every 5 m along each vegetation transect (e.g., at 5, 10, 15 m). At each point we took 4 densitometer readings, one in each cardinal direction to be averaged. To take a reading, we held the densitometer at 12-18 inches in front of body and at elbow height and recorded the number of points covered by canopy vegetation.

### **Soil Moisture**

To investigate a correlation between the nest location of the six focal species and soil moisture, we visually estimated soil moisture status at every 5 m along each vegetation transect (i.e., 5, 10, 15 m), by determining whether the ground at that site had standing water, saturated soil, or dry soil.

## Vegetation Codes Used in Habitat Assessments

BG = Bare Ground

C = Cactus

CWD = Coarse Woody Debris (downed woody material, at least 10 cm diameter at the largest end, and at least 1 m long) – if it is still standing, it was tallied as either Sh/D or T/D.

EMV = Emergent Vegetation (hydric species emerging from water, such as *Typha* and *Scirpus*)

F = Forb (herbaceous non-graminoids)

G = Graminoid (grass-like plants: grasses, rushes, sedges – if the graminoid is mesic or hydric, it was included under MG or EMV categories)

L = Litter

MG = Mesic Graminoid (moist graminoids, not part of permanent or mostly permanent marsh, such as *Carex*, *Juncus*, and some grasses)

R = Rock (at least 10 cm in diameter)

Sh = Shrub/Woody species (live) – dead shrubs or shrub branches were recorded as Sh/D.

Sh/D = Shrub/Woody species (dead)

T = Tree (live)

T/D = Snag

W = Water

Y = Yucca

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**Appendix 5.** Comprehensive species list from avian surveys conducted along the Lower Colorado River in 2008.

Species	Scientific Name	System-Wide Surveys			Habitat Creation Sites		
		Rapid Area Searches	Intensive Area Searches - Breeding Confirmed	Intensive Area Searches - Non-Breeding	Rapid Area Searches	Intensive Area Searches - Breeding Confirmed	Intensive Area Searches - Non-Breeding
Abert's Towhee	<i>Pipilo aberti</i>	x	x	x	x	x	x
American Bittern	<i>Botaurus lentiginosus</i>						x
American Coot	<i>Fulica americana</i>	x		x			
American Crow	<i>Corvus brachyrhynchos</i>	x					
American Goldfinch	<i>Carduelis tristis</i>	x					
American Kestrel	<i>Falco sparverius</i>	x	x	x	x		x
American Pipit	<i>Anthus rubescens</i>				x		
American Robin	<i>Turdus migratorius</i>	x		x			
Anna's Hummingbird	<i>Calypte anna</i>	x		x	x	x	x
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>	x	x	x	x		x
Bank Swallow	<i>Riparia riparia</i>	x		x	x		
Barn Owl	<i>Tyto alba</i>						x
Barn Swallow	<i>Hirundo rustica</i>	x		x			x
Bell's Vireo	<i>Vireo bellii</i>	x	x	x		x	x
Belted Kingfisher	<i>Ceryle alcyon</i>			x			x
Bendire's Thrasher	<i>Toxostoma bendirei</i>	x					x
Bewick's Wren	<i>Thryomanes bewickii</i>	x	x	x			x
Black Phoebe	<i>Sayornis nigricans</i>	x					x
Black-chinned Hummingbird	<i>Archilocus alexandri</i>	x	x	x		x	x
Black-chinned Sparrow	<i>Spizella atrogularis</i>						x
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>	x		x			x
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>	x					x
Black-necked Stilt	<i>Himantopus mexicanus</i>	x		x	x		
Black-tailed Gnatcatcher	<i>Poliophtila melanura</i>	x	x	x	x	x	x

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		Rapid Area Searches	Intensive Area Searches - Breeding Confirmed	Intensive Area Searches - Non-Breeding	Rapid Area Searches	Intensive Area Searches - Breeding Confirmed	Intensive Area Searches - Non-Breeding
Black-throated Gray Warbler	<i>Dendroica nigrescens</i>	x					
Black-throated Sparrow	<i>Amphispiza bilineata</i>	x		x			
Blue Grosbeak	<i>Passerina caerulea</i>	x	x	x	x	x	x
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	x					
Brewer's Blackbird	<i>Euphagus cyanocephalus</i>						x
Brewer's Sparrow	<i>Spizella breweri</i>	x		x			
Brown-crested Flycatcher	<i>Myiarchus tyrannulus</i>	x	x	x			x
Brown-headed Cowbird	<i>Molothrus ater</i>	x	x	x	x	x	x
Bullock's Oriole	<i>Icterus bullockii</i>	x		x	x	x	x
Burrowing Owl	<i>Athene cunicularia</i>				x		x
Cactus Wren	<i>Campylorhynchus brunneicapillus</i>	x					
Canyon Wren	<i>Catherpes mexicanus</i>		x	x			
Cassin's Kingbird	<i>Tyrannus vociferans</i>						x
Cassin's Vireo	<i>Vireo cassinii</i>						x
Cattle Egret	<i>Bubulcus ibis</i>				x		x
Chipping Sparrow	<i>Spizella passerina</i>	x		x			
Clapper Rail	<i>Rallus longirostris</i>	x					
Clark's Grebe	<i>Aechmophorus clarkii</i>	x					
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	x	x	x	x		x
Common Ground-Dove	<i>Columbina passerina</i>	x			x		
Common Loon	<i>Gavia immer</i>			x			
Common Merganser	<i>Mergus merganser</i>			x			
Common Moorhen	<i>Gallinula chloropus</i>	x		x			
Common Nighthawk	<i>Chordeiles minor</i>						x
Common Raven	<i>Corvus corax</i>	x	x	x	x		x
Common Yellowthroat	<i>Geothlypis trichas</i>	x	x	x	x	x	x

