



Annual Report on the Lower Colorado River Riparian Bird Surveys, 2009

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
No. 07SF300004

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Abstract

This report summarizes the methods and results of the 2009 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 report further summarizes results of population size estimates based on all of the first three years of the program (2007-2009), and habitat modeling for select species based on our vegetation assessments of 2008 and 2009. In 2009, we completed system-wide area searches in 80 rapid area search plots and 9 intensive area search plots, which were a subset of the rapid plots. This subset of plots was also used for double-sampling to generate an estimate for the total number of territories of five covered species present in the project area, the 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*). In addition, we conducted 19 intensive area searches in habitat creation sites that had more than two years of growth from habitat creation plantings.

A total of 172 species of birds were detected in all surveys along the Lower Colorado River in 2009, which results in a total of 192 species recorded in 2008 and 2009. All covered species subject to this monitoring effort, except the Gilded Flicker, were detected in at least one site, and all but the Gilded Flicker and Gila Woodpecker were found nesting in at least one habitat creation site. The most widespread and common of the covered species were Bell's Vireo and Yellow Warbler, while Vermilion Flycatcher and Summer Tanager only occur sporadically and in low numbers throughout the project area.

In our habitat association analyses, we concluded that a patchy mosaic of riparian woodland types at an approximately 2-5 ha scale supports the greatest number of covered species and high abundances in many of them. More specifically, we found that Gila Woodpeckers were associated with the presence of large-diameter snags and patches of upland habitat within the riparian habitat mosaic. Vermilion Flycatcher was associated with tall tree cover and the presence of mid-story mesquite, but appeared to avoid salt cedar. Bell's Vireo was also positively associated with tall riparian tree cover, particularly cottonwood, and the presence of shrub mesquite, but avoided upland habitat patches and patches dominated by low ground cover. Yellow Warbler territories were found in tall and low riparian canopy covers, particularly cottonwood and willow, but avoided mesquite, upland habitat patches, and patches dominated by low ground vegetation. In our habitat summaries, we included a full list of habitat variable measurements for all territories that were assessed in the field to serve as a reference sheet for potential use in planting efforts. Finally, we made recommendations for management, additional refinements in habitat creation efforts, and continued monitoring efforts of the riparian birds of the Lower Colorado River.

Introduction

This Lower Colorado River riparian bird inventory and monitoring project was initiated in 2007 as 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 2009 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 report further summarizes results of population size estimates based on all of the first three years of the program, and habitat modeling for select species based on our vegetation assessments of 2008 and 2009.

System-wide monitoring of the LCR MSCP’s riparian 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 separate 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 project goals addressed in the 2009 season included (1) determining presence and estimating breeding population sizes of covered species on the Lower Colorado River and in habitat creation sites, (2) estimating presence and abundances of other riparian landbirds, (3) and determining habitat associations for the covered species based on field habitat assessments. Finally (4), we derived recommendations for restoration and continued bird monitoring under the adaptive management process outlined in the LCR MSCP Science Strategy (BR 2006).

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 and 2009.

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 goals of the plan were 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

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

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- (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 addition, the project area was divided into 13 geographic regions that were used for further stratification of the sampling plots, resulting in the following breakdown of area by stratum for the entire system-wide survey area (Table 1). The area of each stratum was used to calculate estimated population sizes based on the system-wide avian surveys in this report.

Table 2. Area, in km² of habitat strata per geographic strata within the 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
Total	559.20	54.70	49.48	484.00	436.52	53.64	1637.52

A. Plot Selection: System-Wide Surveys

For the 2009 system-wide area searches, a total of 80 new ~9 ha plots were randomly selected from >15,000 plots in nine of the 13 geographic strata. These plots did not include any of the 160 plots that were surveyed in 2007 and 2008. To select plots, we used a stratified random selection using “habitat” as the selection stratum. The entire plots layer was separated into different excel sheets by habitat stratum. In each sheet, we generated a column of random numbers and then sorted the plots layer by those random numbers. We took the top plots off the list as our random selection for 2009. We weighted our plot selection towards the “good” habitats so that we had a higher chance of finding covered species in the system-wide plots. This way, our plot selection included 20 plots in the “good tall” and “good low” categories and ten plots each in the four remaining habitat strata (fair, poor, unsuitable, and marsh). Since some of the originally selected plots were inaccessible, we had a sequential list of alternate plots in the same strata. Based on accessibility and crew safety concerns, the number of plots in habitats marsh, poor, and unsuitable ended up slightly different from ten. Table 2 illustrates the distribution of system-wide survey effort among geographic and habitat strata in 2009. An additional non-randomly selected plot on the Bill Williams River was surveyed to increase coverage of covered species in this important area, but this plot was excluded from all system-wide analyses.

Table 3. Number of system-wide area search plots per geographic and habitat strata surveyed in 2009.

Region #	Region Name	Habitat						Total
		0	1	2	3	4	5	
3	Lake Mead	3				4		7
4	Hoover Dam to Davis Dam	1			3			4
5	Davis Dam to Bill Williams NWR (excluding Havasu NWR)		1		4	1	3	9
6	Havasu NWR	1	4		1		2	8
7	Bill Williams NWR	1	1	3	1	7	1	14
8	Bill Williams to Cibola excluding CRIT		1					1
10	Cibola NWR					1		1
11	Imperial NWR	1					3	4
12	Colorado River from the Imperial NWR to Yuma		12	16	1	1		30

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Region #	Region Name	Habitat						Total
		0	1	2	3	4	5	
13	Yuma to Southerly International Border		1	1				2
Total		7	20	20	10	14	9	80

We used the rapid area search protocol described in GBBO (2008) and below to survey all 81 plots. A random sub-sample of eight of the 80 rapid plots was surveyed intensively to determine actual numbers of breeding birds present in each plot. The intensive area search plots included two in Region 7 (Bill Williams NWR) and six in Region 12 (Colorado River from the Imperial NWR to Yuma).

Some randomly selected plots were inaccessible, so we randomly selected ten alternate plots from each stratum for replacement plots, as needed. Plots that were farther than 2 km from the nearest road, trail, or waterway were replaced, as were plots with > 50% area falling outside the project area boundary. Other plots were replaced because private landowners denied access for surveys, or because they contained wetlands that were inaccessible or otherwise unsafe. In the end, 30 of the originally-selected plots for 2009 were replaced, mostly due to unsafe conditions or denial of access.

B. Plot Selection: Habitat Creation Sites

In habitat creation sites, we collected data using the same basic methods as used for the system-wide intensive area searches. All habitat creation sites were larger than a typical system-wide area search plots, so the sites were subdivided into plots that were small enough to be surveyed in one morning (9 – 20 ha). Unlike in 2008, no surveys were conducted in “pre-development” sites (prior to implementation of habitat creation activities) or in one-year old habitat creation sites in 2009. Nineteen post-development plots with two or more years of growth were surveyed. Overall, 554 acres of habitat creation sites were surveyed in 2008 and 2009. In 2008, 100% of the habitat with 2 or more years of growth was surveyed, and in 2009 78% of the habitat with two or more years of growth was surveyed. An overview of habitat creation site locations is provided in Appendix 1b. Table 4 provides a list of habitat creation sites, planting times, dominant vegetation, and area search type for the 2009 surveys.

Table 4. List of habitat creation sites and plots, stage of habitat creation activities, and type of area search implemented in 2009.

Site and Plot	Restoration Work Phase	Dominant Vegetation	Area Search Type Implemented in 2009
<i>Beal Lake Riparian Habitat Creation Project</i>			
Beal A	planted 2004	screwbean mesquite	intensive

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Site and Plot	Restoration Work Phase	Dominant Vegetation	Area Search Type Implemented in 2009
Beal B	planted 2004	cottonwood-willow	intensive
Beal C	planted 2004	cottonwood-willow	intensive
Beal D	planted 2004	screwbean mesquite	intensive
 <i>Colorado River Indian Tribe</i>			
CRIT 9A	planted 2001	screwbean mesquite	intensive
CRIT 9B	planted 2001	cottonwood-willow	intensive
CRIT 9C	planted 2002	cottonwood-willow/screwbean mesquite	intensive
CRIT 9D	planted 2003	cottonwood-willow/honey mesquite	intensive
CRIT 9E	planted 2005	cottonwood-willow	intensive
 <i>Cibola Valley Conservation and Wildlife Area</i>			
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	not surveyed
CVCA 3 A & B	planted 2007	cottonwood-willow	intensive
CVCA 3 C & D	planted 2007	cottonwood willow/baccaris	intensive
CVCA 5	pre-development	agricultural	not surveyed
CVCA 6	pre-development	agricultural	not surveyed
Crane Roost	pre-development	agricultural	not surveyed
 <i>Cibola Nature Trail</i>			
NT-north	planted 1999	mesquite-cottonwood-willow	intensive
NT-south	planted 1999	mesquite-cottonwood-willow	intensive
Mass Planting	planted 2005	cottonwood-willow	intensive
 <i>Palo Verde Ecological Preserve</i>			
PVER 2A	planted 2007	cottonwood-willow	intensive
PVER 2B	planted 2007	cottonwood-willow	intensive
PVER 3	planted 2008	cottonwood-willow	not surveyed
PVER 4	pre-development	agricultural	not surveyed
PVER 7	pre-development	agricultural	not surveyed

Site and Plot	Restoration Work Phase	Dominant Vegetation	Area Search Type Implemented in 2009
PVER 8	pre-development	agricultural	not surveyed
PVER 9	pre-development	agricultural	not surveyed

2. Avian Monitoring Methods

To monitor birds of the Lower Colorado River in system-wide and habitat creation plots, we conducted a combination of 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 random subset of system-wide survey plots, the data can also be used to calculate detection ratios of the birds present in intensive area search plots. Further details on why this approach was used can be reviewed in GBBO (2008).

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. Intensive area searches involved accurate delineation of breeding territories of all birds present on the plot, using the cumulative knowledge from eight visits.

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, locations, and breeding evidence on the plot. 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. Only one plot could be covered in one morning, and all visits to a plot were done by the same surveyor.

All area searches were conducted between 13 April and 16 June, 2009. 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).

Whether the survey was a rapid or an intensive area search, the surveyor's goal was to record all birds present, and their location, on the plot on each visit. A minimum of two hours was spent to determine breeding status and territory location of covered species in rapid surveys, or of all birds in the intensive surveys. 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.

All bird sightings and territory boundaries were recorded directly on to an aerial photograph or a hand-drawn plot map, which also 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 a system-wide area search, 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”. For habitat creation site area searches, we delineated all territories that crossed the plot border and estimated the percentage, to the nearest 25%, of the territory that was inside the plot. This was done to provide for greater accuracy of territories present for site-based monitoring of habitat creation sites.

All observed breeding evidence was marked on the map, and breeding status, to the extent that it was known, were 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. 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 project area, and they are also known to 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.

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, juvenile, 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 by 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 in mid-April through mid-May, and the second round in mid-May through mid-June, 2009. This was different than the survey periods used in 2008 (which were two weeks later), because after the 2008 field season, it was determined that many breeding birds had already vacated their territories after the middle of June. This shift in survey periods was therefore done to better bracket the breeding season of most riparian species.

If one of the six covered species was found during a rapid area search, surveyors mapped its location, delineated its territory, and marked the location 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, recording confirmed and probable breeding evidence (see below), and determining which individuals were inside or outside of the plot based on the centroid of the polygon describing their activity. Rapid area search data collection was revised for 2009 to collect more data on breeding evidence than previously (for revised methods and datasheet, see Appendix 3). In rapid area searches, territories of covered species were delineated to the best of the surveyor's ability during the two visits. All species known only as migrants in the project area (e.g., Wilson's Warbler, *Wilsonia pusilla*) were automatically classified as presumed non-breeders. If a bird that is known to breed in the project area was found in the same location and displayed behaviors that indicated probable or confirmed breeding on both visits, it was determined a presumed breeder. In some cases, the breeding status of a bird could not be determined in just two visits, in which case it was classified as a presumed non-breeder. Details on how presumed breeders and non-breeders were determined by species can be found in the metadata of the rapid area search database at GBBO.

B. Intensive Area Searches

Intensive area searches were conducted on a subset of system-wide rapid area search plots and on habitat creations sites. Intensive area search plots were visited weekly for a total of eight visits. All territories were delineated for all species (covered and non-covered) 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 in terms of likeliness of nesting was recorded. Confirmed breeding was determined after finding an active nest or dependent young, or after observations of adults carrying nest material, food, or fecal sacs (for complete methods, see GBBO 2008). "Probable" breeding evidence, such as repeated calling near a particular location or mated pair in suitable nesting habitat, was recorded when breeding could not be otherwise confirmed. 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 behaviors in the "probable breeding" category. Also 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 plot map of territories using the cumulative data from all visits to determine the final number and locations of territories by species.

3. Double-Sampling

All rapid bird survey techniques may result in biased estimates of birds that are less detectable than others. For instance, densities of birds that 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 that 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 2009 season of system-wide bird surveys along the Lower Colorado River, we expended 36% of our total effort on intensive surveys, based on recommendations after the 2008 field season. Double-sampling was only done on system-wide survey plots, but not on habitat creation sites.

4. Population Data Analyses

For all intensive area searches, the data were summarized in two ways, by reporting (1) the total number of breeding territories based on end-of-season summaries of all presumed breeders, and (2) the average number of presumed non-breeding individuals detected 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 summary species lists, and were excluded from all quantitative analyses. Rapid area search data were summarized by presumed breeders (estimated number of territories) and presumed non-breeders (average number of detections per visit).

Detection ratios 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, only presumed breeders were included in both the detection ratio calculation and the resulting population size estimates, which were expressed in total number of breeding territories. To automate detection ratio calculation for double-sampling using rapid and intensive area searches, USGS (J. Bart pers. comm.) wrote the program Double Sampling (DS), which we used for all detection ratio calculations and population size estimation for system-wide surveys. This program will be made available for future monitoring efforts along the Lower Colorado River. For this report, we used the program to estimate territory numbers of the covered species and for the ten most abundant species using all data collected in the first three years of the project (2007 – 2009). Since not all strata were surveyed (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. Based on the combined detection ratio for these species, we used a detection ratio correction factor of 1.07 for all population size estimates.

5. Habitat Assessments for Covered Species

Field assessments to describe habitats used by covered species were initiated during the 2008 field season of LCR MSCP bird monitoring and completed in June of 2009. For the habitat assessments, we had a two-year goal of assessing 20 territories per covered species, as sample sizes allowed, paired with 20 non-use sites from the same region-habitat stratum. Only three of the six covered species were common enough in the system to approach this sample size (Tables 5a and 5b): Bell’s Vireo, Yellow Warbler, and Gila Woodpecker. We assessed 34 and 35 territories of Bell’s Vireo and Yellow Warbler, respectively, and 14 territories of Gila Woodpecker, which had large enough home ranges that it was often difficult to locate the territory center or nest. Summer Tanager, Vermilion Flycatcher and Glided Flicker are rare enough in the system, that this sample size goal could not be met based on total population sizes (Tables 5a and 5b).

Table 5a: Distribution of habitat assessments by species and river region of “use” sites (centered on a covered species’ territory or its nest) in 2008 and 2009.

Region	Gila					Total
	Bell’s Vireo	Wood-pecker	Summer Tanager	Vermilion Flycatcher	Yellow Warbler	
4	2	0	0	0	4	6
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	29	10	1	4	18	62
8	0	0	0	0	0	0
11 & 12	3	4	0	0	5	12
Habitat Creation Sites	0	0	0	7	8	15
Total	34	14	1	11	35	95

Table 5b: Distribution of habitat assessments on “non-use” sites (randomly selected in the same habitat stratum and the same or the adjoining river region) in 2008 and 2009. Eleven sites were used for more than one bird species, because they qualified as a non-use site for multiple species.

Region	Gila					Total
	Bell’s Vireo	Wood-pecker	Summer Tanager	Vermilion Flycatcher	Yellow Warbler	
4	5	0	0	0	5	10
5	3	4	0	0	5	12
6	2	6	0	0	6	14
7	17	7	2	3	9	38
8	0	8	1	11	1	21
11 & 12	3	2	0	0	6	11
Habitat Creation Sites	0	0	1	0	9	10
Total	30	27	4	14	41	116

All habitat assessments were completed during the bird survey seasons of 2008 and 2009 and in the last two weeks of September 2008. Habitat assessment on use sites focused on territory centers or nests, if one was found. If the nest was found, the habitat assessment was done after completion of the nesting cycle so as not to disturb it. Non-use sites were selected at random from the same region-habitat stratum, or if no non-use sites were available in the same stratum, the nearest region containing the same habitat type was used for random non-use site selection. We used a combination of landscape variable assessments, basic characterization of the vegetation cover types, and a microhabitat description using the point intercept method. The details of the habitat assessment protocol can be reviewed in Appendix 4.

