

# Lower Colorado River Multi-Species Conservation Program

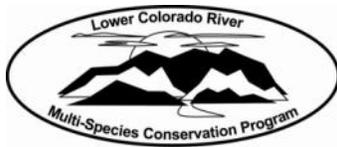


*Balancing Resource Use and Conservation*

## Summary Report on the Lower Colorado River Riparian Bird Surveys, 2008-2010



September 2011



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*Prepared by: Great Basin Bird Observatory, Reno, NV*



Lower Colorado River  
Multi-Species Conservation Program  
Bureau of Reclamation  
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<http://www.lcrmscp.gov>

September 2011

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# Contents

Abstract.....	1
Introduction.....	2
Methods.....	3
Study Area and Sampling Plan .....	3
Plot Selection: System-Wide Surveys .....	8
Plot Selection: Habitat Creation Sites.....	11
Avian Monitoring Methods.....	13
Rapid Area Searches .....	16
Intensive Area Searches.....	17
Double-Sampling .....	17
Population Data Analyses .....	18
Field Habitat Assessments for Covered Species.....	19
Data Analyses for Habitat Associations of Covered Species .....	21
Results.....	22
Overall Species Richness Patterns .....	22
System-Wide Surveys.....	23
System-Wide Rapid Area Searches .....	23
System-Wide Intensive Area Searches .....	29
System-Wide Territory Number Estimates.....	30
Habitat Creation Sites .....	35
Beal Lake Riparian Habitat Creation Site.....	40
Cibola Valley Conservation Area (CVCA) .....	42
Cibola Nature Trail Site .....	44
Palo Verde Ecological Reserve (PVER).....	46
Cibola Mass Planting .....	48
Habitat Assessments of Covered Species .....	51
Basic Habitat Associations of Covered Species .....	51
Habitat Associations Based on Field Habitat Assessments .....	51
Discussion.....	64
Species Richness Patterns .....	64
System-Wide Surveys.....	64
Habitat Creation Sites .....	65
Habitat Associations of Covered Species .....	66
Considerations for Future Bird Monitoring Work on the lower Colorado River .....	67
Literature Cited.....	69

# Tables, Figures, and Appendices

## Tables

Table 1. Codes of dominant vegetation types.....	4
Table 2. Crosswalk of 2010 habitat strata with Anderson and Ohmart (1976), from Bart et al. (2010). .....	6
Table 3. Area, in hectares, of each habitat stratum per region from the 2010 plot delineation in the LCR MSCP project area. ....	7
Table 4. Number of plots available by region and habitat stratum based on the 2010 plot delineation of the LCR MSCP project area. ....	7
Table 5. List of all regions in the LCR MSCP study area, whether they were included in the 2010 plot selection, and reasons for exclusion. ....	9
Table 6. Number of system-wide area search plots per region and habitat stratum surveyed in 2010. ....	10
Table 7. List of habitat creation sites and plots, restoration work phase, and type of area search implemented in 2010. ....	11
Table 8. Behavioral information collected to determine breeding status during area searches.....	15
Table 9a: Number of field habitat assessments conducted at the territory center or nest by species and river region, 2008-2010. ....	20
Table 9b: Number field habitat assessments conducted at non-use sites paired with territories, by species and river region, 2008-2010.....	21
Table 10. Total number of breeding territories of in 80 system-wide rapid area search plots in 2010.....	23
Table 11. Species list of all non-breeding birds in system-wide area search plots in 2010, including both rapid and intensive area searches on 80 plots.....	26
Table 12. Total number of territories by species detected during system-wide intensive area searches, 2010. ....	29
Table 13. Estimated number of territories of covered species, by region-habitat combinations, based on system-wide surveys completed in 2010.....	31
Table 14. Estimated number of individuals of ten of the most abundant species breeding along the lower Colorado River, by region-habitat combination, based on system-wide surveys completed in 2010.....	33
Table 15. Total number of territories, by species, detected in intensive area searches on habitat creation plots in 2008, 2009, and 2010.....	35
Table 16. Presence of migrants and other non-breeders, by species or species groups, detected during intensive area searches at > 2 year-old habitat creation plots surveyed in 2010.....	37
Table 17. Number of breeding territories by species detected in Beal Lake intensive area search plots in 2010. ....	40
Table 18. Total number of breeding territories for bird species on the Beal habitat creation plots, 2008-2010.....	41
Table 19. Number of territories, by species, recorded in Cibola Valley Conservation Area (CVCA) intensive area search plots in 2010. ....	42
Table 20. The total number of breeding territories, by species, recorded on the CVCA habitat creation plots, 2008-2010.....	44
Table 21. Number of breeding territories, by species, found in the Cibola Nature Trail intensive area search plots in 2010. ....	45
Table 22. Total number of breeding territories for bird species in the Nature Trail plots, 2008-2010.....	46

Table 23. Number of territories by species detected in Palo Verde Ecological Reserve (PVER) intensive area search plots in 2010.....	47
Table 24. The total number of breeding territories for bird species on the PVER phase 2 habitat creation plots, 2008-2010.....	48
Table 25. Number of breeding territories, by species, found in the Cibola Mass Planting intensive area search plot in 2010.....	49
Table 26. The total number of breeding territories for bird species on the Cibola Mass Planting site, 2008-2010.....	49
Table 27. Number of breeding territories, by species, found in CVCA 4 rapid area search plot in 2010.....	50
Table 28. Number of breeding territories, by species, found in PVER 4 rapid area search plot in 2010.....	50
Table 29. Number of territories of covered species by habitat stratum, summarized from 80 system-wide area search plots surveyed in 2010.....	51
Table 30a: Bell’s Vireo habitat associations based on categorical variables collected in field habitat assessments on territories and paired non-use sites, 2008-2010.....	52
Table 30b: Bell’s Vireo habitat associations based on continuous variables collected in field habitat assessments and measured in a 707 m <sup>2</sup> (0.17 acre) plot in the center of territories and in paired non-use sites, 2008-2010.....	53
Table 31a: Gila Woodpecker habitat associations based on categorical variables collected in field habitat assessments on territories and paired non-use sites, 2008-2010.....	55
Table 31b: Gila Woodpecker habitat associations based on continuous variables collected in field habitat assessments and measured in a 707 m <sup>2</sup> (0.17 acre) plot in the center of territories and in paired non-use sites, 2008-2010.....	56
Table 32a: Summer Tanager habitat associations based on categorical variables collected in field habitat assessments on territories and paired non-use sites, 2008-2010.....	57
Table 32b: Summer Tanager habitat associations based on continuous variables collected in field habitat assessments and measured in a 707 m <sup>2</sup> (0.17 acre) plot in the center of territories and in paired non-use sites, 2008-2010.....	58
Table 33a: Vermilion Flycatcher habitat associations based on categorical variables collected in field habitat assessments on territories and paired non-use sites, 2008-2010.....	59
Table 33b: Vermilion Flycatcher habitat associations based on continuous variables collected in field habitat assessments and measured in a 707 m <sup>2</sup> (0.17 acre) plot in the center of territories and in paired non-use sites, 2008-2010.....	60
Table 34a: Yellow Warbler habitat associations based on categorical variables collected in field habitat assessments on territories and paired non-use sites, 2008-2010.....	62
Table 34b: Yellow Warbler habitat associations based on continuous variables collected in field habitat assessments and measured in a 707 m <sup>2</sup> (0.17 acre) plot in the center of territories and in paired non-use sites, 2008-2010.....	63

## Figures

Figure 1. Map of the LCR-MSCP study area for system-wide bird surveys.....	3
Figure 2. Comparison of the population size estimates of the eight most common species in 2010 compared with their population size estimates for 2007-2009.....	34
Figure 3. Comparison of the population size estimates of the eight most common species in 2010 compared with their population size estimates for 2007-2009.....	35

## Appendices

Appendix 1. Overview of habitat creation sites of the LCR MSCP in 2009. Map provided by the U.S. Bureau of Reclamation, Lower Colorado River Region. ....	71
Appendix 2a. Example of a system-wide monitoring plot. ....	72
Appendix 2b. Example of a grid plot (when no aerial photo coverage is available).....	73
Appendix 2c. Example of a plot map with grid, including grayscale imagery for reference. ....	74
Appendix 2d. Example of a filled-out plot map from a rapid area search.....	75
Appendix 2e. Example of the first page of a six-page filled-out rapid area search data sheet for plot 7335 in 2010.....	76
Appendix 2f. Example of a filled-out rapid area search end-of-season summary datasheet (first page).. ....	77
Appendix 2g. Example of end-of-season intensive area search data sheet, filled out after eight visits. ....	78
Appendix 2h. Example of an intensive area search data sheet for non-breeders and fly-overs, filled out for one visit. ....	79
Appendix 2i. Example of an end-of-season summary data sheet that provides the final tally of territories. ....	80
Appendix 2j. Example of a species territory map (Bell’s Vireo) compiled at the end of an intensive survey effort for each species on the plot.....	81
Appendix 3. Rapid Area Search Protocol.....	82
Appendix 4a. Presence of migrants and other non-breeders, by species, detected during intensive area searches at Beal Lake habitat creation plots in 2010. ....	84
Appendix 4b. Presence of migrants and other non-breeders, by species, detected during intensive area searches at CVCA habitat creation plots in 2010. ....	87
Appendix 4c. Presence of migrants and other non-breeders, by species, detected during intensive area searches at Nature Trail habitat creation plots in 2010.....	89
Appendix 4d. Presence of migrants and other non-breeders, by species, detected during intensive area searches at PVER habitat creation plots in 2010. ....	91
Appendix 4e. Presence of migrants and presumed non-breeders, by species, detected during intensive area searches at the Cibola Mass Planting site in 2010.....	93
Appendix 4f. Presence of migrants and other non-breeders, by species, detected during rapid area searches at the PVER 2 habitat creation plot in 2010.....	94
Appendix 4g. Presence of migrants and other non-breeders, by species, detected during rapid area searches at the CVCA4 habitat creation plot in 2010.....	95
Appendix 5. Comprehensive species list from avian surveys conducted along the lower Colorado River in 2010. ....	96
Appendix 6: Methods for creating the revised plots layer for 2010. Email correspondence from November 2009. ....	105

# Abstract

This report summarizes the results of the 2010 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 the first three years of the program (2007-2009), compared to the population size estimates for 2010. We also combined habitat modeling data for select species based on our vegetation assessments of 2008-2010. In 2010, we completed system-wide area searches in 80 rapid area search plots and eight intensive area searches conducted on a subset of these. This subset was also used for double-sampling to generate an estimate for the total number of territories of five covered species for 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 16 intensive area searches in habitat creation sites that were planted at least two years previously and two rapid area searches in habitat creation sites that had less than two years of growth.

A total of 186 species of birds were detected in all surveys along the lower Colorado River in 2010, which results in a total of 213 species recorded from 2008-2010. All covered species subject to this monitoring effort 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. Gila Woodpeckers were common in the Bill Williams River region and in upland desert areas but uncommon in riparian areas on the lower Colorado River. Gilded Flickers were not detected breeding in the study area, but several incidental sightings of non-breeding individuals were reported in 2010.

We also conducted an intensive field habitat assessment effort over the past three years, resulting in habitat models for five of the six covered species. We used breeding territories and randomly-selected non-use sites in comparable habitats and regions to determine significant habitat effects on territory placement. In detailed 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 habitat creation efforts. Finally, we made recommendations for habitat creation efforts and for 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” (USBR 2006, p. 4). This report summarizes the methods and results of the 2010 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 four years of the program (data from 2007-2009 compared to data from 2010), and habitat modeling for five covered species based on our vegetation assessments of 2008, 2009, and 2010.

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. In 2010 the Colorado River Indian Tribes Reservation (CRIT) habitat creation sites were not surveyed, but those sites may be surveyed again in future years. The project area also includes portions of Bill Williams and Virgin rivers, as well as previously-established habitat creation sites within the historic floodplain of the Colorado River’s mainstem.

The project goals addressed in the 2010 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, and (3) 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 (USBR 2006).

# Methods

## 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 (Figure 1a). The section extending from Separation Canyon to Lake Mead was surveyed in 2007, but was excluded in 2008, 2009 and 2010.