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		Rapid Area Searches	Intensive Area Searches - Breeding Confirmed	Intensive Area Searches - Non-Breeding	Rapid Area Searches	Intensive Area Searches - Breeding Confirmed	Intensive Area Searches - Non-Breeding
Cordilleran Flycatcher	<i>Empidonax occidentalis</i>	x					
Crissal Thrasher	<i>Toxostoma crissale</i>	x	x	x		x	x
Dickcissel	<i>Spiza americana</i>						x
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	x					x
Eared Grebe	<i>Podiceps nigricollis</i>	x	x	x			
Eurasian Collared-Dove	<i>Streptopelia decaocto</i>	x	x	x			
European Starling	<i>Sturnus vulgaris</i>	x		x	x		x
Ferruginous Hawk	<i>Buteo regalis</i>	x					
Forster's Tern	<i>Sterna forsteri</i>	x					x
Gambel's Quail	<i>Callipepla gambelii</i>	x	x	x	x	x	x
Gila Woodpecker	<i>Melanerpes uropygialis</i>	x	x	x			
Golden Eagle	<i>Aquila chrysaetos</i>	x					
Gray Flycatcher	<i>Empidonax wrightii</i>	x					
Gray Vireo	<i>Vireo vicinior</i>	x					
Great Blue Heron	<i>Ardea herodias</i>	x		x	x		x
Great Egret	<i>Ardea alba</i>	x		x	x		x
Great Horned Owl	<i>Bubo virginianus</i>	x					x
Greater Roadrunner	<i>Geococcyx californianus</i>	x		x	x	x	x
Great-tailed Grackle	<i>Quiscalus mexicanus</i>	x	x	x	x		x
Green Heron	<i>Butorides virescens</i>	x		x			x
Green-tailed Towhee	<i>Pipilo chlorurus</i>	x					
Hammond's Flycatcher	<i>Empidonax hammondii</i>	x					
Hermit Thrush	<i>Catharus guttatus</i>	x		x			
Hooded Oriole	<i>Icterus cucullatus</i>	x	x	x			x
Horned Lark	<i>Eremophila alpestris</i>	x		x	x		x
House Finch	<i>Carpodacus mexicanus</i>	x	x	x	x	x	x

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		Rapid Area Searches	Intensive Area Searches - Breeding Confirmed	Intensive Area Searches - Non-Breeding	Rapid Area Searches	Intensive Area Searches - Breeding Confirmed	Intensive Area Searches - Non-Breeding
House Sparrow	<i>Passer domesticus</i>	x	x	x			
House Wren	<i>Troglodytes aedon</i>	x					x
Inca Dove	<i>Columbina inca</i>						x
Indigo Bunting	<i>Passerina cyanea</i>	x					
Killdeer	<i>Charadrius vociferus</i>	x	x	x	x		x
Ladder-backed Woodpecker	<i>Picoides scalaris</i>	x	x	x			x
Lark Sparrow	<i>Chondestes grammacus</i>	x			x		
Lazuli Bunting	<i>Passerina amoena</i>	x		x			x
Le Conte's Thrasher	<i>Toxostoma lecontei</i>	x					
Least Bittern	<i>Ixobrychus exilis</i>	x		x			x
Lesser Goldfinch	<i>Carduelis psaltria</i>	x		x	x		
Lesser Nighthawk	<i>Chordeiles acutipennis</i>	x	x	x	x		x
Lincoln's Sparrow	<i>Melospiza lincolni</i>	x					
Loggerhead Shrike	<i>Lanius ludovicianus</i>	x	x	x			x
Long-billed Curlew	<i>Numenius americanus</i>				x		x
Lucy's Warbler	<i>Vermivora luciae</i>	x	x	x	x	x	x
MacGillivray's Warbler	<i>Oporornis tolmiei</i>	x		x			x
Mallard	<i>Anas platyrhynchos</i>	x	x	x	x	x	x
Marsh Wren	<i>Cistothorus palustris</i>	x		x			
Mourning Dove	<i>Zenaida macroura</i>	x	x	x	x	x	x
Nashville Warbler	<i>Vermivora ruficapilla</i>	x		x			
Northern Flicker	<i>Colaptes auratus</i>	x		x			
Northern Harrier	<i>Circus cyaneus</i>	x			x	x	x
Northern Mockingbird	<i>Mimus polyglottos</i>	x		x		x	x
Northern Pintail	<i>Anas acuta</i>			x			
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	x		x	x		x