6. Habitat Associations for Covered Species

We used a combination of the original habitat stratification for system-wide surveys and field habitat assessment data to characterize the habitats used by five of the six covered species. Since Gilded Flickers were not detected along the Lower Colorado River in both years of our project, this species is excluded from all habitat data presentations in this report. Our first step in characterizing habitat associations of the other covered species was to look at habitat strata from the system-wide sampling plan, in which the highest numbers of territories were estimated. Second, because most covered species occurred in their greatest abundances in the Bill Williams River region, we examined their distribution among habitat strata in more detail within this region.

Then, we used the habitat assessment data collected on territories of four of the covered species (Bell's Vireo, Yellow Warbler, Gila Woodpecker, and Vermilion Flycatcher) as the basis for (1) habitat descriptors that can be used as guidelines for target habitat structure and floristics in restoration efforts, and (2) determining which habitat variables were statistically good predictors of a breeding territory for each of the four species. The latter analysis was done with univariate logistic regressions using each habitat variable as a predictor for presence in a comparison between used sites and non-use sites, as well as bivariate and trivariate logistic regression on the variables that were selected *a priori* for each species based on its known natural history. The bivariate and trivariate analysis results were either inconclusive or mirrored those of the univariate analyses, which is the reason we are only reporting the results of the univariate analysis in this report.

Results

1. Overall Species Richness Patterns

A total of 172 species of birds were detected in all surveys along the Lower Colorado River in 2009 (Appendix 5), which results in a total of 192 species recorded in 2008 and 2009. Of the 172 species, 76 (44%) were species that use the Lower Colorado River project area only during migration or wintering. Appendix 5 lists all species that are transient in the project area. All 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 149 species were recorded in system-wide surveys, compared with 82 species in habitat creation site surveys. Eight species were unique to habitat creation sites, which were largely migrant species, such as Rufous Hummingbird, Rose-breasted Grosbeak, and Cordilleran Flycatcher. Similar to last year's findings, species that were unique to system-wide survey plots included (1) migrant species, such as Brewer's Sparrow and Olive-sided Flycatcher, (2) species associated with old-growth riparian trees, such as Gila Woodpecker and Brown-crested Flycatcher (3) upland species, such as Cactus Wren and Black-throated Sparrow, and (4) water- and marsh birds, such as Clapper Rail, Sora, Marsh Wren, and a variety of duck species (Appendix 5).

2. System-Wide Surveys

A. Rapid Area Searches

During two rapid area searches of each of 80 plots, we recorded 21,789 adults of 149 species system-wide. Of these, 83 species were presumed breeders and 66 were migrants or presumed non-breeders. The number of territories of presumed breeders varied widely among species, with the most abundant species being either riparian associated (Common Yellowthroat, Abert's Towhee), or generalist species (Mourning Dove, White-winged Dove; Table 6). The most common breeder of the covered species was Bell's Vireo (71 territories), followed by Yellow Warbler (56), Gila Woodpecker (29), Summer Tanager (10) and Vermilion Flycatcher (3). Gilded Flickers were not detected in any of the surveys.

Table 6. Total number of territories of presumed breeders in 80 system-wide rapid area search plots in 2009. Species listed in descending order of abundance.

Species	Number of Territories
Common Yellowthroat	245
Mourning Dove	244
Abert's Towhee	228

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Species	Number of Territories
Verdin	223
White-winged Dove	212
Marsh Wren	183
Yellow-breasted Chat	182
Black-tailed Gnatcatcher	171
Brown-headed Cowbird	169
Gambel's Quail	152
Song Sparrow	141
Great-tailed Grackle	134
Lucy's Warbler	90
Ash-throated Flycatcher	84
House Finch	76
Blue Grosbeak	74
Bell's Vireo*	71
Lesser Nighthawk	60
Ladder-backed Woodpecker	57
Yellow Warbler*	56
American Coot	54
Black-chinned Hummingbird	52
Bewick's Wren	48
Western Kingbird	47
Anna's Hummingbird	46
Eurasian Collared-Dove	32
Phainopepla	31
Rock Wren	30
Gila Woodpecker*	29
Black-throated Sparrow	26
Bullock's Oriole	26
Common Ground-Dove	25
Greater Roadrunner	23
Northern Mockingbird	23
Crissal Thrasher	21
Pied-billed Grebe	20
Say's Phoebe	20
Lesser Goldfinch	17
Killdeer	15
Loggerhead Shrike	12
Costa's Hummingbird	11
European Starling	11
Black Phoebe	10
Common Moorhen	10
Least Bittern	10
Summer Tanager*	10
American Kestrel	9
Black-necked Stilt	8
Canyon Wren	7
Green Heron	7
Brown-crested Flycatcher	6

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Species	Number of Territories
Cactus Wren	6
Clapper Rail	6
House Sparrow	6
Lazuli Bunting	6
Northern Rough-winged Swallow	6
Blue-gray Gnatcatcher	5
Hooded Oriole	5
Horned Lark	5
Mallard	5
Virginia Rail	5
Western Meadowlark	5
Belted Kingfisher	3
Common Raven	3
Great Egret	3
Vermilion Flycatcher*	3
Western Grebe	3
Sharp-shinned Hawk	2
Sora	2
White-throated Swift	2
Black-crowned Night-Heron	1
Brewer's Blackbird	1
Chipping Sparrow	1
Cliff Swallow	1
Cooper's Hawk	1
Eared Grebe	1
Great Blue Heron	1
Northern Harrier	1
Red-tailed Hawk	1
Rock Pigeon	1
Scott's Oriole	1
White-faced Ibis	1
Yellow-headed Blackbird	1

*LCR MSCP covered species

All detections of migrants and presumed non-breeders of 149 species are listed for the two rapid area search periods in Table 7. Yellow Warbler, Summer Tanager, and Bell's Vireos were more numerous in the first than in the second survey period. Gila Woodpeckers were more numerous in the second survey period due to an increase in juveniles, as were Willow Flycatchers (probably due to later migration, rather than juveniles; Table 7).

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Table 7. Number of detections for migrants and presumed non-breeders during system-wide rapid area searches in 2009’s first and second survey periods (mid April - mid May, mid May - mid June, respectively), and the maximum number of birds detected in a survey. Species listed in descending order of abundance.

Species	Total for Survey Period 1	Total for Survey Period 2	Maximum Detected in a Survey
White-faced Ibis	1692	111	1692
Red-winged Blackbird	1068	975	1068
White-winged Dove	325	925	925
Mourning Dove	631	894	894
Tree Swallow	798	17	798
Cliff Swallow	671	540	671
Great-tailed Grackle	661	329	661
Northern Rough-winged Swallow	551	438	551
Yellow-headed Blackbird	468	170	468
American White Pelican	321	1	321
Wilson's Warbler	260	60	260
European Starling	19	221	221
Brown-headed Cowbird	213	117	213
House Finch	61	187	187
Lesser Nighthawk	21	111	111
American Coot	81	39	81
Rock Pigeon	75	39	75
Yellow-rumped Warbler	69	5	69
Turkey Vulture	60	54	60
Verdin	30	55	55
Eurasian Collared-Dove	50	51	51
Warbling Vireo	49	12	49
Western Tanager	38	13	38
Snowy Egret	37	33	37
Nashville Warbler	36	0	36
Great Egret	35	29	35
Violet-green Swallow	32	0	32
Black-necked Stilt	31	9	31
Common Yellowthroat	29	17	29
Gambel's Quail	13	27	27
Western Kingbird	27	23	27
Savannah Sparrow	26	3	26
Black-headed Grosbeak	25	9	25
Common Raven	25	17	25
Phainopepla	12	25	25
Barn Swallow	23	2	23
Mallard	22	14	22
Song Sparrow	22	20	22
Great Blue Heron	20	17	20
Green Heron	8	20	20
Willow Flycatcher*	1	20	20
Double-crested Cormorant	19	16	19

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Species	Total for Survey Period 1	Total for Survey Period 2	Maximum Detected in a Survey
White-throated Swift	19	12	19
Orange-crowned Warbler	18	0	18
White-crowned Sparrow	18	4	18
Common Merganser	15	0	15
Clark's Grebe	0	14	14
Forster's Tern	14	5	14
Bell's Vireo*	13	6	13
Spotted Sandpiper	11	13	13
Western Grebe	13	1	13
Black-throated Gray Warbler	12	2	12
Ladder-backed Woodpecker	12	7	12
Lesser Goldfinch	12	2	12
Loggerhead Shrike	1	12	12
Lucy's Warbler	7	12	12
MacGillivray's Warbler	12	0	12
Eared Grebe	0	11	11
Lazuli Bunting	11	3	11
Townsend's Warbler	11	1	11
Western Wood-Pewee	11	6	11
Brewer's Sparrow	10	0	10
Bullock's Oriole	10	0	10
<i>Empidonax</i> spp.	10	4	10
Hummingbird spp.	10	5	10
Black-chinned Hummingbird	3	9	9
Black-tailed Gnatcatcher	9	4	9
Herring Gull	9	0	9
Redhead	0	9	9
Abert's Towhee	8	7	8
Cinnamon Teal	8	0	8
Gila Woodpecker*	6	8	8
Lark Sparrow	5	8	8
Osprey	6	8	8
Vesper Sparrow	4	8	8
Yellow-breasted Chat	8	6	8
American Goldfinch	2	7	7
American Kestrel	2	7	7
Red-tailed Hawk	7	6	7
Ash-throated Flycatcher	3	6	6
Common Ground-Dove	3	6	6
Indigo Bunting	0	6	6
Killdeer	5	6	6
Northern Pintail	6	0	6
Black-crowned Night-Heron	1	5	5
Black-throated Sparrow	0	5	5
Common Goldeneye	5	3	5
Marsh Wren	4	5	5
Pied-billed Grebe	3	5	5
Vaux's Swift	5	0	5

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Species	Total for Survey Period 1	Total for Survey Period 2	Maximum Detected in a Survey
Yellow Warbler*	5	1	5
Black Phoebe	3	4	4
Cattle Egret	0	4	4
Dusky Flycatcher	4	3	4
Hermit Warbler	4	1	4
Northern Harrier	4	0	4
Pacific-slope Flycatcher	4	3	4
Ruby-crowned Kinglet	4	0	4
Belted Kingfisher	3	0	3
Blue Grosbeak	1	3	3
Crissal Thrasher	3	0	3
Ringed-necked Pheasant	3	3	3
Rock Wren	1	3	3
Say's Phoebe	3	1	3
American Bittern	0	2	2
Anna's Hummingbird	1	2	2
Barn Owl	2	0	2
Bewick's Wren	0	2	2
Canyon Wren	1	2	2
Clapper Rail*	2	0	2
Cooper's Hawk	2	0	2
Dowitcher spp.	2	0	2
Least Bittern	2	1	2
Peregrine Falcon	1	2	2
Ring-necked Duck	2	0	2
Sharp-shinned Hawk	2	0	2
Spotted Towhee	0	2	2
Summer Tanager*	2	0	2
Virginia Rail	0	2	2
Virginia's Warbler	2	0	2
Western Meadowlark	2	2	2
Bald Eagle	0	1	1
Broad-tailed Hummingbird	1	0	1
Brown-crested Flycatcher	1	1	1
Cactus Wren	0	1	1
Canvasback	1	0	1
Caspian Tern	0	1	1
Cassin's Kingbird	1	0	1
Cassin's Vireo	1	0	1
Chipping Sparrow	1	0	1
Clay-colored Sparrow	1	0	1
Common Loon	1	1	1
Common Moorhen	1	1	1
Costa's Hummingbird	1	0	1
Gadwall	0	1	1
Gray Flycatcher	1	0	1
Great Horned Owl	1	0	1
Greater Roadrunner	1	1	1

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Species	Total for Survey Period 1	Total for Survey Period 2	Maximum Detected in a Survey
Green-tailed Towhee	0	1	1
Gull spp.	0	1	1
Hawk spp.	1	0	1
Hermit Thrush	1	0	1
Horned Lark	1	1	1
Long-billed Curlew	0	1	1
Northern Mockingbird	1	1	1
Plumbeous Vireo	1	0	1
Prairie Falcon	1	0	1
Ring-billed Gull	1	0	1
Sage Sparrow	1	0	1
Solitary Vireo spp.	1	0	1
Sora	1	0	1
Varied Thrush	1	0	1
Total (all species)	9106	5975	9106

* LCR MSCP covered species

B. Intensive Area Searches

During system-wide intensive area searches, we recorded and mapped 527 breeding territories of 43 species. We found evidence for four of the covered species nesting in intensive area search plots, with 22 territories of Yellow Warbler, nine of Bell's Vireo, six of Gila Woodpecker, and one Summer Tanager territory (Table 8).

Table 8. Total number of territories by species detected during system-wide intensive area searches, 2009. Listed in descending order of abundance.

Species	Number of Territories
Song Sparrow	70
Yellow-breasted Chat	64
Abert's Towhee	44
Common Yellowthroat	43
White-winged Dove	37
Verdin	34
Mourning Dove	26
Brown-headed Cowbird	25
Yellow Warbler*	22
Black-tailed Gnatcatcher	17
Ladder-backed Woodpecker	12
Gambel's Quail	12
Ash-throated Flycatcher	12
Bewick's Wren	10
Lucy's Warbler	9
Bell's Vireo*	9

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Species	Number of Territories
Western Kingbird	8
Black-chinned Hummingbird	8
Lesser Nighthawk	7
Gila Woodpecker*	6
Red-winged Blackbird	5
House Finch	5
Horned Lark	5
Eurasian Collared-Dove	5
Bullock's Oriole	5
Blue Grosbeak	5
Great-tailed Grackle	4
Greater Roadrunner	2
Anna's Hummingbird	2
Willow Flycatcher*	1
Turkey Vulture	1
Summer Tanager*	1
Phainopepla	1
Marsh Wren	1
Lark Sparrow	1
European Starling	1
Crissal Thrasher	1
Brown-crested Flycatcher	1
Brewers Blackbird	1
Blue-gray Gnatcatcher	1
Belted Kingfisher	1
American Kestrel	1
American Coot	1
Total	527

* LCR MSCP covered species

C. System-Wide Territory Number Estimates

By combining all three of the first years of this project (2007-2009) to calculate a double-sampling based detection ratio, our system-wide population size estimates for presumed breeders of the covered species result in more than 4000 Bell's Vireo territories, more than 3600 Yellow Warbler territories, 2700 Gila Woodpecker territories, 720 Summer Tanager territories, and more than 190 Vermilion Flycatcher territories (Table 9).

Bell's Vireo had the highest estimated population size system-wide of all covered species, and it occurred in 16 strata (of a total of 45 strata surveyed in three years). The second most abundant of the covered species, the Yellow Warbler, occurred in 19 strata. Vermilion Flycatcher occurred in the lowest number of strata (3), compared with Summer Tanager (11) and Gila Woodpecker (16). For all but the Summer Tanager, stratum 7.4 in the Bill Williams River area contained the largest portion of the estimated population size (Table 9).

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Table 9. Estimated number of territories of covered species, by stratum, based on system-wide surveys completed in 2007-2009. Strata combinations are listed as geographic region first, habitat second, separated by a period. For details on strata definitions, see methods. Dashes indicate strata that were not surveyed in 2007, 2008, or 2009. Strata combinations that are not listed were empty (no habitat in that geographic stratum).