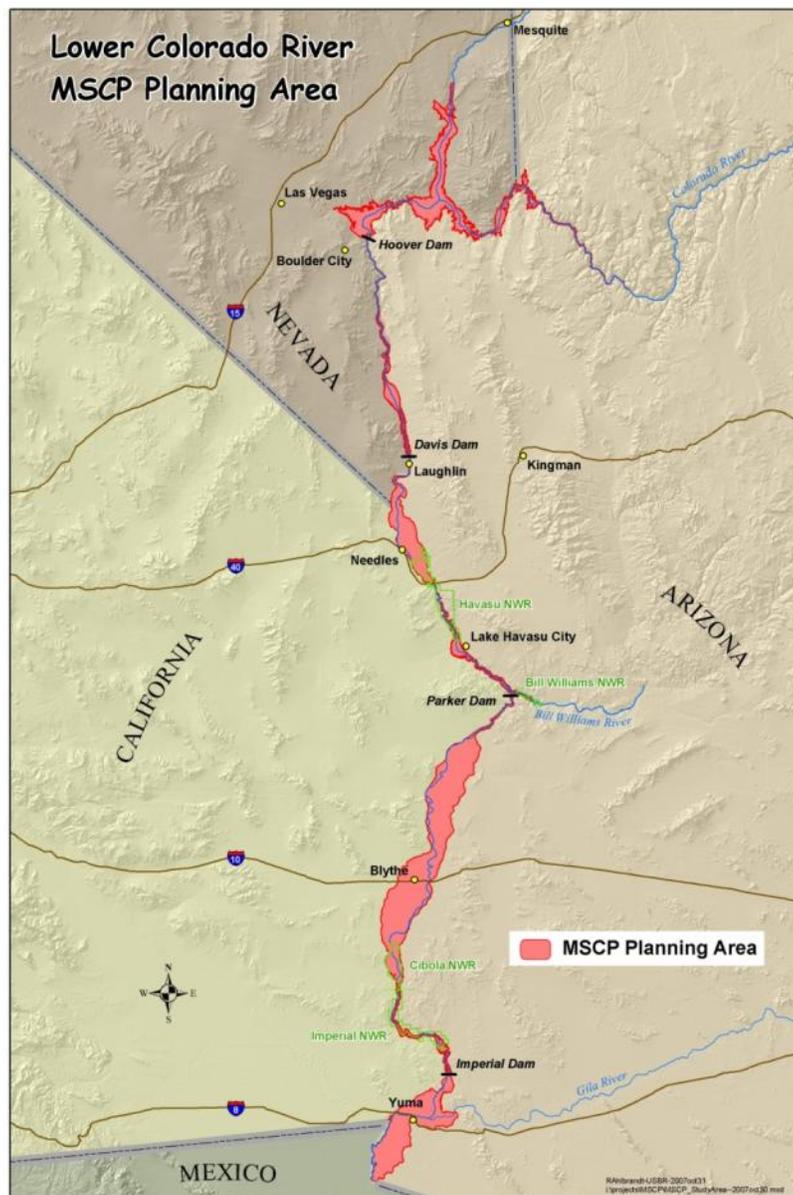


Figure 1. Map of the LCR-MSCP study area for system-wide bird surveys (in pink). Map provided by the U.S. Bureau of Reclamation, Lower Colorado River Region.

The original sampling plan for system-wide avian surveys (Bart et al. 2010) was developed under Work Task D6, *System Monitoring for Riparian Obligate Avian Species* and a more detailed description of it can be found in Bart (2010). The goals of the plan were to: 1) provide a baseline for monitoring long-term population trends of obligate riparian birds throughout the lower Colorado River, including LCR MSCP habitat creation sites; 2) estimate population sizes of obligate riparian birds; and 3) define habitat requirements of LCR MSCP covered species.

To accommodate these goals, potentially-suitable habitat patches were originally defined as “good/fair/poor” and further as “tall/low” (plus “unsuitable” and “marsh” categories) to roughly delineate vegetation covers that are important for the covered species (for more details on the original stratification, see Bart 2007). This stratification was done to be able to adjust survey-effort distribution in order to optimize survey effectiveness for covered species (Bart et al. 2010). The original habitat stratification was based on combined vegetation classes from the Anderson-Ohmart vegetation classification system that was originally used to map vegetation types throughout the project area (Table 1).

**Table 1. Codes of dominant vegetation type (from Anderson and Ohmart 1976; 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

During the first stratification (Bart 2007), survey plots were delineated to divide the entire project area into approximately 9 ha plots and were each assigned to the habitat type that covered the majority of the plot. It is important to note that other habitat types may be present in any plot that is designated to one habitat type. For instance, an “unsuitable” plot may have in a *minority* of its area highly suitable habitat for a covered species, thus explaining survey results that indicate that a small portion of a covered species’ population occurs in “unsuitable” plots.

In the spring of 2010, the sampling design was revised to create a new plots layer, but largely retaining the original grid delineation of approximately 9-ha plots. Several issues were resolved by creating the new plots layer, including achieving a better fit with the MSCP project boundary, better addressing the amount of non-riparian habitat in some areas, and better fitting the size of plots to optimal survey effort. Historically, the Colorado River floodplain was mostly covered by riparian habitat, but today, much of that historic floodplain area is covered by upland habitats due to river management. To update the sampling plot grid, we first clipped the old plots layer to fit the project's current MSCP boundary and, second, we reduced some plot sizes to better reflect the survey area that can effectively be covered in an area search.

The original habitat stratification was further updated in 2010 by (1) revising names of most habitat categories (so as not to presume suitability for covered species), and (2) by joining the original six strata to form just four habitat strata: Tall Woody, Low Woody, Herbaceous, and Unsuitable. Habitat strata were selected to keep the tall and medium woody and the low woody cover types separate (Tall and Low Woody), combine various herbaceous vegetation types into Herbaceous, and combine all else into Unsuitable. The crosswalk from the original Anderson and Ohmart (1976) vegetation types to the habitat strata used for re-stratification in 2010 is provided in Table 2. Further details on habitat strata and plot assignments can be found in Bart et al. (2010).

We retained Bart et al.'s (2010) stratum names for consistency between the two reports, but we recommend that in future revisions of the spatial layer and plot data, the "Unsuitable" class be renamed to "Other", as it entails a variety of different cover types (uplands, disturbed, barren, etc.) that are *presumed* to be unsuitable for covered species. As with all other strata, plots were delineated and classified to reflect the habitat type that covers the *majority* of a plot, but a minority of such a plot may have suitable habitats for covered species, resulting in the possibility that a small portion of covered species populations are reported for "unsuitable" plots. This point is easily clarified with the plot delineation methods, but it causes semantic confusion when reporting survey results.

**Table 2. Crosswalk of 2010 habitat strata with Anderson and Ohmart (1976), from Bart et al. (2010).**

<b>Type</b>	<b>Habitats</b>	
Tall	CW-1	CW-3
Woody (TW)	CW-2	
Low	CR-0	SC-5
Woody (LW)	CW-4	SC-6
	CW-5	SH-1
	CW-6	SH-3
	HM-3	SH-4
	HM-4	SH-5
	HM-5	SH-6
	HM-6	SM-3
	SC-1	SM-4
	SC-2	SM-5
	SC-3	SM-6
	SC-4	
Herba- ceous (H)	AG-0	MA-3
	ATX-0	MA-4
	AW-0	MA-5
	MA-1	MA-6
	MA-2	MA-7
Unsuitable (U)	BW-0	UD-0
	NC-0	

Furthermore, the project area was originally divided into 13 geographic regions (for further details and maps, see Bart 2009 and GBBO 2009), resulting in the following breakdown of area by the revised habitat strata for the entire system-wide survey area (Table 3; further description of regions below). The geographic regions of the original sampling plan were retained in 2010 without changes. The area of each habitat stratum by region is needed for estimating system-wide population sizes for the purpose of this report. In Table 4, we report the number of available plots by habitat strata and regions in the 2010 plots layer (hereafter 2010 plot delineation).

**Table 3. Area, in hectares, of each habitat stratum per region from the 2010 plot delineation in the LCR MSCP project area.**

Geographic Regions	Habitat Strata				Total
	Herbaceous	Low Woody	Tall Woody	Unsuitable	
1	11.81	2723.45	637.67	1197.44	4570.38
2	145.82	1927.66	67.04	453.53	2594.05
3	0.00	7684.46	0.00	8056.50	15740.96
5	40.30	6027.48	82.17	6612.92	12762.88
6	762.51	2953.16	241.71	661.76	4619.14
7	72.83	2789.73	475.81	4414.66	7753.03
8	27.00	2392.52	19.30	8252.11	10690.92
9	107.41	9350.29	124.15	15363.48	24945.34
10	157.67	5605.03	48.85	3387.81	9199.36
11	620.64	2862.68	151.57	438.74	4073.63
12	234.85	2829.05	621.69	6045.60	9731.18
13	0.00	1443.74	588.69	3879.52	5911.95
Total	2180.84	48589.25	3058.66	58764.05	112592.80

**Table 4. Number of plots available by region and habitat stratum based on the 2010 plot delineation of the LCR MSCP project area.**

Geographic Regions	Habitat Strata				Total
	Herbaceous	Low Woody	Tall Woody	Unsuitable	
1	1	298	66	109	474
2	14	212	7	41	274
3	0	844	0	656	1500
5	3	650	10	463	1126
6	70	319	24	54	467
7	6	301	50	337	694
8	3	249	2	439	693
9	9	995	10	925	1939
10	16	614	5	198	833
11	51	291	15	31	388
12	22	291	56	309	678
13	0	160	61	204	425
Total	195	5224	306	3766	9491

In reviewing Table 4, we further decided to combine the Herbaceous and Unsuitable plots into one stratum in 2010, as (1) it is generally accepted that herbaceous vegetation types are largely unsuitable for our covered species, which are all closely tied to woody vegetation covers during breeding (USBR 2008), and (2) only a small proportion of plots fell into the Herbaceous category, justifying a lumping with another category (J. Bart, *pers. comm.*). Therefore, our final number of habitat strata for plot selection was three (Tall Woody, Low Woody, Herbaceous/Unsuitable).

### **Plot Selection: System-Wide Surveys**

For the 2010 system-wide area searches, a total of 80 ~9 ha plots were randomly selected from the 2010 plot delineation covering three habitat strata (Low Woody, Tall Woody, and Herbaceous/Unsuitable) in the eight geographic regions (Table 4). Region was not used to stratify the random site selection in 2010 because, based on plot selections in previous years, we expected a random selection to provide sufficient coverage across available regions. Several regions were purposely excluded from sampling in 2010, including Regions 1 (access problems), 2 (outside the LCR MSCP project area), 3 (lack of riparian vegetation, fluctuating lake levels), 9 (permit unattainable), and 13 (safety concerns). Surveys at Lake Mead (Region 3) in previous years revealed that water levels fluctuated so strongly that riparian areas were much reduced, leaving all but a few plots *de facto* unsuitable for covered species, and the few remaining plots highly variable in habitat condition from year to year. In discussions with USBR, we therefore decided that the complex access issues for the few presumably-suitable habitats warranted that we exclude Region 3 in 2010 (B. Sabin, *pers. comm.*). Finally, by chance, Region 4 (Lake Mohave) had no randomly-selected plots in our 2010 selection (Table 5).

To select plots, we used a stratified random selection using the habitat strata. The plots were separated into Excel spreadsheets by the three strata that describe each plot's dominant vegetation type (Low Woody, Tall Woody and Herbaceous/Unsuitable). In each sheet, we created a column of random numbers, sorted the plots by the random number column, and then selected from the beginning of the list. We weighted the number of plots per stratum toward woody habitats for more intensive survey coverage of covered species, resulting in 35 Low Woody, 25 Tall Woody, and 20 Herbaceous/Unsuitable plots. Sampling the Herbaceous/Unsuitable plots provided an estimate of covered species' populations in areas that might have a minor component of suitable habitat or habitat types that these species are not traditionally known to occupy.

**Table 5. List of all regions in the LCR MSCP study area, whether they were included in the 2010 plot selection, and reasons for exclusion.**

Region	Region Name	Included in 2010 Selection?	Reasons for Exclusion
1	Separation Canyon to Lake Mead	No	not accessible
2	Virgin River	No	outside the LCR MSCP planning area
3	Lake Mead	No	fluctuating water levels
4	Hoover Dam to Davis Dam	Yes	
5	Davis Dam to Bill Williams River (excluding Havasu NWR)	Yes	
6	Havasu NWR (excluding Bill Williams unit)	Yes	
7	Bill Williams unit of the Havasu NWR	Yes	
8	Bill Williams unit to Cibola excluding the Colorado Reservation	Yes	
9	Colorado River Indian Reservation Ahakhav Preserve	No	permits unattainable
10	Cibola NWR	Yes	
11	Imperial NWR	Yes	
12	Colorado River from the Imperial NWR to Yuma	Yes	
13	Yuma to Southerly International Boundary	No	safety concerns

Some of the randomly-selected plots were inaccessible, and we used a sequential list of alternate plots in the same habitat and region, or closest region with the same habitat type, as alternates. Because we needed to use alternate plots, the final number of plots in each stratum and region and slightly differed from our original 2010 selection, with one plot in Region 13 that was excluded from our original selection (Table 6).

Plots that were farther than 2 km from the nearest road, trail, or waterway were replaced with alternate plots. Other plots were replaced because private landowners denied access for surveys, or because they contained wetlands that were inaccessible or otherwise unsafe.