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Northern Shoveler	<i>Anas clypeata</i>	x		x			
Olive-sided Flycatcher	<i>Contopus cooperi</i>	x		x	x		x
Orange-crowned Warbler	<i>Vermivora celata</i>	x		x			
Osprey	<i>Pandion haliaetus</i>	x		x			x
Pacific-slope Flycatcher	<i>Empidonax difficilis</i>	x			x		x
Peregrine Falcon	<i>Falco peregrinus</i>	x					
Phainopepla	<i>Phainopepla nitens</i>	x	x	x	x	x	x
Pied-billed Grebe	<i>Podilymbus podiceps</i>	x					
Plumbeous Vireo	<i>Vireo plumbeus</i>	x		x			
Prairie Falcon	<i>Falco mexicanus</i>			x			
Red-breasted Nuthatch	<i>Sitta canadensis</i>			x			
Red-tailed Hawk	<i>Buteo jamaicensis</i>	x		x			x
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	x	x	x	x		x
Ring-billed Gull	<i>Larus delawarensis</i>	x					
Rock Dove	<i>Columba livia</i>	x					
Rock Wren	<i>Salpinctes obsoletus</i>	x		x			
Rough-legged Hawk	<i>Buteo lagopus</i>						x
Ruddy Duck	<i>Oxyura jamaicensis</i>	x					
Rufous Hummingbird	<i>Selasphorus rufus</i>						x
Say's Phoebe	<i>Sayornis saya</i>	x	x	x	x	x	x
Scott's Oriole	<i>Icterus parisorum</i>				x		x
Sharp-shinned Hawk	<i>Accipiter striatus</i>	x					
Snowy Egret	<i>Egretta thula</i>	x		x			
Song Sparrow	<i>Melospiza melodia</i>	x	x	x	x	x	x
Sora	<i>Porzana carolina</i>	x		x			
Willow Flycatcher	<i>Empidonax trailli</i>	x		x	x	x	x

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Spotted Sandpiper	<i>Actitis macularia</i>		x	x			
Summer Tanager	<i>Piranga rubra</i>	x	x	x		x	x
Swainson's Hawk	<i>Buteo swainsoni</i>			x			
Swainson's Thrush	<i>Catharus ustulatus</i>	x					
Townsend's Warbler	<i>Dendroica townsendi</i>	x		x	x		x
Tree Swallow	<i>Tachycineta bicolor</i>	x	x	x			x
Turkey Vulture	<i>Cathartes aura</i>	x		x	x		x
Verdin	<i>Auriparus flaviceps</i>	x	x	x	x	x	x
Vermilion Flycatcher	<i>Pyrocephalus rubinus</i>	x				x	x
Violet-green Swallow	<i>Tachycineta thalassina</i>	x					x
Virginia Rail	<i>Rallus limicola</i>	x		x			
Warbling Vireo	<i>Vireo gilvus</i>	x	x	x	x	x	x
Western Bluebird	<i>Sialia mexicana</i>						x
Western Kingbird	<i>Tyrannus verticalis</i>	x		x	x	x	x
Western Meadowlark	<i>Sturnella neglecta</i>			x	x		x
Western Tanager	<i>Piranga ludoviciana</i>	x		x			x
Western Wood-Pewee	<i>Contopus sordidulus</i>	x		x			x
White-breasted Nuthatch	<i>Sitta carolinensis</i>	x					
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>	x		x			x
White-faced Ibis	<i>Plegadis chihi</i>	x		x	x		x
White-tailed Kite	<i>Elanus leucurus</i>				x	x	x
White-throated Swift	<i>Aeronautes saxatalis</i>	x					x
White-winged Dove	<i>Zenaida asiatica</i>	x	x	x	x	x	x
Wild Turkey	<i>Meleagris gallopavo</i>						x
Wilson's Warbler	<i>Wilsonia pusilla</i>	x		x	x		x
Yellow Warbler	<i>Dendroica petechia</i>	x	x	x	x	x	x

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Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	x				x	
Yellow-breasted Chat	<i>Icteria virens</i>	x	x	x	x		x
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>	x	x	x	x		x
Yellow-rumped Warbler	<i>Dendroica coronata</i>	x		x			x
<b>Total (all surveys = 158)</b>		<b>129</b>	<b>43</b>	<b>99</b>	<b>56</b>	<b>32</b>	<b>97</b>