Stratum: Region.Habitat	Bell's Vireo	Gila Woodpecker	Summer Tanager	Vermilion Flycatcher	Yellow Warbler
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	0
3.3	0	0	0	0	0
3.4	0	0	0	0	256
3.5	0	0	0	0	0
4.0	0	0	0	0	321
4.1	113	0	4	0	162
4.3	91	0	0	0	0
4.4	103	0	0	0	103
5.0	0	0	0	0	0
5.1	47	12	0	0	35
5.2	0	0	0	0	2
5.3	0	0	0	0	0
5.4	0	0	0	0	0
5.5	0	0	43	0	85
6.0	0	0	0	0	0
6.1	15	11	7	0	35
6.3	117	0	0	0	0
6.4	0	0	0	0	0
6.5	25	0	0	0	139
7.0	0	194	0	0	0
7.1	985	384	168	0	571
7.2	192	44	28	3	92
7.3	194	194	0	0	233
7.4	1796	520	142	189	898
7.5	0	0	0	0	0
8.0	-	-	-	-	-
8.1	-	-	-	-	-
8.3	-	-	-	-	-
8.4	-	-	-	-	-

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Stratum: Region.Habitat	Bell's Vireo	Gila Woodpecker	Summer Tanager	Vermilion Flycatcher	Yellow Warbler
8.5	-	-	-	-	-
9.0	-	-	-	-	-
9.1	-	-	-	-	-
9.2	-	-	-	-	-
9.3	-	-	-	-	-
9.4	-	-	-	-	-
9.5	-	-	-	-	-
10.0	-	-	-	-	-
10.1	0	0	0	0	0
10.2	0	0	0	0	0
10.3	173	0	173	0	173
10.4	0	0	0	0	0
10.5	-	-	-	-	-
11.0	0	110	0	0	0
11.1	5	42	32	5	53
11.2	0	13	0	0	7
11.3	123	368	0	0	0
11.4	0	0	0	0	384
11.5	42	0	42	0	0
12.0	0	0	0	0	0
12.1	7	166	0	0	41
12.2	0	11	3	0	20
12.3	0	336	0	0	0
12.4	0	235	78	0	0
12.5	0	134	0	0	0
13.0	-	-	-	-	-
13.1	-	-	-	-	-
13.2	-	-	-	-	-
13.3	-	-	-	-	-
13.4	-	-	-	-	-
13.5	-	-	-	-	-
Total	4027	2774	720	197	3610

For the ten most abundant species system-wide, we calculated population size estimates using the same methods as for covered species. Based on data from 2007 - 2009, the most common species were Mourning Dove and White-winged Dove with > 25,000 territories estimated to be present (Table 10). Red-winged Blackbirds may be even more numerous, but they were not included in this analysis due to their clustered distribution, which confounds our methods of population size estimation. The ten most abundant species (except the Marsh Wren) were also widespread throughout the project area, with detections in most of the surveyed strata.

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Table 10. Estimated number of territories of the ten most abundant species breeding along the Lower Colorado River, by stratum, based on system-wide surveys completed in 2007 - 2009. Dashes indicate strata that were not surveyed from 2007-2009. For details on strata definitions, see methods. Strata combinations that are not listed were empty (no habitat in that geographic stratum).

Stratum: Region.Habitat	Abert's Towhee	Brown-headed Cowbird	Black-tailed Gnatcatcher	Common Yellowthroat	Gambel's Quail	Marsh Wren	Mourning Dove	Verdin	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	0	743	0	1858	0	1486	372	372	0
3.3	0	43	86	0	86	0	214	43	0	0
3.4	1537	1025	1281	1537	2049	0	2561	768	0	256
3.5	-	-	-	-	-	-	-	-	-	-
4.0	641	0	641	0	160	0	481	160	160	0
4.1	37	78	57	49	18	0	31	25	70	74
4.3	728	182	1364	91	909	0	273	455	0	91
4.4	206	0	619	206	103	0	516	0	0	103
5.0	-	-	-	-	-	-	-	-	-	-
5.1	157	116	41	47	93	0	221	250	262	93
5.2	7	3	2	5	0	0	14	8	0	2
5.3	2694	1122	2694	0	4040	0	4265	1122	2245	1122
5.4	4321	0	3241	0	0	0	1080	2161	2161	1080
5.5	426	341	170	1108	256	554	43	213	128	128
6.0	395	1976	1186	1581	3162	0	395	1186	2767	0
6.1	80	100	41	95	57	7	80	78	108	76
6.3	1405	2576	1639	1522	0	234	585	1288	1873	117
6.4	1252	0	0	0	313	0	626	0	626	0
6.5	38	215	51	796	13	2490	126	202	253	114
7.0	0	0	389	0	194	0	0	194	194	194
7.1	288	631	132	703	240	0	300	384	619	1477

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7.2	133	222	22	175	42	0	208	47	131	422
7.3	233	311	155	233	427	0	583	544	233	427
7.4	1229	1181	992	1323	1607	47	1087	1654	1134	2268
7.5	10	29	19	162	0	48	19	0	29	29
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	24	77	5	58	0	0	48	5	58	39
10.2	4	4	0	0	0	0	7	0	22	0
10.3	691	1555	864	3801	518	346	2419	1901	4838	3801
10.4	0	229	457	686	0	0	1601	229	229	457
10.5	-	-	-	-	-	-	-	-	-	-
11.0	110	219	219	658	329	110	219	329	329	110
11.1	110	147	68	258	76	100	126	163	200	121
11.2	32	32	34	71	17	45	28	45	41	22
11.3	245	613	858	1471	1594	490	613	2575	1717	613
11.4	0	0	192	0	0	384	0	0	192	0
11.5	127	888	169	2537	0	1776	423	423	296	930
12.0	312	312	624	0	624	0	312	624	312	0
12.1	573	746	414	456	297	28	614	656	953	117
12.2	189	155	116	133	124	11	212	181	130	14
12.3	1514	3027	1009	841	505	0	5213	2523	2691	673
12.4	391	235	469	626	313	0	469	782	860	156
12.5	0	134	0	401	134	134	201	268	268	0
13.0	-	-	-	-	-	-	-	-	-	-
13.1	-	-	-	-	-	-	-	-	-	-
13.2	-	-	-	-	-	-	-	-	-	-
13.3	-	-	-	-	-	-	-	-	-	-
13.4	-	-	-	-	-	-	-	-	-	-
13.5	-	-	-	-	-	-	-	-	-	-
Total	20139	18524	21064	21630	20159	6804	27701	21856	26497	15129

3. Habitat Creation Sites

During intensive area searches on 19 plots in habitat creation sites, we recorded 559 breeding territories of 34 species. Four of our six covered species, Bell’s Vireo, Yellow Warbler, Summer Tanager, and Vermilion Flycatcher, were recorded as presumed breeders in the habitat creation sites (Table 11). Gila Woodpecker and Gilded Flickers were not detected. The number of territories detected in habitat creation sites are listed in

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Table 11, and the number of migrants and presumed non-breeders detected in habitat creation sites are listed in Table 12.

Table 11. Total number of territories, by species, detected in intensive area searches on habitat creation plots in 2009. Partial territories included in habitat creation site surveys (see Methods). Species are listed in descending order of abundance.

Species	Number of Territories
Mourning Dove	133
White-winged Dove	94
Abert's Towhee	52.5
Blue Grosbeak	34.8
Brown-headed Cowbird	33.5
Verdin	25
Common Yellowthroat	21.8
Yellow-breasted Chat	21
Song Sparrow	15.8
Anna's Hummingbird	14
Bullock's Oriole	13.5
Yellow Warbler*	12.5
Red-winged Blackbird	11.5
Western Kingbird	10.5
Bell's Vireo*	10
Gambel's Quail	9.8
Indigo Bunting	7.8
Black-tailed Gnatcatcher	4
House Finch	4
Lucy's Warbler	4
Ash-throated Flycatcher	3.8
Black-chinned Hummingbird	2
Summer Tanager*	1.8
Greater Roadrunner	1.5
Vermilion Flycatcher*	1.5
Crissal Thrasher	1
Ladder-backed Woodpecker	1
Northern Harrier	1
Common Ground-Dove	0.5
Northern Mockingbird	0.5
Total	558.5

* LCR MSCP covered species

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Table 12. Number of detections of migrants and presumed non-breeders recorded during intensive area searches on habitat creation plots, 2009. Incidental species and fly-overs are not included. Listed in descending order of abundance.

Species	Total # birds over the 8 surveys
House Finch	236
Red-winged Blackbird	213
Wilson's Warbler	164
Mourning Dove	131
Brown-headed Cowbird	108
Western Wood-Pewee	86
White-winged Dove	80
Lucy's Warbler	69
Abert's Towhee	53
Black-tailed Gnatcatcher	48
Great-tailed Grackle	48
Western Flycatcher spp.	35
Bullock's Oriole	34
Western Kingbird	32
Anna's Hummingbird	26
Warbling Vireo	25
Western Tanager	25
Ladder-backed Woodpecker	23
Blue Grosbeak	22
Hummingbird spp.	19
Song Sparrow	17
White-crowned Sparrow	17
Lesser Nighthawk	16
Indigo Bunting	15
Nashville Warbler	15
Townsend's Warbler	15
Common Yellowthroat	14
Black-headed Grosbeak	12
Northern Rough-winged Swallow	12
Verdin	11
American Goldfinch	10
Killdeer	10
Orange-crowned Warbler	10
Yellow-rumped Warbler	10
Gambel's Quail	9
Yellow Warbler*	9
Horned Lark	8
Summer Tanager*	8
Swainson's Thrush	8
Bell's Vireo*	7
Yellow-breasted Chat	7
Ash-throated Flycatcher	6

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Species	Total # birds over the 8 surveys
Great Horned Owl	6
Vermilion Flycatcher*	6
Willow Flycatcher*	6
Yellow-headed Blackbird	6
Greater Roadrunner	5
White-throated Sparrow	5
Wild Turkey	5
Eurasian Collared-Dove	4
Hooded Warbler	4
MacGillivray's Warbler	4
Black-throated Gray Warbler	3
Crissal Thrasher	3
Dove spp.	3
Hermit Warbler	3
Lesser Goldfinch	3
Ruby-crowned Kinglet	3
Solitary Vireo spp.	3
Sparrow spp.	3
American Kestrel	2
Black-chinned Hummingbird	2
European Starling	2
Green-tailed Towhee	2
Lazuli Bunting	2
Pacific-slope Flycatcher	2
Turkey Vulture	2
Warbler spp.	2
Western Bluebird	2
Barn Owl	1
Bewick's Wren	1
Bushtit	1
Cassin's Vireo	1
Chipping Sparrow	1
Common Ground-Dove	1
Common Raven	1
Cordilleran Flycatcher	1
Falcon spp.	1
Flycatcher spp.	1
Inca Dove	1
Le Conte's Thrasher	1
Northern Harrier	1
Northern Mockingbird	1
Owl spp.	1
Phainopepla	1
Red-shouldered Hawk	1
Rose-breasted Grosbeak	1
Rufous Hummingbird	1

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Species	Total # birds over the 8 surveys
Thrush spp.	1
Western Meadowlark	1

* LCR MSCP covered species

Beal Lake Riparian Habitat Creation Site

In the Beal Lake Riparian habitat creation site, our 2009 intensive area searches in four plots resulted in 97 breeding territories and 176 detections of presumed non-breeders (Tables 13 and 14). Similar to our system-wide findings, Bell's Vireos were the most common breeder of the covered species, with territories in Beal A, B, C, and D. Yellow Warblers were found nesting in Beal B and C, and one Summer Tanager in Beal C (Table 13).

Table 13. Number of breeding territories by species detected in Beal Lake intensive area search plots in 2009. Listed in descending order of abundance.

Species	Number of Territories				
	Beal A	Beal B	Beal C	Beal D	Total Beal
Yellow-breasted Chat	3	6	4	1	14
Abert's Towhee	3.25	2.25	5.25	3	13.75
Verdin	3	2.5	2	3	10.5
Bell's Vireo*	2.5	2.25	3.75	1.5	10
Yellow Warbler*	0	2	5	0	7
Brown-headed Cowbird	2	2	2.25	0	6.25
Song Sparrow	0.5	2.25	2	1	5.75
Common Yellowthroat	0	3.25	2	0	5.25
Mourning Dove	1	4	0	0	5
Blue Grosbeak	0	3.75	0	1	4.75
Indigo Bunting	0	3.5	1	0	4.5
Black-tailed Gnatcatcher	1	0	1	1	3
Gambel's Quail	0	1	0	1	2
Lucy's Warbler	1	0	0	1	2
Bullock's Oriole	0	0	1	0	1
Crissal Thrasher	0	0	1	0	1
Summer Tanager*	0	0	1	0	1
Total	17.25	34.75	31.25	13.5	96.75

* LCR MSCP covered species

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Table 14. Average number of migrants and presumed non-breeders, by species, detected during intensive area searches at Beal Lake habitat creation plots in 2009. Incidental detections and birds that were observed flying over the plots are not included. Listed in descending order of abundance.

Species	Beal A	Beal B	Beal C	Beal D	Beal Total Detections	Beal Average
Lucy's Warbler	0.0	5.4	0.0	0.1	39	5.6
Wilson's Warbler	0.1	0.7	1.4	0.6	20	2.9
Great-tailed Grackle	0.0	2.4	0.0	0.0	17	2.4
Red-winged Blackbird	0.0	2.3	0.0	0.0	16	2.3
Black-tailed Gnatcatcher	0.3	1.9	0.0	0.0	15	2.1
Western Wood-Pewee	0.0	1.4	0.1	0.0	11	1.6
Indigo Bunting	0.0	0.1	0.6	0.7	10	1.4
Mourning Dove	0.0	1.1	0.0	0.0	8	1.1
Bullock's Oriole	0.0	0.7	0.0	0.0	5	0.7
Summer Tanager*	0.0	0.1	0.4	0.0	4	0.6
Blue Grosbeak	0.0	0.0	0.3	0.1	3	0.4
Crissal Thrasher	0.0	0.1	0.3	0.0	3	0.4
Yellow-rumped Warbler	0.0	0.3	0.1	0.0	3	0.4
Ash-throated Flycatcher	0.0	0.0	0.1	0.1	2	0.3
Bell's Vireo*	0.0	0.0	0.1	0.1	2	0.3
Green-tailed Towhee	0.0	0.1	0.0	0.1	2	0.3
Killdeer	0.0	0.0	0.3	0.0	2	0.3
Verdin	0.0	0.0	0.0	0.3	2	0.3
White-throated Sparrow	0.0	0.0	0.0	0.3	2	0.3
Abert's Towhee	0.0	0.0	0.1	0.0	1	0.1
Bewick's Wren	0.1	0.0	0.0	0.0	1	0.1
Bushtit	0.0	0.0	0.1	0.0	1	0.1
Hummingbird spp.	0.0	0.1	0.0	0.0	1	0.1
Lesser Nighthawk	0.0	0.1	0.0	0.0	1	0.1
Townsend's Warbler	0.0	0.1	0.0	0.0	1	0.1
Western Flycatcher spp.	0.0	0.0	0.0	0.1	1	0.1
Western Tanager	0.0	0.1	0.0	0.0	1	0.1
White-crowned Sparrow	0.1	0.0	0.0	0.0	1	0.1
Yellow-breasted Chat	0.0	0.0	0.0	0.1	1	0.1
Total	5.0	122.0	29.0	20.0	176	25.1

* LCR MSCP covered species

Colorado River Indian Tribe (CRIT 9)

Five intensive area search plots in the Colorado River Indian Tribe habitat creation site (CRIT 9) resulted in 158 breeding territories and 740 detections of presumed non-breeders (Tables 15 and 16). Vermilion Flycatchers were found using mesquite woodlands of CRIT 9 A and Summer Tanagers were using cottonwood-willow habitat in CRIT 9 C.

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Table 15. Number of breeding territories by species found in Colorado River Indian Tribe (CRIT 9) intensive area search plots in 2009. Listed in descending order of abundance.

Species	Number of Territories					Total CRIT 9
	CRIT 9 A	CRIT 9 B	CRIT 9 C	CRIT 9 D	CRIT 9 E	
Mourning Dove	19	9	12	7	10	57
White-winged Dove	4	4	10	20	1	39
Abert's Towhee	3.75	2.5	4.75	2.25	3	16.25
Brown-headed Cowbird	5	3	1	1	4	14
Anna's Hummingbird	1	0	3	1	0	5
Gambel's Quail	2	0	1	0.5	1.25	4.75
Verdin	0	0	1.8	2	0	3.8
Blue Grosbeak	0.75	1.25	0	1	0	3
Bullock's Oriole	0	0	0.5	1	0.75	2.25
Ash-throated Flycatcher	0.75	0.25	0	1	0	2
House Finch	0	0	1	1	0	2
Lucy's Warbler	0.5	0.5	0	1	0	2
Vermilion Flycatcher*	1.5	0	0	0	0	1.5
Black-tailed Gnatcatcher	0	0	0	1	0	1
Indigo Bunting	0	1	0	0	0	1
Western Kingbird	0	0	0	0.5	0.5	1
Summer Tanager*	0	0	0.8	0	0	0.8
Greater Roadrunner	0	0	0.5	0.1	0	0.6
Ladder-backed Woodpecker	0	0	0.5	0	0	0.5
Northern Mockingbird	0.5	0	0	0	0	0.5
Total	38.75	21.5	36.85	40.35	20.5	157.95

*LCR MSCP Covered species

Table 16. Average number of migrants and non-breeding individuals, by species, detected during intensive area searches at Colorado River Indian Tribe (CRIT 9) habitat creation plots in 2009. Incidental detections and birds that were observed flying over the plots are not included. Listed in descending order of abundance.