The largest issue necessitating the use of alternate plots in 2010 was significant flooding throughout the Bill Williams River NWR area. At the beginning of the survey season, plots across the river channel from the access road were unsafe to access. We waited for three weeks to make final decisions on these plots, consulted with refuge staff on flood forecasts, and discussed with J. Bart and USBR personnel possible effects to the study design. In the end, we had to drop all the plots in the interior of the Bill Williams River floodplain, but surveyed the plots that were safe to access. Even for several of these, significant wading and swimming was necessary for access; therefore, access problems may need to be taken into account in planning future surveys at the Bill Williams River during seasons when dam releases are likely. In the end, 25 of all originally-selected plots for 2010 were replaced due to unsafe conditions or denial of access. Table 6 shows the final distribution of plots surveyed in 2010, by habitat stratum and region.

An additional, non-randomly selected plot on the Bill Williams River at Kohen Ranch was surveyed again (as in 2008 and 2009) to increase coverage of covered species in this important area. This plot was excluded from all system-wide analyses and from Table 6. The eight intensive area search plots, which consisted of a random subset from the 80 rapid area search plots, included four plots in Region 5 (Davis Dam to Bill Williams River National Wildlife Refuge [NWR], excluding Havasu NWR), two in Region 6 (Havasu NWR), and two in Region 10 (Cibola NWR).

**Table 6. Number of system-wide area search plots per region and habitat stratum surveyed in 2010.**

Region	Region name	Low Woody	Tall Woody	Herba- ceous/ Unsuit- able	Total
1	Separation Canyon to Lake Mead	0	0	0	0
2	Virgin River	0	0	0	0
3	Lake Mead	0	0	0	0
4	Hoover Dam to Davis Dam	0	0	0	0
5	Davis Dam to Bill Williams River (excluding Havasu NWR)	6	0	4	10
6	Havasu NWR (excluding Bill Williams unit)	6	5	1	12
7	Bill Williams unit of the Havasu NWR	4	7	5	16
8	Bill Williams unit to Cibola excluding the Colorado Reservation	6	0	3	9
9	Colorado River Indian Reservation Ahakhav Preserve	0	0	0	0
10	Cibola NWR	6	1	2	9
11	Imperial NWR	5	2	1	8
12	Colorado River from the Imperial NWR to Yuma	4	9	2	15
13	Yuma to Southerly International Boundary	1	0	0	1
Total:		38	24	18	80

## Plot Selection: Habitat Creation Sites

An overview of habitat creation site locations is provided in Appendix 1b. 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 typical system-wide area search plots, so the sites were subdivided into plots that were a reasonable size to be surveyed in one morning (9 – 20 ha). In 2010, the area of all post-development habitat creation sites (i.e., two or more years of growth) could be covered with intensive area searches, and they were thus subdivided into 16 plots intensive-area-search plots (Table 7). Two sites with one year of growth were surveyed using rapid area searches to determine.

**Table 7. List of habitat creation sites and plots, restoration work phase, and type of area search implemented in 2010. Asterisks indicate surveys that only included LCR-MSCP covered species.**

Site and Plot	Restoration Work Phase	Dominant Vegetation	Area Search Type Implemented					
			2008		2009		2010	
			intensive	rapid	intensive	rapid	intensive	rapid
<i>Beal Lake Riparian Habitat Creation Project</i>								
Beal A	planted 2004	screwbean mesquite	X		X		X	
Beal B	planted 2004	cottonwood-willow	X		X		X	
Beal C	planted 2004	cottonwood-willow	X		X		X	
Beal D	planted 2004	screwbean mesquite	X		X		X	
<i>Colorado River Indian Tribe</i>								
CRIT 9A	planted 2001	screwbean mesquite	X		X			
CRIT 9B	planted 2001	cottonwood-willow	*		X			
CRIT 9C	planted 2002	cottonwood-willow/screwbean mesquite	X		X			
CRIT 9D	planted 2003	cottonwood-willow/honey mesquite	X		X			
CRIT 9E	planted 2005	cottonwood-willow	*		X			

<b>Site and Plot</b>	<b>Restoration Work Phase</b>	<b>Dominant Vegetation</b>	<b>Area Search Type Implemented</b>		
<i><b>Cibola Valley Conservation and Wildlife Area</b></i>					
CVCA 1A	planted 2006	cottonwood-willow	X		X
CVCA 1B	planted 2006	cottonwood-willow	X		X
CVCA 1C and D	planted 2006	cottonwood-willow	X		X
CVCA 2 (A,B,C)	planted 2008	cottonwood-willow		X	X
CVCA 3 A & B	planted 2007	cottonwood-willow	X	X	X
CVCA 3 C & D	planted 2007	cottonwood willow/baccharis	X	X	X
CVCA 4	pre-development	cottonwood-willow			X
CVCA 5		agricultural		X	
CVCA 6	pre-development	agricultural		X	
Crane Roost	pre-development	agricultural		X	
<i><b>Cibola Nature Trail</b></i>					
NT-north	planted 1999	mesquite- cottonwood-willow	X	X	X
NT-south	planted 1999	mesquite- cottonwood-willow	X	X	X
Mass Planting	planted 2005	cottonwood-willow	X	X	X
<i><b>Palo Verde Ecological Preserve</b></i>					
PVER 2A	planted 2007	cottonwood-willow	X	X	X
PVER 2B	planted 2007	cottonwood-willow	X	X	X
PVER 3	planted 2008	cottonwood-willow		X	X
PVER 4	pre-development	cottonwood-willow		X	X
PVER 7	pre-development	agricultural		X	
PVER 8	pre-development	agricultural		X	
PVER 9	pre-development	agricultural		X	

When the project began in 2007, double-sampling with rapid and intensive area searches was done on habitat creation sites (J. Bart *pers. comm.*). After analyzing the data, it was decided that the total acreage of habitat creation was too small at that time to provide accurate population size estimates based on the double-sampling method. Therefore, it was decided to cover habitat creation plots with two or more years of growth completely with intensive area searches to provide accurate data for the surveyed area. These accurate data sets that have been collected since then provide a baseline for future monitoring, which will likely necessitate a sampling plan as acreage of habitat creation

sites increases. Pre-development sites were covered with rapid area searches, as it was deemed a lower priority to get intensive coverage in areas that are highly unsuitable for covered and other riparian species.

Beginning next year (2011), rapid and intensive area searches may be done on habitat creation sites in a double-sampling approach due to the increased acreage of 200-400 acres per year, which cannot be covered at a reasonable cost with complete intensive area searches. The habitat creation sites may become an additional habitat stratum to the system-wide effort, with some intensive plots for the system-wide effort being selected from habitat creation sites. For this, the overall detection ratios (system-wide and habitat creation sites) would be used for calculating system-wide population estimates.

## **Avian Monitoring Methods**

To monitor birds of the lower Colorado River in system-wide and habitat creation plots, we conducted rapid and intensive area searches. The goal of the rapid area search effort was to obtain an accurate as possible estimate of breeding territories while optimizing the balance between geographic survey coverage and survey effort. The goal of the intensive area searches was to find and document all territories present on each 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 and density of breeding birds in the study area. Breeding populations are estimated using the ratio of the rapid area search results (number of territories detected) over the intensive area search results (number of territories known to be there) to generate a detection ratio that takes into account how many territories are, on average, missed/overestimated during rapid area searches. After applying this detection ratio to the system-wide rapid surveys, total population size estimates for the project area can be generated (Bart and Hartley 2010). Further details on why this approach was used can be reviewed in GBBO (2008) and Bart et al. (2010).

Rapid area searches for this project 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. Non-breeding birds, such as known migrants or resident birds not breeding in a plot, were counted separately from possible breeders.

To conduct area searches, field surveyors visited the plot with an aerial photo that specified GPS coordinates (in NAD 83) of the plot corners (Appendix 2a-j). Using a combination of a hand-held GPS unit and the aerial photo overlaid with a 50 m UTM grid, 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 and around the plot. For this, surveyors passed within at least 50 m of every point within the plot to assure that all sections of the plot were adequately covered. Only one plot could be

surveyed in one morning, and all visits to an individual plot were done by the same surveyor.

All area searches were conducted between 12 April and 13 June, 2010. 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 5 or 6 hours). Whether the survey was a rapid or an intensive area search, the surveyor's goal was to identify and record data on all birds present within the plot on each visit. 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. More time was spent mapping birds' locations during intensive surveys than on rapid surveys. On intensive surveys we wanted a territory map at the end of the season, and on rapid surveys our mapping effort was mostly to keep data organized and prevent double-counting individual birds.

All bird sightings and territory boundaries were recorded directly on to a gray-scale aerial photograph with a 50 m UTM grid, which also included imagery of the immediate surroundings of the plot (between 20 and 100 m, depending on plot shape). Birds near the edge or just outside the plot were also recorded on the map to prevent double-counting of birds moving across the boundary. At the end of the season, birds that were on the edge and with partial territories in the plot were classified in two ways. First, the surveyor used all detection locations to approximate how much of the territory was within the plot to the nearest 25% (resulting in 0%, 25%, 50%, 75%, or 100% of a territory in a plot). In addition, the surveyor classified each territory as "in" or "out" of the plot based on the centroid of the territory polygon that described their activities during the survey. The "in or out" method was done to provide compatible data with earlier system-wide monitoring data that only employed this method. If these earlier efforts are needed for mid-term monitoring, we recommend continuing both methods of determination of territory location for the time being, but for longer-term monitoring, the partial-territory method will likely be the most effective.

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 for site-based monitoring that allows for joining territory delineations across plot boundaries when evaluating habitat creation sites as a whole.

All observed breeding evidence was marked on the map using shorthand codes (adapted from Bibby et al. 2000), and knowledge of breeding status was recorded explicitly on the data sheet (Table 8, Appendix 2a-j). If we observed confirmed breeding evidence on at least one visit, the bird was determined a breeder. **If an adult bird of a species known to breed in the area was detected on the same territory in three or more consecutive visits during intensive area searches, even if no breeding evidence was observed, it**

was determined a “breeder”, and it was thus included in the total number of breeding territories regardless of direct evidence of nesting. Exceptions to this rule were repeated sightings of Yellow-billed Cuckoo and Willow Flycatcher, both of which breed later than most other landbirds in the project area, and the Willow Flycatcher is also known to occur as a vagrant 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 (McLeod and Koronkiewicz 2010 and Halterman et al. 2009). Therefore, all individuals of these species observed in our surveys were classified as presumed non-breeders.

There was considerable discussion throughout the development of the monitoring plan on how to handle possible and probable breeders for which evidence of a nest or fledglings could not be obtained. In the latest revision, we were asked to treat possible and probable breeders as “breeders”, if they were displaying territorial behavior in the same place for three consecutive visits, but we strongly caution that a portion of these records were *only* based on repeated territorial sightings rather than direct nesting evidence. The survey logistics in sites occupied by covered species can be extraordinarily difficult, making nest searches without major disruption of sensitive breeding activities sometimes impossible. However, we feel that for the purpose of population monitoring, careful delineation of repeated territorial activities provides sufficient evidence that a breeding attempt took place and should therefore be counted as part of the breeding population. As with all breeding bird surveys, very early, very late, and very brief nesting attempts may be missed altogether, but this cannot be addressed without major disruption of a breeding site through a very intensive (and expensive) nest study. In future years, the effect of these outliers may be estimated through a re-analysis of all raw survey data that show records of all birds present on the plot during each survey. Table 8 illustrates how we ranked breeders (confirmed breeding or possible/probable breeding on three consecutive visits) and non-breeders (observed only, or possible/probable breeding on less than three consecutive visits) based on behavioral cues at each visit.

**Table 8. Behavioral information collected to determine breeding status during area searches.**

<b>Categories</b>	<b>Behavior</b>
Observed	Seen or heard only
Possible	Singing Pair seen or heard together
Probable	Territorial display Pair in suitable nesting habitat Courtship and or mate guarding Agitated behavior
Confirmed	Nest building Carrying nest material Prolonged distraction behavior Occupied nest

Food carrying  
Dependent young present  
Fecal sac carrying  
Nest with eggs  
Nest with young

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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., flying over but not landing in the plot), or incidental (i.e., detected in the plot's general area, but not in the plot— same as a casual observation).

### 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 three weeks, with the first round of visits in mid-April through mid-May, and the second round in mid-May through mid-June, 2010. This schedule was the same as in 2009, but different than the survey periods used in 2008, which were two weeks later. After the 2008 field season, it was determined that many breeding birds had already vacated their territories after the middle of June. The 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 several locations where the bird/pair/family group was observed during each survey. For all non-covered species, the surveyors focused their efforts on getting a complete count, avoiding double-counts, recording breeding evidence (Table 8), and determining whether their territory was inside the plot (“in or out” method, see above). 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 non-breeders. **If a bird of a species that is known to breed in the project area was found in the same location and displayed possible, probable, or confirmed breeding behaviors on both visits, it was determined a “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 non-breeder. Rapid area search data collection was revised for 2009 and 2010 to collect more data on breeding evidence (for revised methods and datasheet, see Appendix 3).

## **Intensive Area Searches**

Intensive area searches were conducted on a subset of system-wide rapid area search plots and on all > 2 year-old habitat creation sites. Intensive area search plots were visited weekly for a total of eight visits to each plot. All territories were delineated for all species (covered and non-covered) to the extent possible, but 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 confirm known territory locations and territory boundaries, and to add previously undetected, or poorly delineated, territories with each visit. During intensive area searches, breeding status of individuals could be determined with much greater accuracy than was possible in rapid area searches because of the increased number of visits to the plot. By the last visit, the surveyors were asked to use their data from eight visits to determine 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 (confirmed, followed by probable, followed by possible) for nesting was recorded during each visit (Table 8). At the end of the eight surveys, breeders were determined based on confirmed breeding evidence, or probable and possible breeding evidence collected during three or more consecutive visits to the same territory (see above). 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 final maps of territories by species using the cumulative data from all visits. In 2010, surveyors entered their final territory maps for covered species into ArcGIS as shape files by species and plot in order to provide a digital format for future comparisons.

## **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 rapid survey techniques such as point counts, Emlen transects, and single rapid area searches. 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 by the surveyor. To quantify 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). Double-sampling was only conducted on system-wide survey plots. Post-development habitat creation sites were still restricted enough in area that they could be surveyed with intensive area searches in order

to get a complete count of territories. In future years as the number of planted habitat creation sites grow, a double-sampling design may be implemented.

## 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 breeders, and (2) a list of species that were either migrants or residents that were not confirmed to be breeding within the plot, by species. In this report, fly-overs and incidental sightings were only included in summary species lists, and were excluded from all quantitative analyses. Rapid area search data were summarized by breeders (i.e., estimated number of territories) and number of non-breeders, which include resident birds and migrants, using the plot during one or both of the rapid surveys.

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; Bart and Hartley 2010), 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 2010 data and the DS program to estimate territory numbers of the covered species and of the ten most abundant species system-wide, excluding colonial nesters and other species that are not territorial during nesting. Since not all regions 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 project area. In 2010, we ran the DS program three times with slightly different input files. The first run included only the 2010 data, using all species in the input files to calculate an overall detection ratio. In the second run, we included only the 2010 data but removed all migrants, waterbirds, shorebirds, colonial nesters, doves, and grackles from the detection ratio calculation. In the third run, we used the same reduced species set for the detection ratio, but also included data from 2007-2009 plots in the intensive area search input files. We did this to add to the sample size of detection ratios, since some covered species were not detected during system-wide intensive area searches in 2010. The results from all three DS runs were extraordinarily similar, and a detection ratio of 1.07 for all population size estimates resulted from the 2007-2009 samples, and a separately-calculated detection ratio of 1.07 for all population size estimates resulted from the 2010 data. This was thus used for calculating population size estimates for all sampled covered species and the ten most abundant riparian species in the project area.

## Field Habitat Assessments for Covered Species

Field habitat assessments for covered species were initiated during the 2008 field season of LCR MSCP bird monitoring and completed in June of 2010. For the habitat assessments, we had a three-year goal of assessing at least 20 territories per covered species, as sample sizes allowed, paired with 20 non-use sites. The locations for habitat assessments were selected using both the area search results within intensive and rapid survey plots and incidental discoveries of territories outside of plots but within the LCR MSCP project area. For rare covered species, we used all territories discovered for habitat assessments in order to maximize sample sizes. For the more common covered species, we randomly selected from all discovered territories for habitat assessments. All non-use sites were selected randomly from the same habitat stratum and region, where possible. In some cases, there were no non-use sites available in the same habitat stratum or region, in which case we selected a site randomly from the nearest region with the same habitat stratum.

Habitat assessment on use sites focused on territory centers (for Yellow Warbler, Bell's Vireo, and Summer Tanager) or nests (Gila Woodpecker and Vermilion Flycatcher). Since most Gila Woodpecker and Vermilion Flycatcher nests were obvious and could be monitored easily, the habitat assessment was conducted after completion of the nesting cycle so as not to disturb the nest. Nests of Yellow Warbler, Bell's Vireo, and Summer Tanager were often not located in order to not cause undue disturbance to the nest, so we used the area search results to determine the territory center (see methods above) and used it as the central point for habitat assessments.

At the end of the area search season, we had more territories of Yellow Warblers and Bell's Vireos than needed to meet the sample size. For random selection from these, we stratified to the extent possible by region, habitat stratum, and plot in order to capture geographic and habitat use variation. Most territories of covered species were, however, located in the same general areas, particularly the Bill Williams River (Summer Tanager, Yellow Warbler, Bell's Vireo, and Gila Woodpecker) and habitat creation sites (Beal: Summer Tanager, Yellow Warbler; CRIT: Vermilion Flycatcher). Plots in these areas often had multiple territories of the more common covered species, in which case we randomly selected one of them, but did not assess others in the same plot. For random selection of non-use sites in the same habitat stratum and region, we used random numbers to select a coordinate among qualifying plots outside the one containing the territory. In some cases, the nearest qualifying plots were in another region, but in most cases, the non-use site was in the same region as its paired territory.

Habitat assessments consisted of an intensive field data collection of vegetation and physical site attributes centered on the nest location or center of the breeding territory. The variables selected are described in detail in GBBO (2008, 2009), and they were based on the physical, vegetative, and floristic parameters that were most likely to determine habitat selection in the covered species (see also USBR 2008). The field habitat assessments had to be largely completed in the latter half of the bird survey season because (1) territories were often not fully confirmed until then, and (2) the field

data collection was intensive enough to cause possible nest failure, if it occurred during the early nesting cycle. Therefore, the majority of habitat assessments were completed in late May through June of each year, and the remaining sites were completed in September.

With three years of data, five of the six covered species were common enough in the system to come close or exceed this sample size (Tables 9a and 9b), and we assessed a total 43 Bell’s Vireo, 48 Yellow Warbler, 38 Gila Woodpecker, 19 Summer Tanager, and 14 Vermilion Flycatcher territories paired with non-use sites. Glided Flickers are rare enough in the system that their sample size goal could not be met. In fact, we only found one female Gilded Flicker near one survey plot and, on the chance that it was breeding, assessed the area around the sighting location to determine its breeding status. This sighting was later determined to not represent a territory, but future monitoring efforts may re-assess this location for possible breeding. Unless an actual territory can be located in the future in the Colorado River riparian areas, habitat requirements of this species cannot be quantified for the study area.

The methods of the field habitat assessments included a combination of landscape variables, basic characterization of the vegetation cover types, and microhabitat measurements using a point intercept method. Details of the field habitat assessment protocol can be reviewed in GBBO (2008, 2009).

**Table 9a: Number of field habitat assessments conducted at the territory center or nest by species and river region, 2008-2010.**

<b>Region</b>	<b>Bell’s Vireo</b>	<b>Gila Woodpecker</b>	<b>Summer Tanager</b>	<b>Vermilion Flycatcher</b>	<b>Yellow Warbler</b>	<b>Total</b>
4	2	0	0	0	4	6
5	0	0	0	0	0	0
6	3	2	0	0	2	7
7	31	26	17	4	1	79
8	0	0	0	1	1	2
11, 12, and 13 Habitat Creation Sites	3	10	0	2	10	25
<b>Total Assessments</b>	<b>43</b>	<b>38</b>	<b>19</b>	<b>14</b>	<b>30</b>	<b>144</b>

**Table 9b: Number field habitat assessments conducted at non-use sites paired with territories, by species and river region, 2008-2010.**

<b>Region</b>	<b>Bell's Vireo</b>	<b>Gila Woodpecker</b>	<b>Summer Tanager</b>	<b>Vermilion Flycatcher</b>	<b>Yellow Warbler</b>	<b>Total</b>
4	5	0	0	0	5	10
5	4	4	0	0	5	13
6	7	8	1	0	9	25
7	17	23	13	4	11	68
8	0	8	1	12	2	23
11,12, and 13 Habitat Creation Sites	3	8	2	1	10	24
<b>Total Assessments</b>	<b>39</b>	<b>51</b>	<b>20</b>	<b>17</b>	<b>54</b>	<b>181</b>

## **Data Analyses for Habitat Associations of Covered Species**

The purpose of the field habitat assessments was to quantify habitat associations (i.e., habitat use patterns) of the covered species for which we had sufficient data. We used a combination of the revised habitat stratification for system-wide surveys and field habitat assessment data to characterize habitats used by five of the six covered species. Since Gilded Flickers were not detected along the lower Colorado River until 2010 and only one detection within the LCR MSCP project area occurred that year, no habitat assessments were possible for this species. To determine which habitat strata were most used by covered species, we summarized the number of territories detected during system-wide surveys by the 2010 re-stratification scheme (Tall Woody, Low Woody, Herbaceous, Unsuitable). This provides an overview of basic cover type that each species is selecting.

We also used the field habitat assessment data collected for Bell's Vireo, Yellow Warbler, Gila Woodpecker, Summer Tanager, and Vermilion Flycatcher as the basis for (1) habitat descriptors from all assessed territories that can be used as guidelines for target habitat structure and floristics in habitat creation efforts, and (2) determining which habitat variables were statistically good predictors of a breeding territory for each of the four species. . The habitat assessment consisted of the collecting the following information (for a more detailed list of all habitat data collected, see GBBO 2009):

- (1) digital photographs of the site at a landscape scale (these can be passed 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 (densitometer); and
- (7) soil moisture based on visual assessment categories in the field

Data analysis was done using univariate logistic regressions for each continuous habitat variable as a predictor for presence in a comparison between used sites and non-use sites. Fisher's exact tests were used to compare the categorical variables for use and non-use sites.

## Results

### Overall Species Richness Patterns

A total of 186 species of birds were detected in all surveys along the lower Colorado River in 2010 (Appendix 5), which results in a total of 213 species recorded from 2008 to 2010. Of the 186 species, approximately half were species that use the lower Colorado River project area only during migration or wintering (Appendix 5). All covered species, including the Gilded Flicker, were detected in at least one site. Clapper Rail, Yellow-billed Cuckoo, and Willow Flycatcher were also recorded, but since these species are monitored separately from this effort, they are not discussed in detail in this report (but see McLeod and Koronkiewicz 2010, Halterman et al. 2009). A total of 173 species were recorded in system-wide surveys, compared with 115 species in habitat creation site surveys. Several species, largely migrants and raptors, such as Cordilleran and Brown-crested flycatchers, Baltimore Oriole, Broad-tailed Hummingbird, Gray Hawk, Harris's Hawk, and Swainson's Hawk, were unique to habitat creation sites (all scientific species names in Appendix 5). Similar to previous years' findings, species that were present in system-wide survey plots but not in habitat creation sites included (1) several migrant species, such as Brewer's Sparrow and Gray Vireo, (2) species associated with old-growth riparian trees, such as Gila Woodpecker and Gilded Flicker (3) upland species, such as Cactus Wren, Canyon Wren, and Black-throated Sparrow, and (4) water- and marsh birds, such as Clapper Rail, Sora, Marsh Wren, and a variety of duck and shorebird species (Appendix 5).

In June 2010, a single, positively-identified Gilded Flicker female was recorded as the first sighting of the species during system-wide surveys since the beginning of the monitoring project. It was detected in a randomly-selected, system-wide rapid area search plot south of Blythe, and three follow-up visits to the detection site and surrounding areas produced no evidence of nesting, nor a re-sighting. This bird was observed in open scrub habitat with no large trees or saguaros in the area, which also lead us to believe that she may just have been passing through the area. Family groups of Gilded Flickers were also observed using riparian areas of the Bill Williams River after the nesting season. We are fairly confident that these family groups nested in saguaro cactus habitat near the survey sites, as one nest was confirmed in a saguaro just outside the LCR MSCP project area,

and no evidence of these conspicuous birds was recorded in the riparian areas prior to seeing the family groups after fledging.

## System-Wide Surveys

### System-Wide Rapid Area Searches

During two rapid area searches of each of 80 system-wide plots, we recorded 166 species of birds in 2010. Of these, 96 species were identified as breeders (Table 10) and 70 were migrants or non-breeders (Table 11). The number of breeding territories 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 10). The most common breeder of the covered species was Yellow Warbler (78.5 territories), followed by Bell's Vireo (65.5 territories), Gila Woodpecker (16 territories), Summer Tanager (12 territories) and Vermilion Flycatcher (2 territories). Gilded Flickers were not detected in any of the surveys, but a family group was recorded twice as incidental sightings in the Bill Williams River NWR in mid-June and a single female was observed once south of Blythe, CA, in late May.