Species	CRIT A	CRIT B	CRIT C	CRIT D	CRIT E	Total CRIT 9 Detections	CRIT 9 Average
House Finch	13.0	0.6	0.8	4.4	8.0	214	26.8
Mourning Dove	1.4	0.9	0.4	1.5	5.6	78	9.8
Wilson's Warbler	3.0	1.3	1.1	1.0	0.9	58	7.3
Western Wood-Pewee	2.0	1.0	0.4	0.5	0.6	36	4.5
Black-tailed Gnatcatcher	1.3	0.3	1.8	0.3	0.6	33	4.1
Western Flycatcher spp.	1.0	0.4	2.3	0.4	0.0	32	4.0
Lucy's Warbler	2.4	0.5	0.5	0.4	0.0	30	3.8
Great-tailed Grackle	0.0	0.3	0.3	0.1	2.6	26	3.3
White-winged Dove	0.6	0.9	0.1	0.1	1.5	26	3.3
Brown-headed Cowbird	0.0	0.0	0.1	2.5	0.0	21	2.6
Ladder-backed Woodpecker	1.1	1.3	0.0	0.0	0.0	19	2.4
Western Kingbird	0.6	0.0	0.5	0.4	0.4	15	1.9
Hummingbird spp.	0.4	0.6	0.0	0.3	0.3	12	1.5
Lesser Nighthawk	0.0	0.0	0.0	0.3	1.3	12	1.5

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Species	CRIT A	CRIT B	CRIT C	CRIT D	CRIT E	Total CRIT 9 Detections	CRIT 9 Average
White-crowned Sparrow	0.9	0.4	0.0	0.0	0.0	10	1.3
Bullock's Oriole	0.3	0.5	0.4	0.0	0.0	9	1.1
Anna's Hummingbird	0.4	0.3	0.0	0.4	0.0	8	1.0
Verdin	0.8	0.0	0.0	0.3	0.0	8	1.0
Orange-crowned Warbler	0.0	0.3	0.4	0.3	0.0	7	0.9
Western Tanager	0.4	0.0	0.4	0.0	0.1	7	0.9
Blue Grosbeak	0.0	0.0	0.4	0.0	0.4	6	0.8
Great Horned Owl	0.0	0.1	0.3	0.1	0.3	6	0.8
Vermilion Flycatcher*	0.0	0.0	0.4	0.4	0.0	6	0.8
Bell's Vireo*	0.1	0.0	0.1	0.3	0.0	4	0.5
Black-headed Grosbeak	0.0	0.0	0.1	0.3	0.1	4	0.5
Greater Roadrunner	0.3	0.0	0.0	0.1	0.1	4	0.5
Summer Tanager*	0.0	0.5	0.0	0.0	0.0	4	0.5
Hermit Warbler	0.3	0.0	0.1	0.0	0.0	3	0.4
Hooded Warbler	0.1	0.1	0.0	0.0	0.1	3	0.4
Lesser Goldfinch	0.1	0.0	0.3	0.0	0.0	3	0.4
MacGillivray's Warbler	0.1	0.0	0.0	0.1	0.1	3	0.4
Northern Rough-winged Swallow	0.4	0.0	0.0	0.0	0.0	3	0.4
Townsend's Warbler	0.1	0.0	0.3	0.0	0.0	3	0.4
Yellow-rumped Warbler	0.0	0.0	0.0	0.4	0.0	3	0.4
Abert's Towhee	0.0	0.0	0.0	0.3	0.0	2	0.3
American Kestrel	0.0	0.0	0.3	0.0	0.0	2	0.3
Gambel's Quail	0.0	0.0	0.0	0.3	0.0	2	0.3
Indigo Bunting	0.1	0.0	0.1	0.0	0.0	2	0.3
Red-winged Blackbird	0.0	0.0	0.0	0.0	0.3	2	0.3
Swainson's Thrush	0.0	0.1	0.1	0.0	0.0	2	0.3
Yellow Warbler	0.0	0.0	0.1	0.1	0.0	2	0.3
Ash-throated Flycatcher	0.0	0.0	0.0	0.0	0.1	1	0.1
Black-chinned Hummingbird	0.1	0.0	0.0	0.0	0.0	1	0.1
Inca Dove	0.0	0.1	0.0	0.0	0.0	1	0.1
Northern Harrier	0.0	0.0	0.1	0.0	0.0	1	0.1
Northern Mockingbird	0.0	0.0	0.1	0.0	0.0	1	0.1
Phainopepla	0.1	0.0	0.0	0.0	0.0	1	0.1
Rose-breasted Grosbeak	0.0	0.0	0.1	0.0	0.0	1	0.1
Ruby-crowned Kinglet	0.0	0.0	0.0	0.1	0.0	1	0.1
Rufous Hummingbird	0.0	0.0	0.1	0.0	0.0	1	0.1
Turkey Vulture	0.0	0.0	0.1	0.0	0.0	1	0.1
Total	31.3	10.3	12.4	15.3	23.4	740	92.5

* LCR MSCP covered species

Cibola Valley Conservation Area (CVCA)

Five intensive area search plots in the Cibola Valley Conservation Area (CVCA) sites resulted in 163 breeding territories and a total of 429 detections of presumed non-

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breeders (Tables 17 and 18). Only one covered species, the Yellow Warbler was found breeding at CVCA. Willow Flycatcher was detected as a presumed non-breeder at this site.

Table 17. Number of territories by species detected in Cibola Valley Conservation Area (CVCA) intensive area search plots in 2009. Listed in descending order of abundance.

Species	Number of Territories					Total CVCA
	CVCA 1 A	CVCA 1 B	CVCA 1 CD	CVCA 3 AB	CVCA 3 CD	
Mourning Dove	10	5	10	12	10	47
White-winged Dove	7	0	9	16	10	42
Blue Grosbeak	1.75	2	4.5	3.5	2.25	14
Abert's Towhee	1.5	2.75	3.25	2.75	2	12.25
Red-winged Blackbird	2	0	0	0.5	8	10.5
Brown-headed Cowbird	0	2.75	2.75	2.5	0	8
Song Sparrow	0	2.5	3.5	0	0	6
Bullock's Oriole	2	0.75	2.5	0	0	5.25
Yellow Warbler*		1	2.5	0	0	3.5
Gambel's Quail	0	0	0	2	1	3
Indigo Bunting	0	2.25	0	0	0	2.25
Anna's Hummingbird	0	0	1.25	0	0	1.25
House Finch	0	1	0	0	0	1
Verdin	1	0	0	0	0	1
Ladder-backed Woodpecker	0.5	0	0	0	0	0.5
Western Kingbird	0.5	0	0	0	0	0.5
Total	26.25	20	41.75	40	34.5	162.5

* LCR MSCP covered species

Table 18. Average number of migrants and presumed non-breeders, by species, detected during intensive area searches at Cibola Valley Conservation Area (CVCA) habitat creation plots in 2009. Incidental detections and birds that were observed flying over the plots are not included. Listed in descending order of abundance.

Species	CVCA					CVCA Total Detections	CVCA Average
	1 A	1 B	1 CD	3 AB	3 CD		
Red-winged Blackbird	0.8	5.4	0.0	0.5	6.3	103	12.9
Brown-headed Cowbird	2.4	0.3	0.9	0.3	1.3	40	5.0
Mourning Dove	0.0	0.3	0.0	2.4	1.6	34	4.3
Wilson's Warbler	0.0	1.4	1.3	0.9	0.6	33	4.1
Abert's Towhee	1.0	0.0	1.0	0.8	1.1	31	3.9
White-winged Dove	0.0	0.5	0.0	2.9	0.0	27	3.4
Western Wood-Pewee	0.0	0.0	0.0	0.9	1.4	18	2.3
Warbling Vireo	0.0	0.1	0.9	0.5	0.5	16	2.0
House Finch	0.0	0.1	1.0	0.1	0.0	10	1.3
Song Sparrow	0.1	0.9	0.0	0.1	0.1	10	1.3
Western Tanager	0.0	0.8	0.3	0.1	0.1	10	1.3
Bullock's Oriole	0.1	0.3	0.6	0.0	0.0	8	1.0

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Species	CVCA					CVCA	CVCA
	1 A	1 B	1 CD	3 AB	3 CD	Total Detections	
Gambel's Quail	0.3	0.0	0.0	0.6	0.0	7	0.9
Horned Lark	0.1	0.0	0.0	0.1	0.6	7	0.9
Townsend's Warbler	0.0	0.0	0.5	0.1	0.1	6	0.8
Yellow-headed Blackbird	0.0	0.0	0.0	0.0	0.8	6	0.8
Blue Grosbeak	0.6	0.0	0.0	0.0	0.0	5	0.6
Yellow Warbler*	0.0	0.0	0.5	0.0	0.1	5	0.6
Anna's Hummingbird	0.1	0.0	0.4	0.0	0.0	4	0.5
Common Yellowthroat	0.0	0.0	0.3	0.0	0.3	4	0.5
Swainson's Thrush	0.0	0.0	0.4	0.0	0.1	4	0.5
Dove spp.	0.0	0.0	0.0	0.0	0.4	3	0.4
Nashville Warbler	0.0	0.1	0.0	0.1	0.1	3	0.4
Western Kingbird	0.3	0.0	0.0	0.1	0.0	3	0.4
Black-throated Gray Warbler	0.0	0.0	0.0	0.1	0.1	2	0.3
European Starling	0.3	0.0	0.0	0.0	0.0	2	0.3
Hummingbird spp.	0.0	0.0	0.1	0.0	0.1	2	0.3
Indigo Bunting	0.0	0.1	0.0	0.1	0.0	2	0.3
Ladder-backed Woodpecker	0.0	0.3	0.0	0.0	0.0	2	0.3
Northern Rough-winged Swallow	0.0	0.0	0.0	0.0	0.3	2	0.3
Ruby-crowned Kinglet	0.0	0.0	0.0	0.1	0.1	2	0.3
Warbler spp.	0.0	0.3	0.0	0.0	0.0	2	0.3
Willow Flycatcher*	0.0	0.0	0.0	0.0	0.3	2	0.3
Ash-throated Flycatcher	0.0	0.1	0.0	0.0	0.0	1	0.1
Black-headed Grosbeak	0.0	0.0	0.0	0.1	0.0	1	0.1
Cassin's Vireo	0.0	0.0	0.0	0.1	0.0	1	0.1
Chipping Sparrow	0.0	0.0	0.1	0.0	0.0	1	0.1
Falcon spp.	0.0	0.0	0.0	0.1	0.0	1	0.1
Flycatcher spp.	0.0	0.0	0.0	0.0	0.1	1	0.1
Hooded Warbler	0.0	0.0	0.1	0.0	0.0	1	0.1
Killdeer	0.1	0.0	0.0	0.0	0.0	1	0.1
Lesser Nighthawk	0.0	0.0	0.0	0.0	0.1	1	0.1
McGillivray's Warbler	0.0	0.0	0.0	0.1	0.0	1	0.1
Owl spp.	0.0	0.0	0.0	0.0	0.1	1	0.1
Solitary Vireo spp.	0.0	0.0	0.1	0.0	0.0	1	0.1
Thrush spp.	0.1	0.0	0.0	0.0	0.0	1	0.1
Western Flycatcher spp.	0.0	0.0	0.0	0.1	0.0	1	0.1
Total	6.3	10.8	8.4	11.5	16.8	429	53.6

* LCR MSCP covered species

Cibola Nature Trail Site

Three intensive area search plots at the Cibola Nature Trail site resulted in 101 breeding territories and a total of 313 detections of presumed non-breeders (Tables 19 and 20). Yellow Warblers had territories in both Nature Trail plots. Of the covered species, Bell's

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Vireos, Yellow Warblers, and Willow Flycatchers were also detected as presumed non-breeders on the Nature Trail.

Table 19. Number of breeding territories, by species, found in the Cibola Nature Trail intensive area search plots in 2009 listed in descending order of abundance.

Species	Number of Territories		
	Nature Trail North	Nature Trail South	Total Nature Trail
Mourning Dove	0	15	15
Abert's Towhee	3.75	6	9.75
Verdin	4	5.75	9.75
Western Kingbird	3.5	5.5	9
Common Yellowthroat	3	5	8
Anna's Hummingbird	3.75	4	7.75
Blue Grosbeak	5	2	7
White-winged Dove		7	7
Yellow-breasted Chat	4	3	7
Bullock's Oriole	1.75	3.25	5
Brown-headed Cowbird	3		3
Song Sparrow	2	1	3
Black-chinned Hummingbird	1	1	2
Yellow Warbler*	2	0	2
Ash-throated Flycatcher	0.75	1	1.75
Greater Roadrunner		1	1
House Finch	0	1	1
Red-winged Blackbird		1	1
Common Ground-Dove		0.5	0.5
Total	37.5	63	100.5

* LCR MSCP covered species

Table 20. Average number of migrants and presumed non-breeders, by species, detected during intensive area searches at Cibola Nature Trail habitat creation plots in 2009. Incidental detections and birds that were observed flying over the plots are not included. Listed in descending order of abundance.

Species	Nature Trail North	Nature Trail South	Total Nature Trail	Nature Trail Average
Wilson's Warbler	2.0	3.4	43	5.4
Brown-headed Cowbird	0.0	4.3	34	4.3
Red-winged Blackbird	0.0	3.9	31	3.9
Western Wood-Pewee	0.8	1.4	17	2.1
White-winged Dove	0.0	1.6	13	1.6
House Finch	1.4	0.1	12	1.5
Anna's Hummingbird	0.3	1.1	11	1.4
American Goldfinch	0.8	0.5	10	1.3
Mourning Dove	0.0	1.1	9	1.1

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Species	Nature Trail North	Nature Trail South	Total Nature Trail	Nature Trail Average
Bullock's Oriole	0.0	0.9	7	0.9
Killdeer	0.0	0.9	7	0.9
Nashville Warbler	0.0	0.9	7	0.9
Northern Rough-winged Swallow	0.0	0.9	7	0.9
Warbling Vireo	0.3	0.6	7	0.9
Abert's Towhee	0.0	0.8	6	0.8
Western Kingbird	0.0	0.8	6	0.8
Western Tanager	0.1	0.6	6	0.8
Black-headed Grosbeak	0.3	0.4	5	0.6
Common Yellowthroat	0.0	0.6	5	0.6
Song Sparrow	0.0	0.6	5	0.6
Townsend's Warbler	0.1	0.5	5	0.6
Wild Turkey	0.6	0.0	5	0.6
Yellow-breasted Chat	0.4	0.3	5	0.6
Blue Grosbeak	0.5	0.0	4	0.5
Yellow-rumped Warbler	0.3	0.3	4	0.5
Eurasian Collared-Dove	0.0	0.4	3	0.4
Great-tailed Grackle	0.0	0.4	3	0.4
Orange-crowned Warbler	0.0	0.4	3	0.4
White-throated Sparrow	0.0	0.4	3	0.4
Willow Flycatcher*	0.3	0.1	3	0.4
Ash-throated Flycatcher	0.1	0.1	2	0.3
Lazuli Bunting	0.3	0.0	2	0.3
Pacific-slope Flycatcher	0.0	0.3	2	0.3
Solitary Vireo spp.	0.3	0.0	2	0.3
Swainson's Thrush	0.0	0.3	2	0.3
Western Bluebird	0.0	0.3	2	0.3
Bell's Vireo*	0.0	0.1	1	0.1
Black-throated Gray Warbler	0.1	0.0	1	0.1
Common Ground-Dove	0.0	0.1	1	0.1
Cordilleran Flycatcher	0.1	0.0	1	0.1
Greater Roadrunner	0.1	0.0	1	0.1
Hummingbird spp.	0.0	0.1	1	0.1
Ladder-backed Woodpecker	0.0	0.1	1	0.1
Le Conte's Thrasher	0.1	0.0	1	0.1
Lesser Nighthawk	0.0	0.1	1	0.1
Turkey Vulture	0.1	0.0	1	0.1
Verdin	0.0	0.1	1	0.1
Western Flycatcher spp.	0.1	0.0	1	0.1
Western Meadowlark	0.1	0.0	1	0.1
White-crowned Sparrow	0.0	0.1	1	0.1
Yellow Warbler*	0.0	0.1	1	0.1
Total	9.4	29.8	313	39.1

* LCR MSCP covered species

Palo Verde Ecological Reserve (PVER)

In two intensive area search plots at the Palo Verde Ecological Reserve (PVER), 24 breeding territories and 187 presumed non-breeders were detected (Tables 21 and 22). We found no covered species as breeders at PVER in 2009, but one Yellow Warbler and one Willow Flycatcher were detected as presumed non-breeders. The PVER sites had, again this year, two unusual species: The Northern Harrier nest that was active in 2008 was also active in 2009, with both parents vigorously defending the nest and carrying food to the nest. The Mallard pair that nested in the site in 2008 was again present early in the season, but no breeding was confirmed in 2009.