**Table 10. Total number of breeding territories of in 80 system-wide rapid area search plots in 2010. The number of territories in each plot was determined by the surveyor after the second survey. Species listed in descending order of abundance. Partial territories are represented with decimals (see methods for details).**

<u>Species</u>	<u>Number of Territories</u>
White-winged Dove	424
Mourning Dove	370.5
Red-winged Blackbird	368.5
Yellow-breasted Chat	353
Common Yellowthroat	344.25
Song Sparrow	326.25
Abert's Towhee	241.75
Brown-headed Cowbird	229
Yellow-headed Blackbird	189
European Starling	171
Verdin	165.75
Black-tailed Gnatcatcher	154
Lucy's Warbler	154
Great-tailed Grackle	150.75
Gambel's Quail	137.5
Cliff Swallow	100
Blue Grosbeak	88.5

<b>Species</b>	<b>Number of Territories</b>
*Yellow Warbler	78.5
American Coot	72.75
Anna's Hummingbird	72.5
Marsh Wren	68.75
*Bell's Vireo	65.5
House Finch	63.5
Ash-throated Flycatcher	63.25
Crissal Thrasher	61.25
Bewick's Wren	56
Ladder-backed Woodpecker	48.1
Lesser Nighthawk	40
Bullock's Oriole	37
Turkey Vulture	32
Black-chinned Hummingbird	30.5
Pied-billed Grebe	28
Lesser Goldfinch	27.5
Western Kingbird	25.25
Common Moorhen	22
Phainopepla	21.5
Eurasian Collared-Dove	18.5
Lawrence's Goldfinch	18
Greater Roadrunner	17
Brown-crested Flycatcher	15.75
*Gila Woodpecker	15.65
Least Bittern	15
House Sparrow	13
Northern Rough-winged Swallow	13
Costa's Hummingbird	12.25
*Summer Tanager	12.25
Cactus Wren	11.75
Horned Lark	10.75
Black-throated Sparrow	10
American Kestrel	8.25
Killdeer	7.75
Great Blue Heron	7.25
Northern Mockingbird	7.25
Ruddy Duck	7
Rock Pigeon	6.75
Black-crowned Night-Heron	6
Green Heron	5.5
Say's Phoebe	5.5

<b>Species</b>	<b>Number of Territories</b>
Indigo Bunting	5
Canyon Wren	4.5
Western Wood-Pewee	4
Common Ground-Dove	3.75
Black Phoebe	3.25
Clark's Grebe	3
Eared Grebe	3
Virginia Rail	3
Rock Wren	2.75
Western Meadowlark	2.75
Spotted Sandpiper	2.5
Black-necked Stilt	2
Common Raven	2
Great Egret	2
Lark Sparrow	2
Lazuli Bunting	2
Osprey	2
*Vermilion Flycatcher	2
*Clapper Rail	1.75
American Bittern	1
Black Rail	1
Duck Hybrid	1
Hooded Oriole	1
Inca Dove	1
Lesser Scaup	1
Mallard	1
Sora	1
Tree Swallow	1
Western-type Flycatcher	1
Western Screech-Owl	1
White-tailed Kite	1
Willow Flycatcher	1
*Yellow-billed Cuckoo	1
Burrowing Owl	0.75
Hummingbird spp.	0.75
Northern Harrier	0.5
Snowy Egret	0.5
Great Horned Owl	0.25

\*LCR MSCP covered species

**Table 11. Species list of all non-breeding birds in system-wide area search plots in 2010, including both rapid and intensive area searches on 80 plots. Species that were just observed flying over plots, but not landing in them, are identified with a ^. Species known to be only migrants through the lower Colorado River area are identified with a \*. Incidental sightings that were not from inside or above the plot are not included.**

<u>Species</u>	<u>Detected on system-wide surveys, 2010</u>
American Avocet	X
American Goldfinch	X
American Kestrel	X
American Pipit	X*
American Robin	X*
Anna's Hummingbird	X
Ash-throated Flycatcher	X
Audubon's Yellow-rumped Warbler	X*
Baird's Sandpiper	X*
Bank Swallow	X*
Barn Swallow	X*
Belted Kingfisher	X
Bendire's Thrasher	X
Bewick's Wren	X
Black Swift	X^
Black-headed Grosbeak	X*
Black-necked Stilt	X
Black-throated Gray Warbler	X*
Black-throated Sparrow	X
Blue Grosbeak	X
Blue-gray Gnatcatcher	X
Brewer's Blackbird	X*
Brewer's Sparrow	X*
Bronzed Cowbird	X
Brown-headed Cowbird	X
Bufflehead	X^*
Bullock's Oriole	X
California Gull	X^
Canyon Towhee	X
Caspian Tern	X^*
Cassin's Kingbird	X*
Cassin's Vireo	X*
Cedar Waxwing	X*
Chipping Sparrow	X*

Species	Detected on system-wide surveys, 2010
Cinnamon Teal	x
Cliff Swallow	x
Common Black-Hawk	x^
Common Ground-Dove	x
Common Poorwill	x
Common Raven	x
Common Yellowthroat	x
Cooper's Hawk	x
Crissal Thrasher	x
Double-crested Cormorant	x^
Dusky Flycatcher	x*
<i>Empidonax</i> spp.	x
Eurasian Collared-Dove	x
European Starling	x
Forster's Tern	x^*
Gambel's Quail	x
Gila Woodpecker	x
Gilded Flicker	x
Golden-crowned Sparrow	x*
Gray Flycatcher	x*
Gray Vireo	x*
Great Blue Heron	x^
Great Egret	x^
Greater Roadrunner	x
Great-tailed Grackle	x
Green Heron	x
Green-tailed Towhee	x*
Green-winged Teal	x^*
Hammond's Flycatcher	x*
Hermit Thrush	x*
Hermit Warbler	x*
Hooded Oriole	x
Horned Lark	x
House Finch	x
Indigo Bunting	x
Killdeer	x
Ladder-backed Woodpecker	x
Lark Sparrow	x
Lazuli Bunting	x*
Least Bittern	x

<b>Species</b>	<b>Detected on system-wide surveys, 2010</b>
Least Sandpiper	x*
Lesser Goldfinch	x
Lesser Nighthawk	x
Lincoln's Sparrow	x*
Loggerhead Shrike	x
Long-billed Curlew	x*
MacGillivray's Warbler	x*
Mallard	x
Merlin	x*
Mourning Dove	x
Myrtle Warbler	x*
Nashville Warbler	x*
Northern Harrier	x
Northern Mockingbird	x
Northern Rough-winged Swallow	x
Olive-sided Flycatcher	x*
Orange-crowned Warbler	x*
Osprey	x^
Pacific-slope Flycatcher	x*
Peregrine Falcon	x^
Red-tailed Hawk	x
Red-winged Blackbird	x
Ring-billed Gull	x^
Ruby-crowned Kinglet	x*
Rufous Hummingbird	x*
Savannah Sparrow	x*
Say's Phoebe	x
Semipalmated Plover	x*
Sharp-shinned Hawk	x*
Snowy Egret	x^
Solitary Sandpiper	x*
Sora	x
Swainson's Thrush	x*
Townsend's Warbler	x*
Tree Swallow	x*
Turkey Vulture	x
Vaux's Swift	x^*
Verdin	x
Violet-green Swallow	x*

<b>Species</b>	<b>Detected on system-wide surveys, 2010</b>
Virginia's Warbler	x*
Warbling Vireo	x
Western Sandpiper	x*
Western Grebe	x
Western Kingbird	x
Western Sandpiper	x*
Western Tanager	x*
Western Wood-Pewee	x*
White-crowned Sparrow	x*
White-faced Ibis	x^
White-throated Swift	x^
White-winged Dove	x
Wilson's Phalarope	x*
Wilson's Warbler	x*
Yellow Warbler	x
Yellow-breasted Chat	x
Yellow-headed Blackbird	x

### **System-Wide Intensive Area Searches**

During system-wide intensive area searches (n = 8 plots) in 2010, we recorded and mapped 217.5 breeding territories of 32 species. We found evidence for only one of the covered species, the Bell's Vireo, nesting in an intensive area search plot from the system-wide survey effort (Table 12). We found considerably fewer LCR MSCP covered species in the system-wide intensive plots compared to previous years, because no intensive plots were located in the heart of the Bill Williams River NWR, a stronghold for most covered bird species. This area received no intensive coverage in 2010 due to random site selection and access issues (see Methods for more details).

**Table 12. Total number of territories by species detected during system-wide intensive area searches, 2010. Listed in descending order of abundance.**

<b>Species</b>	<b>Number of Territories</b>
Yellow-headed Blackbird	35
Abert's Towhee	22.75
Great-tailed Grackle	22
Black-tailed Gnatcatcher	15.75

<b>Species</b>	<b>Number of Territories</b>
Lucy's Warbler	15
Red-winged Blackbird	14
Mourning Dove	13.5
White-winged Dove	11.5
Gambel's Quail	9
Crissal Thrasher	7.5
Brown-headed Cowbird	7
Common Yellowthroat	6.75
Blue Grosbeak	4.75
Song Sparrow	4.75
Verdin	3.75
Lesser Nighthawk	3
Greater Roadrunner	2.5
Western Kingbird	2.25
Ash-throated Flycatcher	2
Common Moorhen	2
Marsh Wren	2
Virginia Rail	2
Anna's Hummingbird	1.75
Western Meadowlark	1.75
Horned Lark	1.25
Bell's Vireo*	1
Mallard	1
Pied-billed Grebe	1
Ladder-backed Woodpecker	0.25
Phainopepla	0.25
Say's Phoebe	0.25
Spotted Sandpiper	0.25

\*LCR-MSCP covered species

### **System-Wide Territory Number Estimates**

Results from the DS (double-sampling) program (Bart and Hartley 2010) analysis for 2010 for system-wide minimum population size estimates for LCR MSCP covered species were: more than 4000 Bell's Vireo territories, more than 2000 Yellow Warbler territories, more than 900 Gila Woodpecker territories, more than 200 Summer Tanager territories, and 8 Vermilion Flycatcher territories (Table 13).

Bell's Vireo had the highest estimated population size system-wide of all covered species, and it occurred in six habitat-region combinations of the 20 total combinations

surveyed in 2010. The second most abundant of the covered species, the Yellow Warbler, occurred in nine habitat-region combinations. Vermilion Flycatcher occurred in the lowest number of combinations (1), compared with Summer Tanager (4) and Gila Woodpecker (6). Region 7 (Bill Williams River NWR) had by far the largest number of covered species of all regions (Table 13).

**Table 13. Estimated number of territories of covered species, by region-habitat combinations, based on system-wide surveys completed in 2010. Combinations are listed as geographic region and habitat stratum, separated by a period. For details on strata definitions, see methods. Dashes indicate that no plots were surveyed in that Region.Habitat combination during 2010.**

<b>Region. Habitat</b>	<b>Bell's Vireo</b>	<b>Yellow Warbler</b>	<b>Gila Woodpecker</b>	<b>Summer Tanager</b>	<b>Vermilion Flycatcher</b>
5.1	-	-	-	-	-
5.2	109	0	0	0	0
5.3	-	-	-	-	-
5.4	0	0	0	0	0
6.1	2	2	0	0	0
6.2	85	128	11	0	0
6.3	-	-	-	-	-
6.4	0	0	0	0	0
7.1	102	126	19	29	0
7.2	1019	383	127	64	0
7.3	-	-	-	-	-
7.4	989	104	109	36	0
8.1	-	-	-	-	-
8.2	0	34	51	0	0
8.3	-	-	-	-	-
8.4	0	0	0	0	0
10.1	0	0	0	0	0
10.2	0	0	0	0	0
10.3	-	-	-	-	-
10.4	0	0	0	0	0
11.1	0	3	0	1	0
11.2	0	0	0	0	0
11.3	0	0	0	0	0
11.4	-	-	-	-	-
12.1	0	29	5	0	4
12.2	0	347	0	0	0
12.3	-	-	-	-	-
12.4	0	0	0	0	0
13.1	0	0	0	0	0

<b>Region. Habitat</b>	<b>Bell's Vireo</b>	<b>Yellow Warbler</b>	<b>Gila Woodpecker</b>	<b>Summer Tanager</b>	<b>Vermilion Flycatcher</b>
13.2	0	0	147	0	0
13.3	-	-	-	-	-
13.4	-	-	-	-	-
<b>Total:</b>	4613	2310	938	259	8

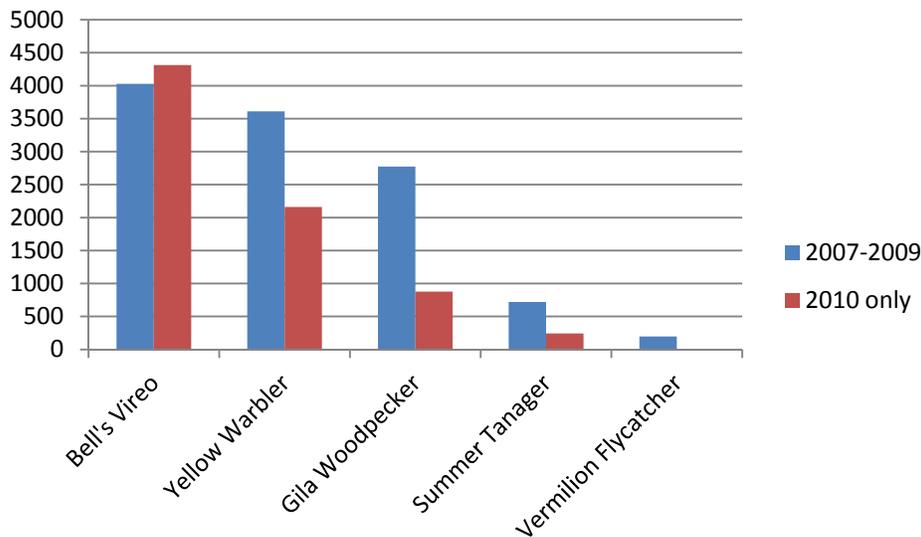
For the ten most abundant riparian species detected system-wide in 2010, we estimated population sizes using the same methods as for covered species. Based on our data, the most abundant species were Common Yellowthroat and Abert's Towhee with more than 22,000 territories estimated to be present, closely followed by Black-tailed Gnatcatcher, Lucy's Warbler, and Yellow-breasted Chat with more than 17,000 territories each (Table 14). Blackbirds, White-winged and Mourning doves, European Starlings, Brown-headed Cowbirds, and Gambel's Quail may be even more numerous, but they were not included in this analysis due to their clustered distributions or lack of territoriality, which confounds our methods of population size estimation. The ten most abundant species were relatively widespread throughout the project area, with detections in most region-habitat combinations.