Table 21. Number of territories by species detected in Palo Verde Ecological Reserve (PVER) intensive area search plots in 2009. Listed in descending order of abundance.

Species	Number of Territories		
	PVER 2 A	PVER 2 B	Total PVER
Common Yellowthroat	4	3.75	7.75
White-winged Dove	0	6	6
Blue Grosbeak	1.75	2.25	4
Brown-headed Cowbird	0	2.25	2.25
Mourning Dove	0	1	1
Northern Harrier	1	0	1
Song Sparrow	0	1	1
Abert's Towhee	0	0.5	0.5
Total	6.75	16.75	23.5

*LCR MSCP covered species

Table 22. Average number of migrants and presumed non-breeders, by species, detected during intensive area searches at Palo Verde Ecological Reserve (PVER) habitat creation plots in 2009. Incidental detections and birds that were observed flying over the plots are not included. Listed in descending order of abundance.

Species	PVER 2A	PVER 2B	PVER Total	PVER Average
Red-winged Blackbird	4.3	0.0	34	4.3
White-winged Dove	0.0	1.6	13	1.6
Abert's Towhee	0.8	0.6	11	1.4
White-crowned Sparrow	0.4	0.3	5	0.6
Wilson's Warbler	0.1	0.5	5	0.6
Great-tailed Grackle	0.3	0.0	2	0.3
Common Yellowthroat	0.1	0.1	2	0.3
Mourning Dove	0.0	0.3	2	0.3
Anna's Hummingbird	0.0	0.3	2	0.3
Sparrow spp.	0.3	0.0	2	0.3
Common Raven	0.0	0.1	1	0.1
Barn Owl	0.0	0.1	1	0.1
Black-chinned Hummingbird	0.0	0.1	1	0.1
Indigo Bunting	0.0	0.1	1	0.1

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Species	PVER 2A	PVER 2B	PVER Total	PVER Average
Red-shouldered Hawk	0.0	0.1	1	0.1
Willow Flycatcher*	0.0	0.1	1	0.1
Yellow-breasted Chat	0.0	0.1	1	0.1
Bullock's Oriole	0.1	0.0	1	0.1
Lesser Nighthawk	0.1	0.0	1	0.1
Song Sparrow	0.1	0.0	1	0.1
Yellow Warbler*	0.1	0.0	1	0.1
Total	6.6	4.5	178	22.3

* LCR MSCP covered species

Cibola Mass Planting

One intensive area search at the Cibola Mass Planting resulted in 11 breeding territories and 90 detections of presumed non-breeders (Tables 23 and 24). We detected no covered species at the Mass Planting site in 2009, neither as presumed breeders nor non-breeders.

Table 23. Number of breeding territories, by species, found in the Cibola Mass Planting intensive area search plot in 2009. Listed in descending order of abundance.

Species	Number of Territories Cibola Mass Planting
Mourning Dove	8
Blue Grosbeak	2
Common Yellowthroat	0.75
Total	10.75

* LCR MSCP covered species

Table 24. Average number of migrants and presumed non-breeders, by species, detected during intensive area searches at the Cibola Mass Planting habitat creation plots in 2009. Incidental detections and birds that were observed flying over the plots are not included. Listed in descending order of abundance.

Species	Total Detections CVCM- Mass Planting	CVCM- Mass Planting Average
Red-winged Blackbird	27	3.4
Brown-headed Cowbird	13	1.6
Western Kingbird	8	1.0
Nashville Warbler	5	0.6
Wilson's Warbler	5	0.6
Blue Grosbeak	4	0.5
Bullock's Oriole	4	0.5
Western Wood-Pewee	4	0.5
Common Yellowthroat	3	0.4

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Species	Total Detections CVCM- Mass Planting	CVCM- Mass Planting Average
Hummingbird spp.	3	0.4
Abert's Towhee	2	0.3
Black-headed Grosbeak	2	0.3
Warbling Vireo	2	0.3
Anna's Hummingbird	1	0.1
Eurasian Collared-Dove	1	0.1
Horned Lark	1	0.1
Ladder-backed Woodpecker	1	0.1
Song Sparrow	1	0.1
Sparrow spp.	1	0.1
Western Tanager	1	0.1
White-winged Dove	1	0.1
Total	90	11.3

* LCR MSCP covered species

4. Habitat Associations of the Covered Species

A. Bill Williams River

When examining the distribution of detected breeding territories of the covered species among the sampling strata, we found that the Bill Williams River region supported among the largest numbers of covered species' territories (Tables 5a and 9). For this reason, we examined the number of detections among the habitat strata just for that area (geographic region 7; Table 25). First, the distribution of plots among available habitat strata appears representative of available plots in that region, with the greatest number being in habitat stratum 4 ("Poor"). Appendix 6 shows a representative example of a plot in this stratum, which has a portion of unvegetated riverine habitat that likely led to its classification. Habitat stratum 4 was the only stratum in which all five covered species were present, and while some of the species appeared more abundant in other strata, these had low enough sample sizes to prevent a conclusive finding in this regard.

Table 25. Average number of detections in rapid area searches of LCR-MSCP covered species per plot surveyed across the Bill Williams NWR region in all habitat strata (0-5) in 2009.

Species	7.0 (1 plot)	7.1 (1 plot)	7.2 (3 plots)	7.3 (3 plots)	7.4 (7 plots)	7.5 (1 plot)
Bell's Vireo	0	5	6.3	2.3	9	0
Gila Woodpecker	4	3	1.7	0.3	3	0
Summer Tanager	0	2	1	0	0.3	0
Vermilion Flycatcher	0	0	0	0	0.4	0
Yellow Warbler	0	25	7.3	0	3.1	0
Total	4	35	16.3	2.7	15.9	0

B. Habitat Associations Based on Field Measurements

Based on our field habitat assessments in active territories and non-use sites of the covered species, we used a variety of habitat features and variables to predict the likelihood of the species nesting (Tables 26 and 27). Sample sizes vary because some variables were inadvertently not recorded during the 2008 habitat assessments. Gila Woodpecker tended to be more likely to have a territory if snags ($p = 0.038$) and upland habitat ($p = 0.076$) were available in the territory area. Most Gila Woodpecker territories also had tall cliffs, dry washes, surface water, large trees, and mistletoe available in or near the territory (Table 26).

Vermilion Flycatcher was more likely to have a territory if abundant cover of large trees was available, based on four measures ($p < 0.05$ for all). They also showed a trend to being associated with mid-canopy mesquite ($p = 0.075$), but avoiding the presence of salt cedar ($p = 0.050$). Most Vermilion Flycatcher territories also had surface water in or near the territory (Table 26). Summer Tanagers were too rare to allow for a meaningful sample size for characterizing the habitat and landscape features in their territories from our data. We plan to collect more habitat data on these less common covered species (Summer Tanager, Gila Woodpecker, and Vermilion Flycatcher) to increase the sample sizes in 2010.

Bell's Vireo presence was positively associated with dense upper canopy cover based on three measures, as well as with the presence of cottonwood (all $p < 0.005$). It also had a weak ($p = 0.026$) positive association with number of shrub mesquites, but a negative relationship with percent of territory covered by low vegetation ($p < 0.001$). Most Bell's Vireo territories also had surface water, dry washes, upland habitat, and large trees and snags in or near the territory, suggesting that, like the Gila Woodpecker, their likelihood of nesting increases in areas that provide a diversity of mature riparian and other habitat types on a landscape scale (i.e., 1 km; Table 26). However, Bell's Vireos avoided the presence of upland habitat inside their territory area ($p = 0.007$).

Finally, Yellow Warbler presence was positively associated with dense upper canopy (five variables) and lower canopy (one variable) cover (all $p < 0.05$). The species also responded positively to the presence of both cottonwood and willow (both $p < 0.001$) but negatively to two measures of mesquite presence (both $p < 0.05$). The presence of large Goodding's willow had a positive effect on the likelihood of a Yellow Warbler territory being present ($p = 0.012$), as did the presence of shrub-sized salt cedar ($p = 0.009$). Presence of upland habitat in the territory area and dense cover by low vegetation were both avoided (both $p < 0.05$). Most Yellow Warbler territories also had surface water at or near the territory (Tables 26 and 27).

Table 26: Categorical habitat variables measured in territories of the covered species and in all non-use sites. Variables were considered based on their possible importance to one more of the covered species. Asterisks denote the patterns that show a statistical trend. All proportions of 75% or greater are in bold.

Percent of Territories With Habitat Feature Present

Categorical Habitat Variable	Gila Woodpecker		Vermilion Flycatcher		Summer Tanager		Bell's Vireo		Yellow Warbler		Non-Use Sites (All Species)	
	Percent Territories	Sample Size	Percent Territories	Sample Size	Percent Territories	Sample Size	Percent Territories	Sample Size	Percent Territories	Sample Size	Percent Sites	Sample Size
<i>Landscape Features</i>												
Charcoaled stems w/in 100 m	34	14	0	10	0	2	50	34	25	32	29	96
Cliffs 30 ft or taller w/in 100 m	79	14	20	10	0	2	69	35	29	34	48	96
Water source in territory	14	14	40	10	0	2	23	35	52	33	32	96
Water source w/in 100 m	14	14	40	10	0	2	49	35	71	31	57	96
Water source w/in 1000 m	86	14	90	10	50	2	94	34	100	31	94	96
Dry wash > 5 ft wide in territory	57	14	10	10	0	2	34	35	6	33	30	96
Dry wash > 5 ft wide w/in 100 m	64	14	30	10	100	2	69	35	29	34	51	96
Dry wash > 5 ft wide w/in 1000 m	79	14	50	10	100	2	91	35	70	33	88	96
Upland habitat in territory	64(*)	14	0	10	50	2	9	35	6*	34	32	96
Upland habitat w/in 100 m	57	14	0	10	50	2	66	35	15	34	56	96
Upland habitat w/in 1000 m	79	14	50	10	50	2	94	32	48	33	77	96
<i>Availability of Large Trees and Snags</i>												
Trees >12 cm DBH in territory	86	14	60*	10	100	2	94	35	85	34	60	96

Percent of Territories With Habitat Feature Present

Categorical Habitat Variable	Gila Woodpecker		Vermilion Flycatcher		Summer Tanager		Bell's Vireo		Yellow Warbler		Non-Use Sites (All Species)	
	Percent Territories	Sample Size	Percent Territories	Sample Size	Percent Territories	Sample Size	Percent Territories	Sample Size	Percent Territories	Sample Size	Percent Sites	Sample Size
Trees >12 cm DBH w/in 100 m	100	14	60	10	100	2	94	35	91	32	79	96
Trees >12 cm DBH w/in 1000 m	100	14	80	10	100	2	97	34	100	31	95	96
Snags >12 cm DBH in territory	43*	14	10	10	50	2	26	34	47	34	11	96
Snags >12 cm DBH w/in 100m	29	14	10	10	100	2	52	33	67	33	20	96
Snags >12 cm DBH w/in 1000 m	71	14	40	10	100	2	97	33	85	33	68	96
Branches >12 cm in territory	79	14	50	10	50	2	59	34	76	34	43	96
Branches >12 cm w/in 100 m	79	14	50	10	100	2	85	33	88	32	63	96
Branches >12 cm w/in 1000 m	86	14	60	10	100	2	100	32	97	32	90	96
Availability of relevant Tree and Shrub Species												
(within 30m diameter circle created around the nest or territory center)												
<i>Populus fremontii</i> present	8	12	30	10	100	2	63	32	73*	33	12	78
Mesquite spp. present	33	12	90	10	100	2	76	33	21*	33	58	78
Mesquite spp. 4 m tall or taller present	27	11	78(*)	9	100	2	60	30	19	32	34	85
Saltcedar spp. present	25	12	10(*)	10	50	2	63	32	52	33	51	78
Willow spp. present	8	12	10	10	100	2	38	32	73*	33	17	78

Percent of Territories With Habitat Feature Present

Categorical Habitat Variable	Gila Woodpecker		Vermilion Flycatcher		Summer Tanager		Bell's Vireo		Yellow Warbler		Non-Use Sites (All Species)	
	Percent Territories	Sample Size	Percent Territories	Sample Size	Percent Territories	Sample Size	Percent Territories	Sample Size	Percent Territories	Sample Size	Percent Sites	Sample Size
<i>Availability of Food Sources and Moist Soils</i>												
Anthills in territory	79*	14	90	10	0	2	54	35	74	34	51	96
Anthills w/in 100 m	93	14	90	10	50	2	91	34	91	33	76	96
Anthills w/in 1000 m	100	14	100	10	100	2	100	34	100	32	100	96
Mistletoe in territory	43	14	10	10	0	2	26	35	0	34	15	96
Mistletoe w/in 100 m	43	14	20	10	50	2	40	35	12	34	30	96
Mistletoe w/in 1000 m	93	14	30	10	50	2	59	34	33	33	60	96
Saturated soil or standing water in territory	17	12	10	10	0	2	30	33	52	33	19	83

* p < 0.05, (*) p < 0.1 in comparison with non-use sites.

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Table 27: Continuous habitat variables measured in a 707 m² (0.17 acre) plot in the center of territories of covered species. Listed are averages, range, and sample size for each variable from the raw data (i.e., number of individual plants or species, percentage of plot). Asterisks denote the patterns that show a statistical trend. These data were collected using the tree, shrub, and point-intercept habitat protocols (see Appendix for details). *Tamarix aphylla* and several other species were only included in the large tree category because all individuals we found were large.