**Table 14. Estimated number of individuals of ten of the most abundant species breeding along the lower Colorado River, by region-habitat combination, based on system-wide surveys completed in 2010. For details on strata definitions, see methods. Dashes indicate that no plots were surveyed in that Region.Habitat combination during 2010.**

<b>Region.Habitat</b>	<b>Abert's Towhee</b>	<b>Ash-throated Flycatcher</b>	<b>Black-tailed Gnatcatcher</b>	<b>Blue Grosbeak</b>	<b>Common Yellowthroat</b>	<b>Crissal Thrasher</b>	<b>Lucy's Warbler</b>	<b>Song Sparrow</b>	<b>Verdin</b>	<b>Yellow-breasted Chat</b>
5.1	-	-	-	-	-	-	-	-	-	-
5.2	3156	769	3078	387	1208	856	4193	336	1405	139
5.3	-	-	-	-	-	-	-	-	-	-
5.4	1507	0	425	227	1020	312	340	0	567	0
6.1	23	3	20	3	16	8	8	4	13	4
6.2	1110	192	598	342	1238	363	683	907	309	1323
6.3	-	-	-	-	-	-	-	-	-	-
6.4	306	153	306	102	0	102	306	0	153	0
7.1	111	30	27	26	158	17	115	556	28	650
7.2	1083	411	422	593	924	264	921	828	465	1720
7.3	-	-	-	-	-	-	-	-	-	-
7.4	435	444	562	419	311	493	1027	518	571	2092
8.1	-	-	-	-	-	-	-	-	-	-
8.2	398	102	646	246	170	136	357	0	170	204
8.3	-	-	-	-	-	-	-	-	-	-
8.4	0	0	0	0	0	0	0	0	0	0
10.1	1	0	1	1	2	0	0	0	0	1
10.2	1019	399	886	355	1330	222	643	133	355	1330
10.3	-	-	-	-	-	-	-	-	-	-
10.4	61	315	132	0	1317	0	0	527	0	0
11.1	7	1	1	0	27	0	0	8	10	11
11.2	508	190	486	169	2409	84	127	1291	402	1965
11.3	0	0	0	0	666	0	0	56	0	0
11.4	-	-	-	-	-	-	-	-	-	-
12.1	57	11	21	41	97	11	6	58	91	30
12.2	693	173	866	347	1083	173	87	433	996	173
12.3	-	-	-	-	-	-	-	-	-	-
12.4	923	308	308	431	1230	862	0	0	923	0
13.1	-	-	-	-	-	-	-	-	-	-
13.2	0	0	0	0	0	0	0	0	0	0
13.3	-	-	-	-	-	-	-	-	-	-

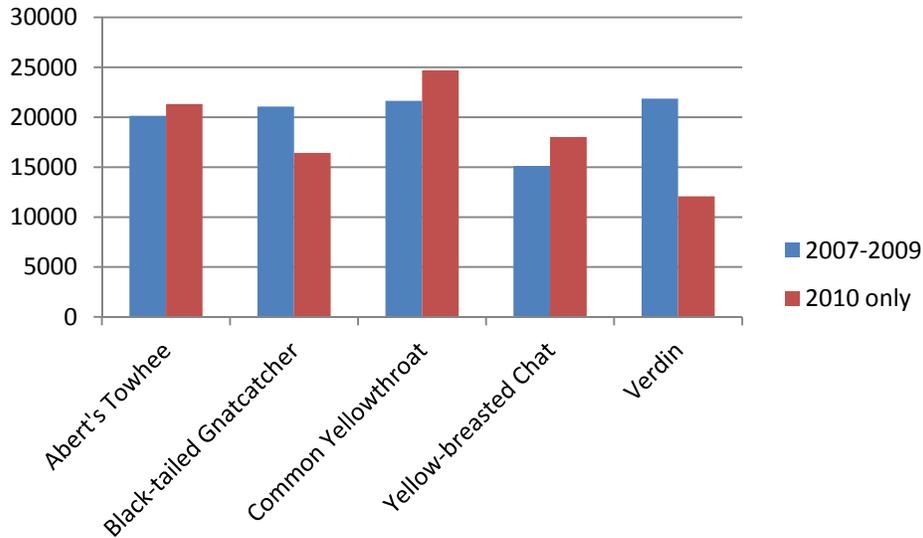
Region. Habitat	Abert's Towhee	Ash-throated Flycatcher	Black-tailed Gnatcatcher	Blue Grosbeak	Common Yellowthroat	Crissal Thrasher	Lucy's Warbler	Song Sparrow	Verdin	Yellow-breasted Chat
13.4	-	-	-	-	-	-	-	-	-	-
<b>Total:</b>	22797	7003	17567	7377	26409	7807	17623	11307	1291	1928
									4	0

Population size estimates for covered species were generally higher in 2007-2009 than in 2010 (Fig. 2). Bell's Vireos population size estimates were the only ones similar among the two time periods. The 2010 estimates may overall be lower based on the smaller sample size of plots occupied by covered species and the lack of access to the Bill Williams River area (see Methods).



**Figure 2. Population size estimates of LCR-MSCP covered species for 2007-2009 and 2010.**

Population size estimates for five abundant riparian species system-wide were similar between the 2007-2009 and 2010 (Fig. 3). These riparian species are more generalist in their habitat use than the covered species, which explains that the different selection in sampling areas affected their abundances less than the covered species.



**Figure 3. Comparison of the population size estimates of the eight most common species in 2010 compared with their population size estimates for 2007-2009.**

## Habitat Creation Sites

During intensive area searches on habitat creation sites in 2010, we recorded 473.5 breeding territories of 35 species. Four of the six covered species, Bell's Vireo, Yellow Warbler, Summer Tanager, and Vermilion Flycatcher, were recorded as breeders in habitat creation sites. Gila Woodpecker and Gilded Flickers were not detected. The numbers of territories detected in habitat creation sites are listed in Table 15, and a list of migrants and other non-breeders detected in habitat creation sites are listed in Table 16.

**Table 15. Total number of territories, by species, detected in intensive area searches on habitat creation plots in 2008, 2009, and 2010. CRIT restoration sites were not surveyed in 2010 and were therefore excluded. Species are listed in alphabetical order.**

Species	2008	2009	2010	Total
Abert's Towhee	21	36.25	49	106.25
American Kestrel			0.75	0.75
Anna's Hummingbird	1	9	11.75	21.75
Ash-throated Flycatcher		1.75	2.25	4
Barn Owl			0.75	0.75
Bell's Vireo*	4	10	21.5	35.5
Black-chinned Hummingbird	1	2	3.5	6.5
Black-tailed Gnatcatcher	2	3	13.25	18.25

<b>Species</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>Total</b>
Blue Grosbeak	37	31.75	24.75	93.5
Brown-headed Cowbird	1	19.5	51.5	72
Bullock's Oriole	10	11.25	9.25	30.5
Common Ground-Dove		0.5		0.5
Common Yellowthroat	15	21.75	12	48.75
Crissal Thrasher	1	1	3.25	5.25
Eurasian Collared-Dove			1	1
European Starling			1.5	1.5
Gambel's Quail	4	5	3.75	12.75
Greater Roadrunner	1	1	1.5	3.5
Great-tailed Grackle			3	3
House Finch	6	2	3	11
Indigo Bunting		6.75	3.75	10.5
Ladder-backed Woodpecker		0.5	2.25	2.75
Lesser Goldfinch			1	1
Lucy's Warbler	2	2	7.75	11.75
Mallard	1			1
Mourning Dove	14	76	57.5	147.5
Northern Harrier	1	1	1	3
Phainopepla	1			1
Red-winged Blackbird		11.5	13	24.5
Say's Phoebe			0.25	0.25
Song Sparrow	27	15.75	8.75	51.5
Summer Tanager*		1	1	2
Verdin	7	21.25	12.75	41
Warbling Vireo	2			2
Western-type Flycatcher			2	2
Western Kingbird	7	9.5	9.25	25.75
White-tailed Kite**	0			0
White-winged Dove	4	55	60	119
Yellow Warbler*	9	12.5	23	44.5
Yellow-breasted Chat	7	21	17	45
<b>Total</b>	<b>186</b>	<b>389.5</b>	<b>437.5</b>	<b>1013</b>

\* LCR MSCP covered species

In 2010, 113 species (compared to 90 species in 2009) of non-breeders and known migrants were detected in habitat creation plots over the course of the field season. Some of the most interesting included the Baltimore Oriole, Bendire's Thrasher, Crissal Thrasher, Brown-crested Flycatcher, Great Crested Flycatcher, Northern Parula, Lazuli x Indigo Bunting hybrid, and Harris's and Gray hawks. Several LCR MSCP covered species were also observed with no breeding evidence, including Bell's Vireo, Summer Tanager, Yellow Warbler, and Willow Flycatcher. All species of migrants and other non-

breeders are listed in Table 16, and they are reported by habitat creation plot for 2008-2010 in Appendix 4a-g.

**Table 16. Presence of migrants and other non-breeders, by species or species groups, detected during intensive area searches at > 2 year-old habitat creation plots surveyed in 2010. Fly-overs are included in this list (identified with an \*), but incidental birds that were not inside or above the plot are not included. Bird know to only be migrants on the lower Colorado River are identified with a ^. Listed in alphabetical order**

Species	Present in $\geq$ one habitat creation plot in 2010
American Kestrel	x
American Robin	x*
American White Pelican	x^*
Anna's Hummingbird	x
Ash-throated Flycatcher	x
Audubon's Yellow-rumped Warbler	x*
Baltimore Oriole	x*
Bank Swallow	x^*
Barn Owl	x
Barn Swallow	x^*
Bell's Vireo*	x
Bendire's Thrasher	x
Black-chinned Hummingbird	x
Black-crowned Night-Heron	x
Black-headed Grosbeak	x*
Black-tailed Gnatcatcher	x
Black-throated Gray Warbler	x*
Blue Grosbeak	x
Brewer's Blackbird	x
Broad-tailed Hummingbird	x*
Brown-crested Flycatcher	x
Brown-headed Cowbird	x
Bullock's Oriole	x
Cassin's Kingbird	x*
Cassin's Vireo	x*
Cedar Waxwing	x*
Chipping Sparrow	x*
Cliff Swallow	x
Common Ground-Dove	x
Common Raven	x
Common Yellowthroat	x

<b>Species</b>	<b>Present in <math>\geq</math> one habitat creation plot in 2010</b>
Cooper's Hawk	x
Cordilleran Flycatcher	x*
Costa's Hummingbird	x
Crissal Thrasher	x
Double-crested Cormorant	x^
Dusky Flycatcher	x*
<i>Empidonax</i> spp.	x
Eurasian Collared-Dove	x
European Starling	x
Forster's Tern	x^*
Gambel's Quail	x
Gray Flycatcher	x*
Gray Hawk	x*
Great Blue Heron	x^
Great Crested Flycatcher	x*
Great Egret	x^
Great Horned Owl	x
Greater Roadrunner	x
Great-tailed Grackle	x
Green Heron	x^
Green-tailed Towhee	x*
Hammond's Flycatcher	x*
Harris's Hawk	x^*
Hermit Thrush	x*
Hermit Warbler	x*
House Finch	x
Indigo Bunting	x
Killdeer	x
Ladder-backed Woodpecker	x
Lazuli Bunting	x*
Lazuli x Indigo Bunting Hybrid	x
Lesser Goldfinch	x
Lesser Nighthawk	x
Lincoln's Sparrow	x*
Lucy's Warbler	x
MacGillivray's Warbler	x*
Mallard	x
Mourning Dove	x
Myrtle Yellow-rumped Warbler	x*