Continuous Habitat Variable	Gila Woodpecker				Vermilion Flycatcher				Summer Tanager				Bell's Vireo				Yellow Warbler			
	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size
Total Trees and Tree Species																				
# Trees total (all size classes)	13	1	35	12	38	2	169	10	49	37	60	2	34	0	102	32	69	0	556	33
# <i>Tamarix ramosissima</i>	2	0	22	13	0	0	0	10	4	0	7	2	6	0	43	32	6	0	74	33
# <i>Salix gooddingii</i>	1	0	15	13	1	0	12	10	15	9	20	2	6	0	37	32	51	0	556	33
# trees of Mesquite spp.	6	0	32	13	29	0	169	10	7	6	7	2	11	0	64	32	1*	0	15	33
# <i>Populus fremontii</i>	0	0	2	13	5	0	31	10	24	21	27	2	10	0	66	32	11	0	52	33
Large Trees																				
# High canopy trees (> 10 m tall)	1	0	7	12	5	0	31	10	15	13	17	2	7*	0	38	32	16*	0	108	33
# Trees >20 cm DBH	7	1	25	12	16	0	43	10	21	8	34	2	18	0	63	32	20*	0	53	33
% Of plot with high canopy trees	22	0	70	11	67*	48	123	9	98	90	105	2	51*	17	127	30	64*	0	158	32
# Large riparian trees (> 20 cm DBH and > 4 m tall)	5	1	17	12	16*	0	43	10	21	8	34	2	16	0	57	32	19*	0	53	33
# Large <i>Populus fremontii</i>	0	0	2	13	5	0	31	10	15	8	21	2	5*	0	24	32	8	0	45	33
# Large <i>Salix gooddingii</i>	1	0	11	13	1	0	12	10	5	0	9	2	5	0	29	32	10*	0	32	33
# Large <i>Tamarix aphylla</i>	1	0	6	13	0	0	3	10	0	0	0	2	0	0	0	32	0	0	0	33
# Large <i>Tamarix ramosissima</i>	0	0	4	13	0	0	0	10	1	0	2	2	2	0	8	32	1	0	6	33

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Continuous Habitat Variable	Gila Woodpecker				Vermilion Flycatcher				Summer Tanager				Bell's Vireo				Yellow Warbler			
	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size
Mid Canopy and Understory Trees																				
# Mid canopy trees (4 - < 10 m)	6	0	25	12	24	0	110	10	31	17	44	2	22	0	78	32	38*	0	367	33
# Understory trees (1.4 - < 4 m)	6	0	19	12	9	0	59	10	3	3	3	2	6	0	26	32	15*	0	160	33
# Understory <i>Tamarix ramosissima</i>	1	0	10	13	0	0	0	10	0	0	0	2	2	0	25	32	3*	0	74	33
# Understory <i>Salix gooddingii</i>	0	0	3	13	0	0	0	10	2	0	3	2	1	0	12	32	11	0	160	33
# Understory <i>Prosopis pubescens</i>	0	0	0	13	0	0	0	10	0	0	0	2	0	0	0	32	0	0	0	33
# Understory <i>Prosopis glandulosa</i>	3	0	14	13	7	0	59	10	2	0	3	2	3*	0	26	32	1	0	12	33
# Understory <i>Populus fremontii</i>	0	0	0	13	0	0	1	10	0	0	0	2	0	0	4	32	1	0	7	33
Shrubs and Ground Cover																				
# Shrub species	3	0	7	12	2	0	3	10	4	4	4	2	3	1	5	30	2	0	6	33
% Of plot with cover < 50 cm tall	79	53	100	11	62	55	72	9	70	68	72	2	62*	42	87	30	59*	38	84	32

* p < 0.05, (*) p < 0.1 in comparison with non-use sites.

Discussion

1. Species Richness Patterns

When reviewing the species lists (Appendix 5), several important patterns emerge. First, the Gilded Flicker was not detected in any of the three years of surveys throughout the LCR MSCP project area during either standardized surveys or 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 and Vermilion Flycatcher are uncommon breeders and appear to have a spotty distribution within the study area.

Our observations in 2008 were mirrored in 2009 in that (1) there were fewer upland species in habitat creation sites than found system-wide, 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 marsh habitats on restoration sites are being surveyed under a different work task using a different protocol (the North American Marsh Bird Protocol, used to detect secretive marsh birds such as Clapper Rail); and (3) species that are associated with old-growth riparian trees are less prevalent in habitat creation sites than system-wide. As the habitat creation areas mature, more of these species are expected to colonize the sites.

2. 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. All estimates of number of territories present system-wide should be viewed as a conservative estimate, as not all strata have yet been surveyed, and our protocols tend to err on the side of classifying a bird as a presumed non-breeder, if insufficient evidence of nesting was found during the surveys. Overall abundances were greatest in both generalist species, such as Brown-headed Cowbird, Gambel's Quail, and Great-tailed Grackle, and riparian specialist species, such as Yellow-breasted Chat, Song Sparrow, and Yellow Warbler, reflecting the wide variety of habitat types and habitat quality present system-wide. The system-wide distribution of all covered species indicates that even the fairly common ones, Bell's Vireo and Yellow Warbler, were clearly more abundant in some region-habitat strata than in others (Tables 5a and 9). Generally, local and regional stability in populations increases, the more geographically connected and widespread subpopulations become. Therefore, among the signs of system-wide species recovery that can be monitored with the methods used here, is not only an increase in abundance of breeders, but also an evening out of system-wide distribution. The Bill Williams River region (geographic stratum 7) held overall the largest proportion of covered species. We recommend that it may be viewed as a restoration reference area for the project.

3. Habitat Creation Sites

Similar to our findings in 2008, the post-development habitat creation sites supported breeding populations of four of the six covered species, with only Gila Woodpecker and Gilded Flicker not detected. The Gila Woodpecker was not detected, most likely because the habitat creation sites are still too young to produce sufficient numbers of trees that are large enough for woodpecker cavities. Old-growth riparian canopy trees are relatively uncommon in the current landscape of the Lower Colorado River, and continued 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. One cavity-nester, the Ladder-backed Woodpecker, was actually detected at the Cibola Valley Conservation Area (Table 17), but this individual was associated with a relic tree that was just outside the habitat creation site, and its territory reached far enough into the plot to be delineated.

4. Habitat Associations of Covered Species

Bird-habitat association studies, such as the one conducted as part of this study, try to use habitat variables as predictors of presence or abundance of bird species. These studies are by nature correlative, meaning that they cannot by themselves identify causal relationships that pinpoint the actual habitat variables that cause the bird to be present in a site. Only an experimental design, where each habitat variable is carefully manipulated to offer a selection along a gradient to birds would produce causal relationships, and such experiments are almost always unfeasible. However, riparian birds tend to be extraordinarily selective for habitat, as our results indicate, and we feel that correlative analyses are appropriately informative to describe this selectivity for the purpose of restoration planning. Some variables, though, that show significant differences between occupied and unoccupied sites may show these differences because they are correlated with other habitat variables, for example a lack of ground vegetation in a riparian shrub thicket that acts to shade out the understory. In this discussion, we therefore identify those variables that are most likely to be selected by the covered bird species based on their known natural history, and de-emphasize those statistical relationships that are likely a “by-product” of habitat variables selected by the species.

Our field habitat assessments and findings in the Bill Williams River region suggest that the four covered species, for which we have adequate data, are associated with habitat variables that are addressed in habitat creation efforts of the LCR MSCP. Habitat stratum 1 (“Good/Tall”) of the system-wide sampling plan indeed appears to be suitable for a large number of covered species, but curiously, so does habitat stratum 4 (“Poor”) that had all five covered species. As the example of the Bill Williams River demonstrates, a patchy landscape may be more typical in a southwestern riparian setting than solid tall canopy cover over large expanses (Appendix 6). We found particularly noteworthy that patchy habitat, rather than being necessarily less suitable, can represent a natural mosaic patterns typical of riverine environments that may be suitable for the widest variety of riparian-associated species (Table 25, Appendix 6).

Gila Woodpeckers were associated with the presence of large-diameter snags and patches of upland habitat. The former habitat association is well known for this species, while the latter likely reflects an indifference to, or even avoidance of, dense vegetation cover types, which is in contrast to most of the other covered species. Woodpeckers in general have fairly large home ranges and, compared with the other species, are likely less dependent on resources directly around the nest site other than the presence of a large tree for nest cavities.

Our habitat data for Vermilion Flycatcher suffered somewhat from the low sample size of available territories (10, most of which were in one restoration area), but nonetheless, several patterns emerged from the analysis. Cover by large trees and presence of mid-canopy mesquite were the best predictors of a territory. This was also the only covered species for which we found a trend toward avoiding salt cedar.

Nesting Bell's Vireos appear to prefer dense cover by fairly tall canopies, particularly cottonwood, and shrub-sized mesquite, but avoided large patches of ground vegetation and upland habitat. Based on the variety of microhabitats this species occupies and its fairly widespread system-wide distribution, it may be the most flexible in habitat use among the covered species. The presence of riparian woodland cover and nearby surface water, however, appears to be true requirements for nesting of this species.

Yellow Warblers apparently prefer to place their territory in overall dense woodland covers, particularly cottonwood and willow, but largely avoiding mesquite and patches of upland habitat inside their territory. It also appeared that they avoided patches of very dense ground vegetation in their immediate territory, which is likely a correlate of dense shrub and tree cover, rather than a habitat requirement of the species. Yellow Warblers also did not avoid salt cedar, but were in fact positively associated with shrub-sized salt cedar. This species is a good example of a riparian bird developing a tolerance for the exotic salt cedar after decades of salt cedar invasion into southwestern riparian areas. It is likely that salt cedar is less suitable to Yellow Warblers than its native counterparts, shrub and tree willows, but it appears suitable enough to sustain part of the current breeding populations of this covered species.

Based on their rarity, we were not able to assess Summer Tanager breeding habitat very well. Based on the two territories that we had available, variables describing tall canopy, old-growth tree habitats were most prevalent feature of occupied sites, which is agreement with what is known about the natural history of this species.

5. Considerations for Habitat Management and Restoration

By combining our findings for each of the covered species, we recommend that the habitat creation efforts continue to incorporate a mosaic approach to habitat patch creation, at an intermediate landscape scale of approximately 2-5 ha. By varying patches across the landscape, the varying habitat requirements of all covered species can be integrated. We also recommend the consideration of creating surface water, or marsh

features, if feasible, as these would very likely increase the overall bird species diversity in habitat creation sites based on our species richness patterns results. Unlike perhaps for marsh birds and other waterbirds, we believe that the main effect of nearby surface water on terrestrial riparian species would be an increase in invertebrate productivity, so even small water features would likely have a significant effect on riparian birds. Based on our habitat assessments, it also appears that barren or sparsely vegetated patches, if small, do not necessarily decrease habitat value to covered species, but may be part of a desired mosaic effect across the riparian landscape.

As expected, the three main components of current habitat creation efforts, achieving dense cover by cottonwood, mesquite, and willow woodlands, are critical to all covered species. All species had a fairly high overall percentage of their territory covered with low (< 50 cm) vegetation (Table 27), which suggests that early seral stages and understory vegetation continue to be important for long-term maintenance of suitable habitat. We specifically included Tables 26 and 27 in this report that show averages and ranges of habitat variables as observed in occupied territories, so they may be used by restoration planners as a reference for approximate target tree densities and other variables when planning vegetation plantings.

6. Considerations for Future Bird Monitoring Work on the Lower Colorado River

In the 2009 field season, we made additional slight improvements to the survey methods used for bird monitoring in this project. We moved the survey periods up by two weeks to better capture the early breeders and to avoid deflating the population size estimates because of birds vacating their territories near the end of the survey season. The disadvantage of this decision is that a large number of migrant individuals need to be accounted for when reviewing the raw data of the rapid area searches. Additional analyses could be done using the double sampling on intensive area search plots to estimate the effect of migrant individuals on rapid area search results. We also made major strides toward better defining presumed breeders and non-breeders, particularly by explicitly recording all breeding-related behaviors in all surveys. It is enormously difficult to integrate actual nest searches into a monitoring effort of this scope, so all nesting-related behaviors are critical in making objective decisions on breeding status.

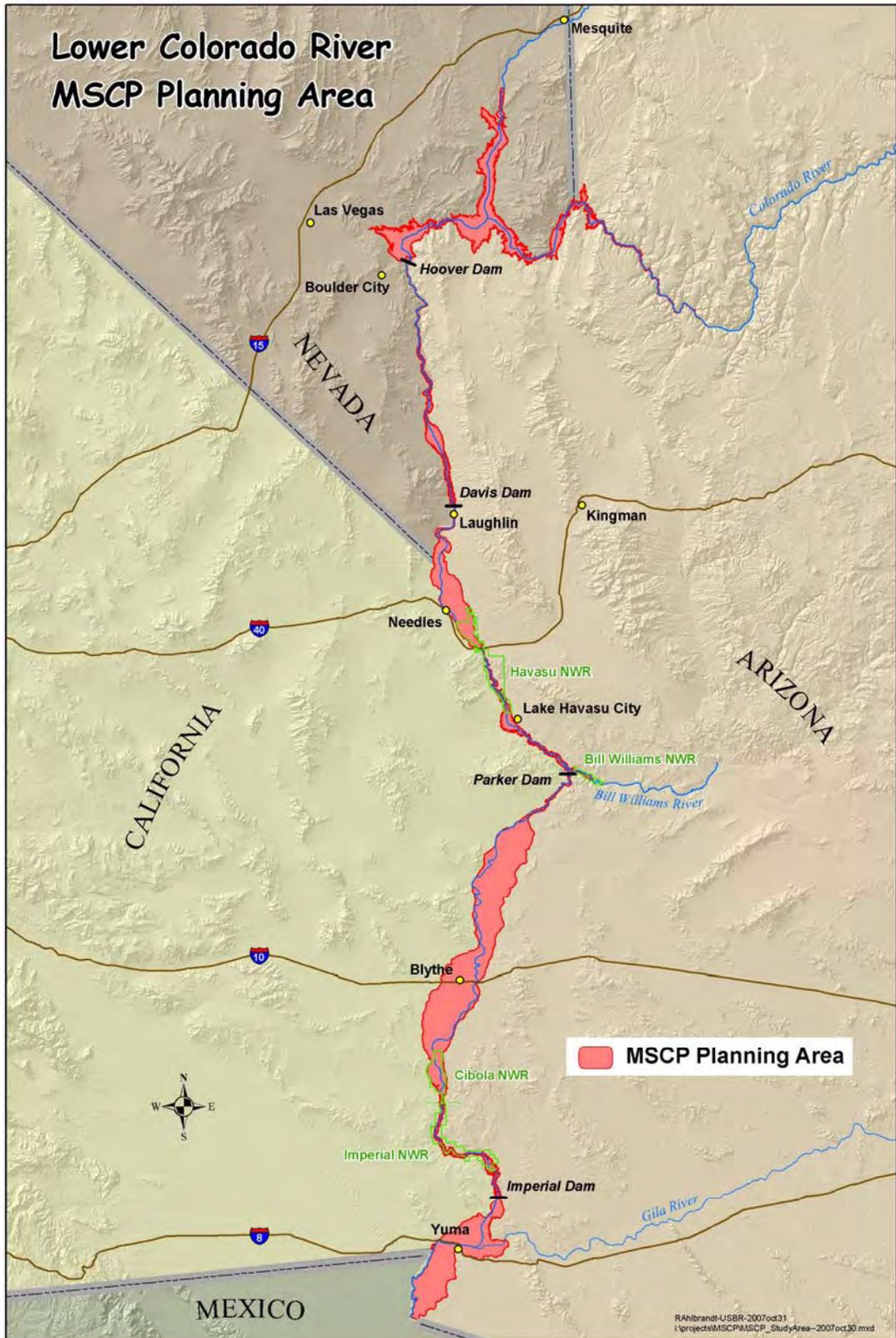
Additionally, additional analyses surveys could be considered in calculating system-wide territory numbers, although these would likely only lead to minor improvements. The sampling plan is very robust in a sense that detection ratios for rapid surveys are close to 1, and all surveys are based on repeatable, objective protocols that have been refined over three years of implementation. However, to further refine the estimate of total number of territories, (1) detection ratios could be calculated separately for groups of species with similar expected detection rates, and (2) the previously un-sampled strata may be sampled to estimate number of territories in these regions. Neither of these would likely change the overall population size estimates by much, unless survey coverage of new strata reveal significant unknown populations. This is fairly unlikely, though, as the survey effort in the first three years was allocated such that most regions that are expected to support covered species were surveyed.

If detection rates become sufficiently studied in these first few years of program implementation, survey coverage among strata could be improved by allocating less effort to intensive area searches and more effort to additional rapid area searches. We consider the two-rapid-area-search approach an improvement over just one rapid visit, as it is likely one of the reasons that the detection ratios are as high as they are in our findings, and the ability to detect population change may improve by increasing rapid survey coverage throughout the project area. Nonetheless, the current sampling plan appears to be worked out well enough that these changes may only provide moderate improvements in current monitoring efficiency and effectiveness.