<b>Species</b>	<b>Present in <math>\geq</math> one habitat creation plot in 2010</b>
Nashville Warbler	x*
Northern Harrier	x
Northern Mockingbird	x
Northern Parula	x*
Northern Rough-winged Swallow	x
Olive-sided Flycatcher	x*
Orange-crowned Warbler	x*
Osprey	x^
Pacific-slope Flycatcher	x*
Phainopepla	x
Plumbeous Vireo	x*
Red-winged Blackbird	x
Ruby-crowned Kinglet	x*
Rufous Hummingbird	x*
Say's Phoebe	x
Snowy Egret	x^
Song Sparrow	x
Summer Tanager*	x
Swainson's Hawk	x^*
Swainson's Thrush	x*
Townsend's Warbler	x*
Tree Swallow	x*
Turkey Vulture	x^
Vaux's Swift	x^*
Violet-green Swallow	x*
Warbling Vireo	x*
Western-type Flycatcher	x*
Western Kingbird	x
Western Tanager	x*
Western Wood-Pewee	x*
White-crowned Sparrow	x*
White-faced Ibis	x^
White-tailed Kite	x^
White-throated Swift	x^
White-winged Dove	x
Willet	x*
Willow Flycatcher*	x
Wilson's Warbler	x*
Yellow Warbler*	x

<b>Species</b>	<b>Present in <math>\geq</math> one habitat creation plot in 2010</b>
Yellow-breasted Chat	x
Yellow-headed Blackbird	x
Yellow-rumped Warbler	x*

\* LCR MSCP covered species

### Beal Lake Riparian Habitat Creation Site

In the Beal Lake Riparian habitat creation site, our 2010 intensive area searches in four plots resulted in 143.25 breeding territories (Table 17) and 77 species of migrants and other non-breeders (Appendix 4a). Similar to our system-wide survey findings, Bell's Vireos were the most numerous breeder of all covered species, with partial territories in Beal A, B, C, and D (for specific locations for these habitat creation site plot designations, see USBR publications on habitat creation projects). Yellow Warblers were found nesting in Beal B and C, and one Summer Tanager territory partially in Beal B and C. In Table 18, the numbers of breeding territories over the last three years (2008-2010) are listed by species.

**Table 17. Number of breeding territories by species detected in Beal Lake intensive area search plots in 2010. Listed in descending order of abundance.**

<b>Species</b>	<b>Number of Territories</b>				
	<b>Beal A</b>	<b>Beal B</b>	<b>Beal C</b>	<b>Beal D</b>	<b>Total</b>
Abert's Towhee	4	6.75	10	4.25	25
Bell's Vireo*	3.75	8.75	6.75	0.25	19.5
Yellow-breasted Chat	4	7	3	1.5	15.5
Black-tailed Gnatcatcher	1.75	4.5	3.25	3	12.5
Yellow Warbler*	0	5	6.5	0	11.5
Verdin	1	2.5	3.25	4	10.75
Lucy's Warbler	1.75	3.75	0.75	1.25	7.5
Brown-headed Cowbird	1.5	4	0	0	5.5
Blue Grosbeak	0.25	1	1.75	1.75	4.75
Mourning Dove	0	4.5	0	0	4.5
Anna's Hummingbird	0	3	1	0	4
Bullock's Oriole	0	2	1	0	3
Great-tailed Grackle	0	3	0	0	3
White-winged Dove	0	3	0	0	3
Crissal Thrasher	0	1	1	0.75	2.75
Gambel's Quail	0.25	1.25	0	0.5	2

Species	Number of Territories				Total
	Beal A	Beal B	Beal C	Beal D	
House Finch	0	2	0	0	2
Common Yellowthroat Black-chinned	0	1.5	0	0	1.5
Hummingbird	0	1	0	0	1
Eurasian Collared-Dove	0	0	1	0	1
Greater Roadrunner	0	1	0	0	1
Song Sparrow	1	0	0	0	1
Summer Tanager*	0	0.5	0.5	0	1
Total	19.25	67	39.75	17.25	143.25

\* LCR MSCP covered species

**Table 18. Total number of breeding territories for bird species on the Beal habitat creation plots, 2008-2010.**

Species	Year		
	2008	2009	2010
Abert's Towhee	8	13.75	25
Anna's Hummingbird			4
Bell's Vireo*	3	10	19.5
Black-chinned Hummingbird	1		1
Black-tailed Gnatcatcher	2	3	12.5
Blue Grosbeak	9	4.75	4.75
Brown-headed Cowbird	1	6.25	5.5
Bullock's Oriole	1	1	3
Common Yellowthroat		5.25	1.5
Crissal Thrasher	1	1	2.75
Eurasian Collared-Dove			1
Gambel's Quail	3	2	2
Greater Roadrunner	1		1
Great-tailed Grackle			3
House Finch			2
Indigo Bunting		4.5	
Lucy's Warbler	2	2	7.5
Mourning Dove	3	5	4.5
Song Sparrow	6	5.75	1
Summer Tanager*		1	1
Verdin	6	10.5	10.75
Western Kingbird	1		
White-winged Dove	1		3
Yellow Warbler*	2	7	11.5

Species	Year		
	2008	2009	2010
Yellow-breasted Chat	5	14	15.5
Total	57	96.75	143.25

\* LCR MSCP covered species

## Cibola Valley Conservation Area (CVCA)

Six intensive area search plots in the Cibola Valley Conservation Area (CVCA) sites resulted in 355.75 breeding territories (Tables 19) and a total of 72 species of migrants and other non-breeders (Appendix 4b). One covered species, the Yellow Warbler, was found breeding at CVCA during this study, with three territories in CVCA 1 CD. Willow Flycatcher was detected as a presumed non-breeder at this site, but see also McLeod and Koronkiewicz 2010 and Halterman et al 2009. In Table 20, we list the number of breeding territories, by species, in CVCA over the past three years (2008-2010).

**Table 19. Number of territories, by species, recorded in Cibola Valley Conservation Area (CVCA) intensive area search plots in 2010. Listed in descending order of abundance.**

Species	Number of Territories						Total
	CVCA1 CD	CVCA1 A	CVCA1 B	CVCA2 (all)	CVCA3 AB	CVC A3 CD	
Red-winged Blackbird	0	0	0	120	10	3	133
Mourning Dove	21	4	5	17	3	3	53
White-winged Dove	24	2	5	12	7	0	50
Brown-headed Cowbird	17	2	0	20	4	5	48
Abert's Towhee	4.25	2	3	7	2.5	2.5	21.25
Blue Grosbeak	2.25	1.5	1.5	3.5	3.25	1.75	13.75
Song Sparrow	1	1	1	7	0	0	10
Indigo Bunting	0.75	1	2	0	0	0	3.75
Common Ground-Dove	0	0	0	3	0	0	3
Common Yellowthroat	0	0	0	3	0	0	3
Yellow Warbler*	3	0	0	0	0	0	3
Anna's Hummingbird	1	0	1	0	0	0.75	2.75
Bullock's Oriole	0.5	0.5	1	0	0	0	2
Western-type Flycatcher	2	0	0	0	0	0	2
Gambel's Quail	0	0	0	0	0.25	1.5	1.75

**Number of Territories**

<b>Species</b>	<b>CVCA1</b>	<b>CVCA1</b>	<b>CVCA1</b>	<b>CVCA2</b>	<b>CVCA3</b>	<b>CVC</b>	<b>Total</b>
	<b>CD</b>	<b>A</b>	<b>B</b>	<b>(all)</b>	<b>AB</b>	<b>A3 CD</b>	
European Starling	0	0.5	1	0	0	0	1.5
Ladder-backed Woodpecker	0.25	0.75	0.25	0	0	0	1.25
Lesser Goldfinch	0	1	0	0	0	0	1
Western Kingbird Black-chinned	0	0.75	0	0	0	0	0.75
Hummingbird	0	0	0.5	0	0	0	0.5
Greater Roadrunner	0	0	0	0	0.5	0	0.5
<b>Total</b>	<b>77</b>	<b>17</b>	<b>21.25</b>	<b>192.5</b>	<b>30.5</b>	<b>17.5</b>	<b>355.7</b>

\* LCR MSCP covered species

**Table 20. The total number of breeding territories, by species, recorded on the CVCA habitat creation plots, 2008-2010.**

<u>Species</u>	<u>Year</u>		
	<u>2008</u>	<u>2009</u>	<u>2010</u>
Abert's Towhee	9	12.25	14.25
Anna's Hummingbird		1.25	2.75
Black-chinned Hummingbird			0.5
Blue Grosbeak	17	14	10.25
Brown-headed Cowbird		8	28
Bullock's Oriole	3	5.25	2
Common Ground-Dove			0
Common Yellowthroat	2		0
European Starling			1.5
Gambel's Quail	1	3	1.75
Greater Roadrunner			0.5
House Finch	4	1	
Indigo Bunting		2.25	3.75
Ladder-backed Woodpecker		0.5	1.25
Lesser Goldfinch			1
Mourning Dove	3	47	36
Red-winged Blackbird		10.5	13
Song Sparrow	14	6	3
Verdin		1	
Warbling Vireo	1		
Western-type Flycatcher			2
Western Kingbird	1	0.5	0.75
White-winged Dove	2	42	38
Yellow Warbler*	3	3.5	3
<b>Total</b>	<b>60</b>	<b>158</b>	<b>163.25</b>

\* LCR MSCP covered species

### **Cibola Nature Trail Site**

Three intensive area search plots at the Cibola Nature Trail site resulted in 101 breeding territories (Tables 21) and a total of 42 species of migrants and other non-breeders (Appendix 4c). Yellow Warblers had territories in both Nature Trail plots. Of the covered species, Bell's Vireos, Yellow Warblers, and Willow Flycatchers were also detected as presumed non-breeders. In Table 22, we list the number of breeding territories, by species, on the Nature Trail plots over the past three years (2008-2010).

**Table 21. Number of breeding territories, by species, found in the Cibola Nature Trail intensive area search plots in 2010. Listed in descending order of abundance.**

<b>Species</b>	<b>Number of Territories</b>		
	<b>Nature Trail North</b>	<b>Nature Trail South</b>	<b>Total Nature Trail</b>
Mourning Dove	3	6	9
Western Kingbird	3.5	3.75	7.25
Brown-headed Cowbird	3	3	6
Abert's Towhee	3.5	2.25	5.75
White-winged Dove	3	2	5
Yellow Warbler*	2.75	2.25	5
Anna's Hummingbird	2.5	1	3.5
Blue Grosbeak	0.75	2.5	3.25
Bullock's Oriole	1.75	1	2.75
Common Yellowthroat	1.25	1	2.25
Verdin	1	1	2
Yellow-breasted Chat	0.5	1	1.5
Ash-throated Flycatcher	1.25	0	1.25
Bell's Vireo*	1	0	1
House Finch	0	1	1
Ladder-backed Woodpecker	0.75	0.25	1
Black-tailed Gnatcatcher	0.75	0	0.75
American Kestrel	0	0.5	0.5
Crissal Thrasher	0.5	0	0.5
Say's Phoebe	0.25	0	0.25
<b>Total</b>	<b>31.5</b>	<b>28.5</b>	<b>60</b>

\* LCR MSCP covered species

**Table 22. The total number of breeding territories for bird species in the Nature Trail plots, 2008-2010.**

<u>Species</u>	<u>Year</u>		
	<u>2008</u>	<u>2009</u>	<u>2010</u>
Abert's Towhee	4	9.75	5.75
American Kestrel			0.5
Anna's Hummingbird	1	7.75	3.5
Ash-throated Flycatcher		1.75	1.25
Bell's Vireo*			1
Black-chinned Hummingbird		2	
Black-tailed Gnatcatcher			0.75
Blue Grosbeak	5	7	3.25
Brown-headed Cowbird		3	6
Bullock's Oriole	5	5	2.75
Common Ground-Dove		0.5	
Common Yellowthroat	6	8	2.25
Crissal Thrasher			0.5
Greater Roadrunner		1	
House Finch	1	1	1
Ladder-backed Woodpecker			1
Mourning Dove	6	15	9
Phainopepla	1		
Red-winged Blackbird		1	
Say's Phoebe			0.25
Song Sparrow	3	3	
Verdin	1	9.75	2
Warbling Vireo	1		
Western Kingbird	5	9	7.25
White-winged Dove	1	7	5
Yellow Warbler*	4	2	5
Yellow-breasted Chat	2	7	1.5
<b>Total</b>	<b>47</b>	<b>100.5</b>	<b>59.5</b>

\* LCR MSCP covered species

### **Palo Verde Ecological Reserve (PVER)**

In three intensive area search plots at the Palo Verde Ecological Reserve (PVER), 117.25 breeding territories (Table 23) and 53 species of migrants and other non-breeders were detected (Appendix 4d). PVER 3 was surveyed using the intensive method for the first time in 2010. We found the first evidence of covered species breeding at PVER this year, including Yellow Warbler and Bell's Vireo territories in PVER 2. In addition, Yellow

Warblers, Bell's Vireos, Summer Tanagers, and Willow Flycatchers were detected as presumed non-breeders. The PVER sites had, again, two unusual species. The Northern Harrier nest that was active in 2008 and 2009 was also active in 2010, with both parents vigorously defending and carrying food to the nest. The Mallard pair that nested in the site in 2008 and was present in 2009 was present again in 2010, but we were unable to confirm breeding. In Table 24 we list the number of breeding territories, by species, in PVER2 over the past three years (2008-2010).