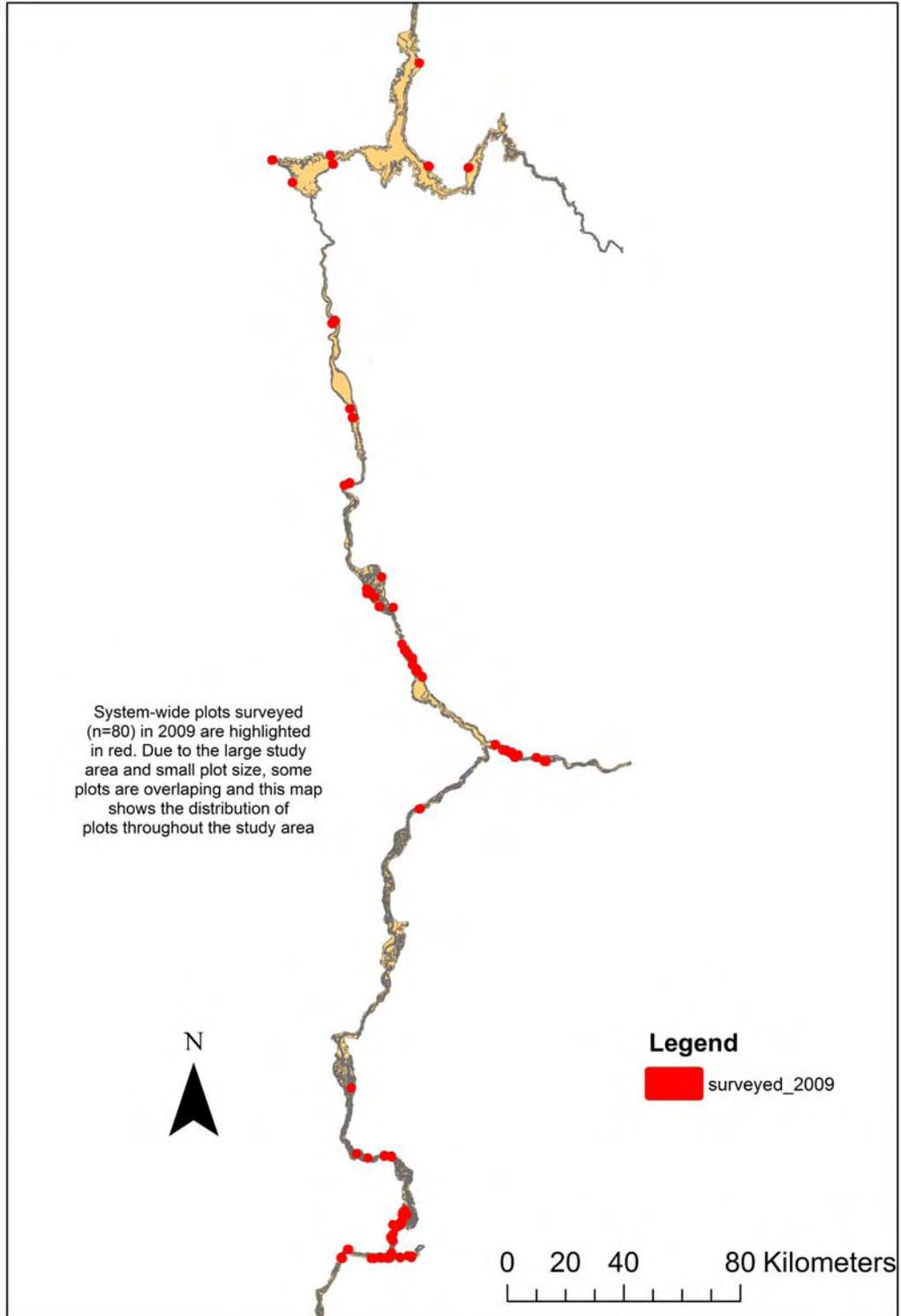
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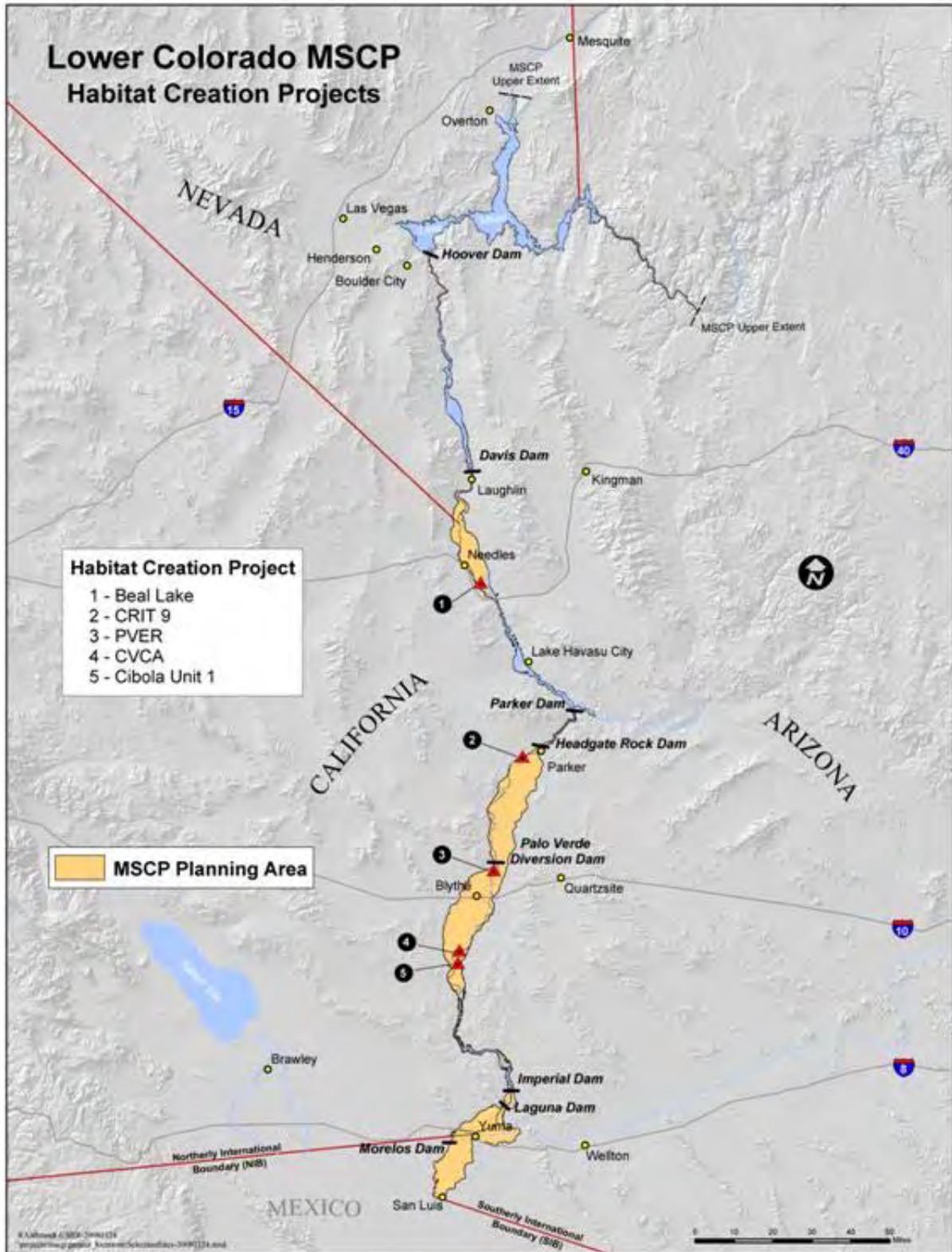
Appendix 1a. Map of the LCR-MSCP study area for system-wide bird surveys (in pink). Map provided by the U.S. Bureau of Reclamation, Lower Colorado River Region.



Appendix 1b. Map of the LCR-MSCP system-wide bird survey plots (N=80) in red.



Appendix 1c. Overview of habitat creation sites of the LCR MSCP in 2009. Map provided by the U.S. 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** ___

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

Appendix 3. Rapid Area Search Protocol 2009

In 2009, 80 plots were surveyed twice: once between 15 April and 15 May and again between 15 May and 15 June. There were ~3-4 weeks between the 2 surveys.

The goal in a rapid survey is to record all birds in the plot during the survey time, recording fly-overs (i.e., birds that are not observed landing in the riparian corridor) separately from birds using the riparian corridor (for feeding and breeding). All surveys are done in fair weather conditions from sunrise until the entire plot has been surveyed (not to extend past 12 noon). Surveyors will spend the visit scouring the plot (passing within 50 m of every point within the plot) to record all birds.

There are 2 main differences between intensive rapid surveys:

1. Rapid surveys happen 2 times in the season- once in the 1st half of the season and once in the 2nd half- Intensive surveys happen once a week for 8 weeks throughout the season.
2. In rapid surveys, we will not be making territory maps for all the species in the plot- We will just need to determine the number of breeding pairs of all species in the plot. We will still mark down individuals' locations on the grid or photomap, and we will use this information to determine if territories should be counted in or out.
3. We *will* map the territories of the covered species (6 birds) as best we can in 2 visits. This information will be used in collecting habitat data for the covered species.

So the basics to be collected in the rapid area search:

- We need to know, to the best of our abilities, if birds are using the plot for breeding or if they are just passing through (e.g. migrants, fly-overs, fledged young at the end of the season, etc.)
- When we are recording data, it will be very important to separate the breeders from all the non-breeders. The counts of breeders will be compared to the counts on the intensively surveyed plots to create our detection ratios in the analysis stage.
- Following up on the previous statement, it will be very important to distinguish males, females, and juveniles and record this information thoroughly. We want to avoid "unknown" birds as much as possible since it is unclear if they are breeders or not.
- It will be challenging in some cases to determine if birds are breeding. Early in the season we expect birds to be singing- a clear sign of attempting to breed. If a bird is not exhibiting any clear breeding behavior, just feeding, but it is a known breeder in the area, spend a little more time to see if it transitions from feeding to a breeding activity.
- Many migrants will be present the 1st half of the season- Know which birds are known breeders and which are known migrants- don't spend time with known migrants- record their presence and move on to the next bird. Similarly, record fly-overs and move on.

- One of the trickiest examples may be the Yellow Warbler. YWARs breed on the LCR and as far north as the arctic, so birds we see may be migrants or they may be local breeders. Spend extra time with these birds if they are not exhibiting breeding behavior to try to determine if they are staying or migrating. If they are eating non-stop and with a flock of migrants, that could be a sign. Take lots of notes on the individuals that you are unsure about, and after the survey discuss the details with your crew and me.

If LCR MSCP focal species are found, surveyors will map their locations and make a rough estimate of their territories and nest locations based on their visit. Any breeding activity will be recorded using the codes established for LCR, which allow us to distinguish breeding evidence by phase of the breeding cycle and reliability. In addition, males, females, juveniles, and group sizes will be explicitly recorded.

Territories on the edge:

Locations of the birds using the edge of the plot or moving between the outside and inside of the plot will be mapped so as to prevent double-counting. **These partial territories near the plot boundary need special attention, since they can significantly influence our breeding density estimate.** If an individual is using the plot edge or moving on and off the plot, two methods will be used to determine if the bird should be counted “in” the plot on the rapid survey summary sheet. If the individual has a nest on the plot (that you can find or pinpoint the general location, like “in this mesquite or that tamarisk thicket), then it is “in”. Second, the surveyor will mark on the map the locations where the bird is observed by plotting all the singing and other locations where the individual is seen on that morning. Next, the surveyor will connect the dots to form a loose territory and determine the centroid. Finally, if the centroid of the individual’s established territory is in the plot, and then the bird is counted as “in.”

Many species have territories smaller than a few hectares. So, with our current plot sizes (>9ha), many territories will clearly be within the plot. Remember, it is important to spend more time with the edge birds since counting these birds in or out of the plot can bias counts high or low.

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. We tried to do an even amount of assessments across the geographic strata, but since covered species were only found in several strata, we used all the locations where the species was rare (e.g. Yuma) and randomly selected locations across vegetation strata for regions where covered species were common (e.g. Bill Williams NWR). 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) digital photographs of the site at a landscape scale (these will be passes on to BOR as metadata);
- (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).

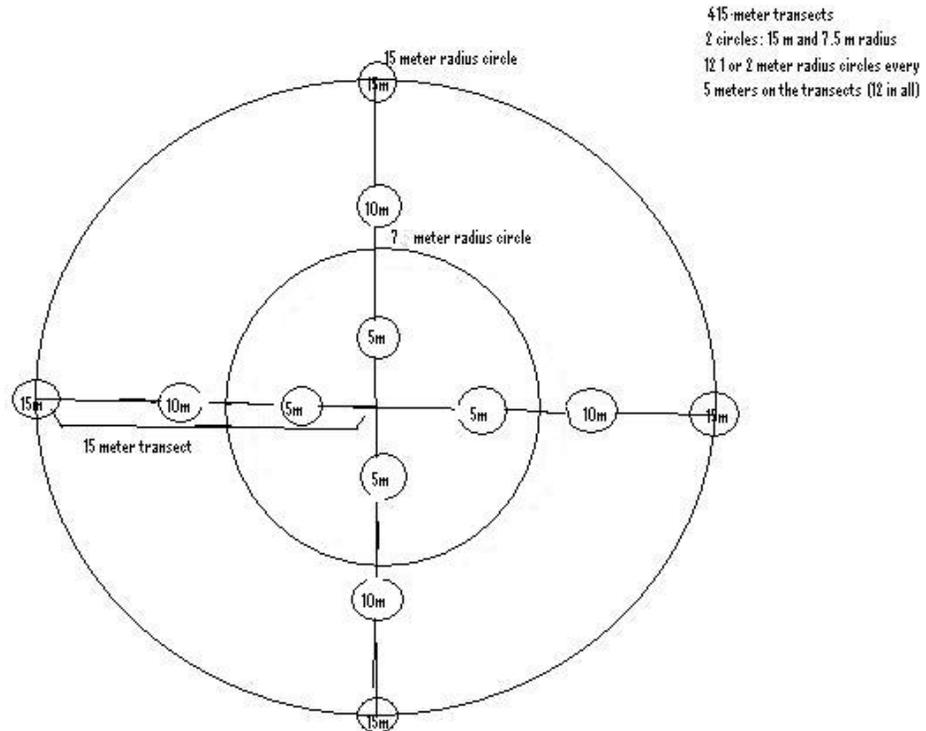


Figure 1. Habitat assessment vegetation transect set up.

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).

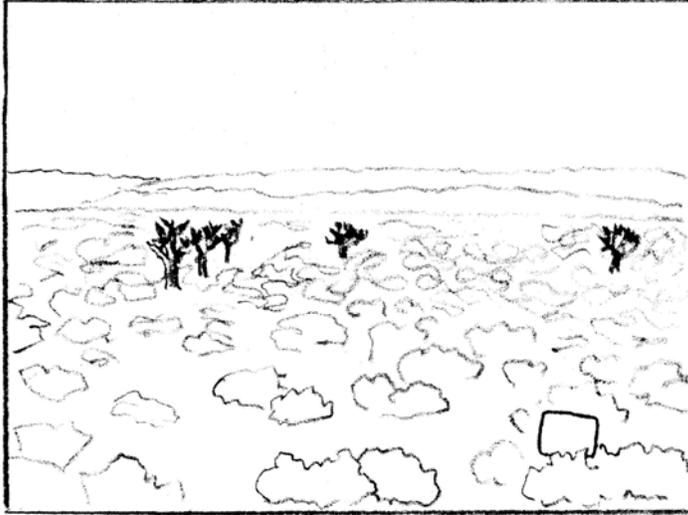


Figure 2. Illustrated example of a habitat assessment photograph.

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 densiometer readings every 5 m along each vegetation transect (e.g., at 5, 10, 15 m). At each point we took 4 densiometer readings, one in each cardinal direction to be averaged. To take a reading, we held the densiometer 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 (hydic 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 2009. Parentheses indicate those species that are only present as migrants and are not known to breed in the project area. Asterisks indicate species covered by the LCR MSCP.

Species	Scientific Name	System-Wide Surveys			Habitat Creation Sites	
		Rapid Area Searches - Presence	Intensive Area Searches - Presumed Breeder	Intensive Area Searches - Presumed Non-Breeder	Intensive Area Searches - Presumed Breeder	Intensive Area Searches - Presumed Non-Breeder
Abert's Towhee	<i>Pipilo aberti</i>	x	x	x	x	x
(American Bittern)	<i>Botaurus lentiginosus</i>	x				
American Coot	<i>Fulica americana</i>	x	x			
(American Goldfinch)	<i>Carduelis tristis</i>	x		x		x
American Kestrel	<i>Falco sparverius</i>	x	x	x		x
(American Pipit)	<i>Anthus rubescens</i>			x		
(American White Pelican)	<i>Pelecanus erythrorhynchos</i>	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
(Bald Eagle)	<i>Haliaeetus leucocephalus</i>	x		x		
Barn Owl	<i>Tyto alba</i>	x				x
(Barn Swallow)	<i>Hirundo rustica</i>	x		x		
Bell's Vireo*	<i>Vireo bellii</i>	x	x	x	x	x
(Belted Kingfisher)	<i>Ceryle alcyon</i>	x	x	x		
(Bewick's Wren)	<i>Thryomanes bewickii</i>	x	x	x		x
Black Phoebe	<i>Sayornis nigricans</i>	x	x	x		
Black-chinned Hummingbird	<i>Archilocus alexandri</i>	x	x	x	x	x
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>	x	x			
(Black-headed Grosbeak)	<i>Pheucticus melanocephalus</i>	x		x		x
Black-necked Stilt	<i>Himantopus mexicanus</i>	x	x	x		
Black-tailed Gnatcatcher	<i>Polioptila melanura</i>	x	x		x	x
(Black-throated Gray Warbler)	<i>Dendroica nigrescens</i>	x		x		x
Black-throated Sparrow	<i>Amphispiza bilineata</i>	x	x			
Blue Grosbeak	<i>Passerina caerulea</i>	x	x	x	x	x
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	x	x			

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Species	Scientific Name	System-Wide Surveys			Habitat Creation Sites	
		Rapid Area Searches - Presence	Intensive Area Searches - Presumed Breeder	Intensive Area Searches - Presumed Non-Breeder	Intensive Area Searches - Presumed Breeder	Intensive Area Searches - Presumed Non-Breeder
(Brewer's Blackbird)	<i>Euphagus cyanocephalus</i>	x	x			
(Brewer's Sparrow)	<i>Spizella breweri</i>	x		x		
(Broad-tailed Hummingbird)	<i>Selasphorus platycercus</i>	x		x		
Brown-crested Flycatcher	<i>Myiarchus tyrannulus</i>	x	x			
Brown-headed Cowbird	<i>Molothrus ater</i>	x	x	x	x	x
Bullock's Oriole	<i>Icterus bullockii</i>	x	x	x	x	x
Bushtit	<i>Psaltriparus minimus</i>					x
	<i>Campylorhynchus</i>					
Cactus Wren	<i>brunneicapillus</i>	x	x			
(Canvasback)	<i>Aythya valisineria</i>	x				
Canyon Wren	<i>Catherpes mexicanus</i>	x	x			
Caspian Tern	<i>Sterna caspia</i>	x				
(Cassin's Kingbird)	<i>Tyrannus vociferans</i>	x				
(Cassin's Vireo)	<i>Vireo cassinii</i>	x				x
Cattle Egret	<i>Bubulcus ibis</i>	x				
(Cedar Waxwing)	<i>Bombycilla cedrorum</i>			x		
(Chipping Sparrow)	<i>Spizella passerina</i>	x	x			x
Cinnamon Teal	<i>Anas cyanoptera</i>	x				
Clapper Rail	<i>Rallus longirostris</i>	x	x			
Clark's Grebe	<i>Aechmophorus clarkii</i>	x				
(Clay-colored Sparrow)	<i>Spizella pallida</i>	x				
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	x	x	x		
(Common Goldeneye)	<i>Bucephala clangula</i>	x				
Common Ground-Dove	<i>Columbina passerina</i>	x	x	x	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		

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Species	Scientific Name	System-Wide Surveys			Habitat Creation Sites	
		Rapid Area Searches - Presence	Intensive Area Searches - Presumed Breeder	Intensive Area Searches - Presumed Non-Breeder	Intensive Area Searches - Presumed Breeder	Intensive Area Searches - Presumed Non-Breeder
Common Raven	<i>Corvus corax</i>	x	x	x		x
Common Yellowthroat	<i>Geothlypis trichas</i>	x	x	x	x	x
(Cooper's Hawk)	<i>Accipiter cooperii</i>	x	x	x		
(Cordilleran Flycatcher)	<i>Empidonax occidentalis</i>					x
Costa's Hummingbird	<i>Calypte costae</i>	x	x			
Crissal Thrasher	<i>Toxostoma crissale</i>	x	x	x	x	x
Double-crested Cormorant	<i>Phalacrocorax auritus</i>	x		x		
(Dusky Flycatcher)	<i>Empidonax oberholseri</i>	x		x		
(Eared Grebe)	<i>Podiceps nigricollis</i>	x	x			
Eurasian Collared-Dove	<i>Streptopelia decaocto</i>	x	x	x		x
European Starling	<i>Sturnus vulgaris</i>	x	x	x		x
(Forster's Tern)	<i>Sterna forsteri</i>	x				
(Gadwall)	<i>Anas strepera</i>	x				
Gambel's Quail	<i>Callipepla gambelii</i>	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		x		
Great Blue Heron	<i>Ardea herodias</i>	x	x	x		
Great Egret	<i>Ardea alba</i>	x	x	x		
Great Horned Owl	<i>Bubo virginianus</i>	x				x
Greater Roadrunner	<i>Geococcyx californianus</i>	x	x		x	x
Great-tailed Grackle	<i>Quiscalus mexicanus</i>	x	x	x		x
Green Heron	<i>Butorides virescens</i>	x	x	x		
(Green-tailed Towhee)	<i>Pipilo chlorurus</i>	x		x		x
(Hermit Thrush)	<i>Catharus guttatus</i>			x		
(Hermit Warbler)	<i>Dendroica occidentalis</i>	x		x		x
(Herring Gull)	<i>Larus argentatus</i>	x				
Hooded Oriole	<i>Icterus cucullatus</i>	x	x	x		

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(Hooded Warbler)	<i>Wilsonia citrina</i>					X
Horned Lark	<i>Eremophila alpestris</i>	X	X	X		X
House Finch	<i>Carpodacus mexicanus</i>	X	X	X	X	X
House Sparrow	<i>Passer domesticus</i>	X	X			
Inca Dove	<i>Columbina inca</i>					X
Indigo Bunting	<i>Passerina cyanea</i>	X			X	X
Killdeer	<i>Charadrius vociferus</i>	X	X	X		X
Ladder-backed Woodpecker	<i>Picoides scalaris</i>	X	X	X	X	X
Lark Sparrow	<i>Chondestes grammacus</i>	X		X		
(Lazuli Bunting)	<i>Passerina amoena</i>	X	X	X		X
Least Bittern	<i>Ixobrychus exilis</i>	X	X			
Le Conte's Thrasher	<i>Toxostoma lecontei</i>					X
Lesser Goldfinch	<i>Carduelis psaltria</i>	X	X	X		X
Lesser Nighthawk	<i>Chordeiles acutipennis</i>	X	X	X	X	X
(Lincoln's Sparrow)	<i>Melospiza lincolnii</i>			X		
Loggerhead Shrike	<i>Lanius ludovicianus</i>	X	X			
(Long-billed Curlew)	<i>Numenius americanus</i>			X		
Lucy's Warbler	<i>Vermivora luciae</i>	X	X	X	X	X
(MacGillivray's Warbler)	<i>Oporornis tolmiei</i>	X		X		X
Mallard	<i>Anas platyrhynchos</i>	X	X	X	X	
Marsh Wren	<i>Cistothorus palustris</i>	X	X			
(Merlin)	<i>Falco columbarius</i>			X		
Mourning Dove	<i>Zenaida macroura</i>	X	X	X	X	X
(Nashville Warbler)	<i>Vermivora ruficapilla</i>	X		X		X
(Northern Harrier)	<i>Circus cyaneus</i>	X	X	X	X	X
Northern Mockingbird	<i>Mimus polyglottos</i>	X	X		X	X
(Northern Pintail)	<i>Anas acuta</i>	X				
Northern Rough-winged	<i>Stelgidopteryx serripennis</i>	X	X	X		X

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		Rapid Area Searches - Presence	Intensive Area Searches - Presumed Breeder	Intensive Area Searches - Presumed Non-Breeder	Intensive Area Searches - Presumed Breeder	Intensive Area Searches - Presumed Non-Breeder
Swallow						
(Olive-sided Flycatcher)	<i>Contopus cooperi</i>			X		
(Orange-crowned Warbler)	<i>Vermivora celata</i>	X		X		X
(Osprey)	<i>Pandion haliaetus</i>	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
Pied-billed Grebe	<i>Podilymbus podiceps</i>	X	X			
(Plumbeous Vireo)	<i>Vireo plumbeus</i>	X				
Prairie Falcon	<i>Falco mexicanus</i>	X				
(Red-eyed Vireo)	<i>Vireo olivaceus</i>			X		
(Redhead)	<i>Aythya americana</i>	X				
(Red-shouldered Hawk)	<i>Buteo lineatus</i>					X
Red-tailed Hawk	<i>Buteo jamaicensis</i>	X	X			
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	X		X	X	X
(Ring-necked Duck)	<i>Aythya collaris</i>	X				
Ring-necked Pheasant	<i>Phasianus colchicus</i>	X				
Rock Pigeon	<i>Columba livia</i>	X	X	X		
Rock Wren	<i>Salpinctes obsoletus</i>	X	X			
(Rose-breasted Grosbeak)	<i>Pheucticus ludovicianus</i>					X
(Ruby-crowned Kinglet)	<i>Regulus calendula</i>	X				X
(Rufous Hummingbird)	<i>Selasphorus rufus</i>					X
(Sage Sparrow)	<i>Amphispiza belli</i>	X				
(Savannah Sparrow)	<i>Passerculus sandwichensis</i>	X				
Say's Phoebe	<i>Sayornis saya</i>	X	X		X	
(Scott's Oriole)	<i>Icterus parisorum</i>	X	X			
(Sharp-shinned Hawk)	<i>Accipiter striatus</i>	X	X	X		
Snowy Egret	<i>Egretta thula</i>	X		X		

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(Solitary Sandpiper)	<i>Tringa solitaria</i>	x				
Song Sparrow	<i>Melospiza melodia</i>	x	x		x	x
(Sora)	<i>Porzana carolina</i>	x	x			
(Spotted Sandpiper)	<i>Actitis macularia</i>	x				
Summer Tanager*	<i>Piranga rubra</i>	x	x		x	x
(Swainson's Thrush)	<i>Catharus ustulatus</i>			x		x
(Townsend's Warbler)	<i>Dendroica townsendi</i>	x		x		x
(Tree Swallow)	<i>Tachycineta bicolor</i>	x		x		
Turkey Vulture	<i>Cathartes aura</i>	x		x		x
(Varied Thrush)	<i>Ixoreus naevius</i>	x				
(Vaux's Swift)	<i>Chaetura vauxi</i>	x				
Verdin	<i>Auriparus flaviceps</i>	x	x	x	x	x
Vermilion Flycatcher*	<i>Pyrocephalus rubinus</i>	x	x		x	x
(Vesper Sparrow)	<i>Poocetes gramineus</i>	x				
(Violet-green Swallow)	<i>Tachycineta thalassina</i>	x		x		
Virginia Rail	<i>Rallus limicola</i>	x	x			
(Virginia's Warbler)	<i>Vermivora virginiae</i>	x				
(Warbling Vireo)	<i>Vireo gilvus</i>	x		x		x
(Western Bluebird)	<i>Sialia mexicana</i>			x		x
Western Grebe	<i>Aechmophorus occidentalis</i>	x	x			
Western Kingbird	<i>Tyrannus verticalis</i>	x	x	x	x	x
Western Meadowlark	<i>Sturnella neglecta</i>	x	x	x		x
(Western Tanager)	<i>Piranga ludoviciana</i>	x		x		x
(Western Wood-Pewee)	<i>Contopus sordidulus</i>	x		x	x	x
(Whimbrel)	<i>Numenius phaeopus</i>			x		
(White-crowned Sparrow)	<i>Zonotrichia leucophrys</i>	x		x		x
White-faced Ibis	<i>Plegadis chihi</i>	x	x	x		
(White-throated Sparrow)	<i>Zonotrichia albicollis</i>					x

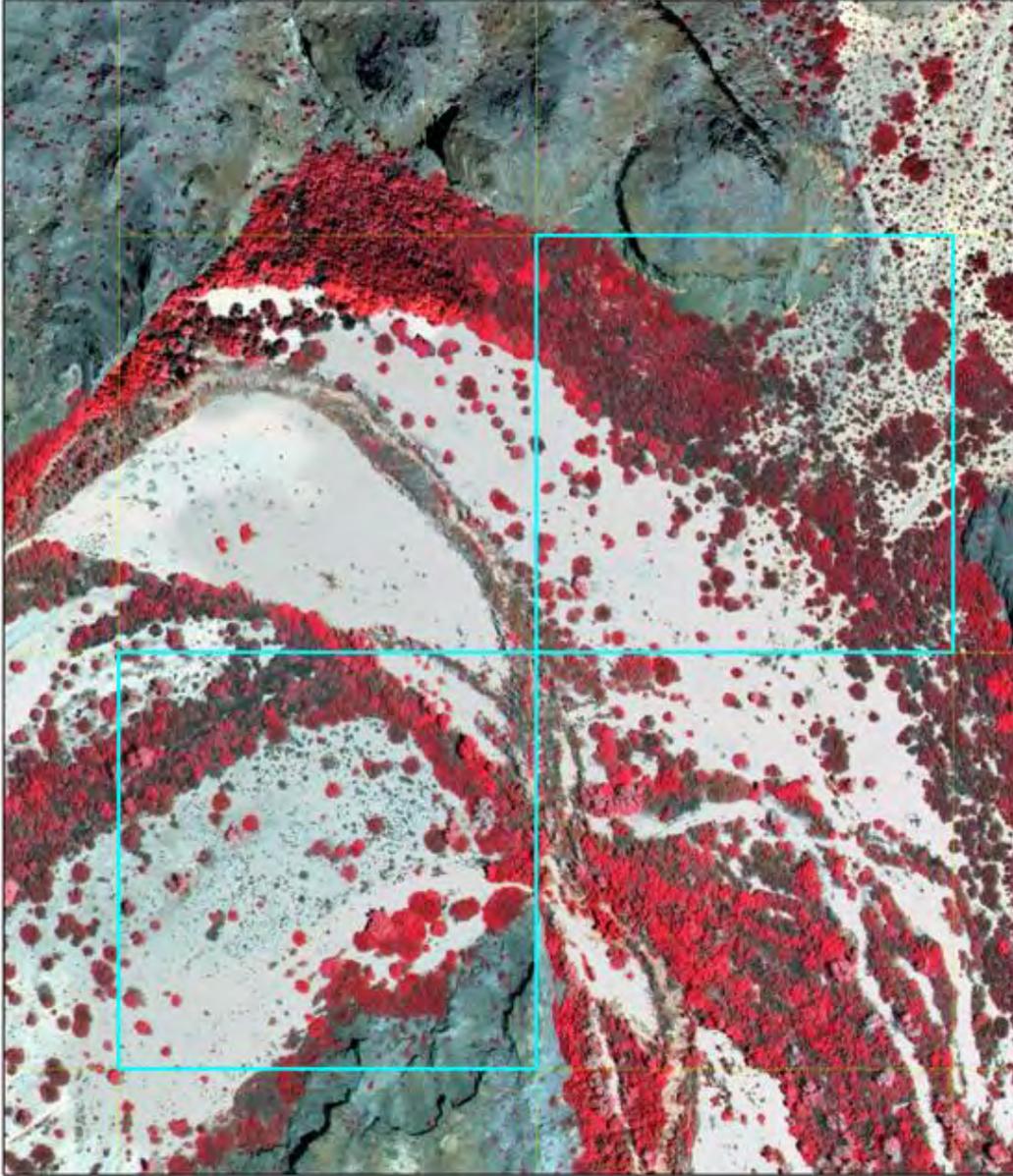
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		Rapid Area Searches - Presence	Intensive Area Searches - Presumed Breeder	Intensive Area Searches - Presumed Non-Breeder	Intensive Area Searches - Presumed Breeder	Intensive Area Searches - Presumed Non-Breeder
White-throated Swift	<i>Aeronautes saxatalis</i>	x	x	x		
White-winged Dove	<i>Zenaida asiatica</i>	x	x	x	x	x
Wild Turkey	<i>Meleagris gallopavo</i>					x
Willow Flycatcher*	<i>Empidonax traillii</i>	x		x		x
(Wilson's Warbler)	<i>Wilsonia pusilla</i>	x		x		x
Yellow Warbler*	<i>Dendroica petechia</i>	x	x		x	x
Yellow-breasted Chat	<i>Icteria virens</i>	x	x	x	x	x
	<i>Xanthocephalus</i>					
Yellow-headed Blackbird	<i>xanthocephalus</i>	x	x	x		x
(Yellow-rumped Warbler)	<i>Dendroica coronata</i>	x				x
Total		149	83	94	35	80

* LCR MSCP covered species

Appendix 6: Two representative system-wide survey plots in the Bill Williams River region (both plots in stratum 7.4).

7313 and 7296



0 40 80 160 Meters
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