**Table 23. Number of territories by species detected in Palo Verde Ecological Reserve (PVER) intensive area search plots in 2010. Listed in descending order of abundance.**

Species	Number of Territories			Total
	PVER 2A	PVER 2B	PVER 3	
White-winged Dove	2	7	18	27
Common Yellowthroat	3.25	5	14.25	22.5
Brown-headed Cowbird	3	4	12	19
Blue Grosbeak	2.25	4.25	9.5	16
Mourning Dove	0	3	5	8
Song Sparrow	3	1.75	0.75	5.5
Abert's Towhee	2	2	1	5
Yellow Warbler*	1	2.5	0	3.5
Anna's Hummingbird	0.75	0.75	1	2.5
Black-chinned Hummingbird	1	1	0	2
Western Kingbird	0.75	0	1	1.75
Bullock's Oriole	0.75	0.75	0	1.5
Bell's Vireo*	1	0	0	1
Northern Harrier	1	0	0	1
Barn Owl	0	0.75	0	0.75
Lucy's Warbler	0	0.25	0	0.25
Total	21.75	33	62.5	117.25

\* LCR MSCP covered species

**Table 24. The total number of breeding territories for bird species on the PVER phase 2 habitat creation plots, 2008-2010.**

<b>Species</b>	<b>Year</b>		
	<b>2008</b>	<b>2009</b>	<b>2010</b>
Abert's Towhee		0.5	4
Anna's Hummingbird			1.5
Barn Owl			0.75
Bell's Vireo*	1		1
Black-chinned Hummingbird			2
Blue Grosbeak	5	4	6.5
Brown-headed Cowbird		2.25	7
Bullock's Oriole			1.5
Common Yellowthroat	4	7.75	8.25
House Finch	1		
Lucy's Warbler			0.25
Mallard	1		
Mourning Dove		1	3
Northern Harrier	1	1	1
Song Sparrow	2	1	4.75
Western Kingbird			0.75
White-winged Dove		6	9
Yellow Warbler*			3.5
<b>Total</b>	<b>15</b>	<b>23.5</b>	<b>54.75</b>

\*LCR MSCP covered species

## **Cibola Mass Planting**

### **Intensive Area Searches of Habitat Creation Plots**

One intensive area search at the Cibola Mass Planting resulted in 16.75 breeding territories (Table 25) and 24 species of migrants and other non-breeders (Appendix 4e). We detected no covered species at the Mass Planting site in 2010, neither as presumed breeders nor non-breeders, but we recorded a diversity of migrants and other non-breeders in the site. Table 26 lists the total number of breeding territories among the years 2008-2010.

**Table 25. Number of breeding territories, by species, found in the Cibola Mass Planting intensive area search plot in 2010. Listed in descending order of abundance.**

<b>Species</b>	<b>Total</b>
Brown-headed Cowbird	5
Mourning Dove	5
White-winged Dove	5
Ash-throated Flycatcher	1
Western Kingbird	0.5
American Kestrel	0.25
Total	16.75

**Table 26. The total number of breeding territories for bird species on the Cibola Mass Planting site, 2008-2010.**

<b>Species</b>	<b>Year</b>		
	<b>2008</b>	<b>2009</b>	<b>2010</b>
American Kestrel			0.25
Ash-throated Flycatcher			1
Blue Grosbeak	1	2	
Brown-headed Cowbird			5
Bullock's Oriole	1		
Common Yellowthroat	3	0.75	
Mourning Dove	2	8	5
Song Sparrow	2		
Western Kingbird			0.5
White-winged Dove			5
Total	9	10.75	16.75

### **Rapid Area Searches of Habitat Creation Plots**

In 2010, we conducted rapid area searches on two plots in the habitat creation sites with one year of growth at CVCA 4 and PVER 4. No LCR MSCP species were found breeding at either site, but we did observe a Yellow Warbler foraging in PVER 4. Several riparian species, including Common Yellowthroat and Song Sparrow, were also observed in the plots but not all had territories in these plots (Tables 27-28, Appendix 4f-g).

**Table 27. Number of breeding territories, by species, found in CVCA 4 rapid area search plot in 2010. Listed in descending order of abundance.**

<b>Species</b>	<b>Number of Territories</b>
Red-winged Blackbird	27
Gambel's Quail	7
Abert's Towhee	6
White-winged Dove	5
Mourning Dove	3.5
Brown-headed Cowbird	1.5
Blue Grosbeak	1
Ash-throated Flycatcher	0.5
Western Kingbird	0.5

**Table 28. Number of breeding territories, by species, found in PVER 4 rapid area search plot in 2010. Listed in descending order of abundance.**

<b>Species</b>	<b>Number of Territories</b>
Red-winged Blackbird	80
Common Yellowthroat	11
Blue Grosbeak	7
Brown-headed Cowbird	5
Mourning Dove	1
Northern Harrier	1
White-winged Dove	1
Western Kingbird	0.5
White-tailed Kite	0.25
Total	106.75

## Habitat Assessments of Covered Species

### Basic Habitat Associations of Covered Species

For the six covered species, we summarized the number of territories detected in system-wide surveys of 2010 by habitat strata (Tall Woody, Low Woody, and Herbaceous/Unsuitable). The results are displayed in Table 29, which illustrates that Tall Woody had the overall greatest number of covered species territories, but also a small number of territories that were found in the “Unsuitable” category. This result is, again, likely due to the fact that a plot that is labeled as predominantly “Unsuitable” may contain a small amount of (possibly very) suitable habitat cover. It is therefore important to include all habitat strata for population monitoring, although the less suitable plots may require a lesser amount of survey coverage than the other habitat strata to estimate total population sizes.

**Table 29. Number of territories of covered species by habitat stratum, summarized from 80 system-wide area search plots surveyed in 2010.**

Species	Tall Woody (n= 21)	Low Woody (n= 18)	Unsuitable (n= 7)
Bell's Vireo	35	19	11.5
Gila Woodpecker	9.65	4.5	1.5
Gilded Flicker	0	0	0
Summer Tanager	10.75	1	0.5
Vermilion Flycatcher	2	0	0
Yellow Warbler	65.5	14	1

### Habitat Associations Based on Field Habitat Assessments

Based on field habitat assessments over three years in territories and paired non-use sites of the covered species, we used habitat variables obtained from these field measurements to predict the likelihood of the species nesting (Tables 30-34). This habitat modeling effort was based on categorical (Tables 30a-34a) and continuous variables (Tables 30b-34b) describing the territory conditions in comparison with similar non-use sites. Sample sizes varied slightly in some variables from the total number of sites assessed because some variables were omitted during earlier habitat assessment efforts.

We found that Bell’s Vireo territories were placed in sites that had significantly less upland vegetation, more large trees, more cottonwood trees and mesquite, and greater canopy cover than non-use sites (Tables 30a and 30b). Gila Woodpeckers were found in

sites that had more cliffs (probably due to the fact that most were found in the Bill Williams River area where cliffs are abundant), more nearby surface water, more large trees and snags, more willows, and more mistletoe infestations than non-use sites (Tables 31a and 31b). Summer Tanager territories were located in sites that had less upland vegetation, more large trees, more saltcedar, more willow, more cottonwood trees, and greater canopy cover than did non-use sites (Tables 32a and 32b). Vermilion Flycatcher territories were placed in sites that had less evidence of recent burns, less often a dry wash nearby, less upland vegetation, less saltcedar, but more canopy cover than did non-use sites (Tables 33a and 33b). Finally, Yellow Warbler territories were located in sites that were less often near dry washes, had less upland vegetation, more large trees, more cottonwood trees, less mesquite, but more willows and greater canopy cover than did non-use sites (Tables 34a and 34b). In Tables 30-34, we present the detailed data that came from our field habitat assessments, so that they may be used for habitat creation planning, further habitat modeling efforts, and monitoring of suitable habitat for covered species.

**Table 30a: Bell's Vireo habitat associations based on categorical variables collected in field habitat assessments on territories and paired non-use sites, 2008-2010. Bold entries indicate significant relationships ( $p < 0.05$ ), with the direction (positive or negative) of the association indicated by the sign of the coefficient in the logistic regression.**

Categorical Habitat Variable	Use Sites			Non-use sites			Logistic Regression	
	# territories	% territories	Sample Size	# sites	% sites	Sample Size	p-value	Sign of coef.
<b><i>Landscape Features</i></b>								
Charcoaled stems w/in 100 m	20	47	43	12	29	41	.12	+
Cliffs 30 ft or taller w/in 100 m	25	57	44	20	49	41	.52	+
Water source in territory	12	27	44	13	32	41	.81	-
Water source w/in 100 m	24	55	44	26	63	41	.51	-
Water source w/in 1000 m	41	95	43	38	93	41	.67	+
Dry wash > 5 ft wide in territory	15	34	44	15	37	41	.67	-
Dry wash > 5 ft wide w/in 100 m	30	68	44	25	61	41	.82	+
Dry wash > 5 ft wide w/in 1000 m	39	69	44	36	88	41	1	
<b>Upland habitat in territory</b>	<b>4</b>	<b>9</b>	<b>44</b>	<b>12</b>	<b>29</b>	<b>41</b>	<b>.025</b>	-
Upland habitat w/in 100 m	24	55	44	26	63	41	.51	-
Upland habitat w/in 1000 m	32	78	41	31	76	41	1	
<b><i>Large Trees and Snags</i></b>								
<b>Trees &gt;12 cm DBH in territory</b>	<b>39</b>	<b>89</b>	<b>44</b>	<b>24</b>	<b>59</b>	<b>41</b>	<b>.003</b>	+
Trees >12 cm DBH w/in 100 m	40	91	44	34	83	41	.34	+
Trees >12 cm DBH w/in 1000 m	42	98	43	41	100	41	1	
Snags >12 cm DBH in territory	9	21	43	5	12	41	.38	+
Snags >12 cm DBH w/in 100m	19	45	42	14	34	41	.37	+

Categorical Habitat Variable	Use Sites			Non-use sites			Logistic Regression	
	# territories	% territories	Sample Size	# sites	% sites	Sample Size	p-value	Sign of coef.
Snags >12 cm DBH w/in 1000 m	36	86	42	28	68	41	.07	+
Branches >12 cm in territory	23	54	43	20	49	41	.83	+
Branches >12 cm w/in 100 m	33	79	42	26	63	41	.15	+
Branches >12 cm w/in 1000 m	40	98	41	37	90	41	.36	+
<b>Tree and Shrub Species (within 30m diameter circle)</b>								
<b>Populus fremontii present</b>	<b>26</b>	<b>63</b>	<b>41</b>	<b>3</b>	<b>9</b>	<b>33</b>	<b>.000</b>	<b>+</b>
<b>Mesquite spp. present</b>	<b>33</b>	<b>80</b>	<b>41</b>	<b>15</b>	<b>45</b>	<b>33</b>	<b>.003</b>	<b>+</b>
<b>Mesquite spp. 4 m or taller present</b>	<b>24</b>	<b>62</b>	<b>39</b>	<b>13</b>	<b>38</b>	<b>34</b>	<b>.05</b>	<b>+</b>
Saltcedar spp. present	24	59	41	22	67	33	.63	-
Willow spp. present	17	41	41	10	30	33	.34	+
<b>Food Sources</b>								
Anthills in territory	28	64	44	21	51	41	.28	+
Anthills w/in 100 m	40	93	43	33	81	41	.11	+
Anthills w/in 1000 m	43	100	43	41	100	41	1	
Mistletoe in territory	11	25	44	5	12	41	.17	+
Mistletoe w/in 100 m	16	36	44	11	27	41	.36	+
Mistletoe w/in 1000 m	24	56	43	25	61	41	.66	-

**Table 30b: Bell's Vireo habitat associations based on continuous variables collected in field habitat assessments and measured in a 707 m<sup>2</sup> (0.17 acre) plot in the center of territories and in paired non-use sites, 2008-2010. Bold entries indicate significant relationships ( $p < 0.05$ ), with the direction (positive or negative) of the association indicated by the sign of the coefficient in the logistic regression.**

Continuous Habitat Variable	Use Sites				Non-use sites				Logistic Regression	
	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size	p-value	Sign of coef.
<b>Total Trees and Tree Species</b>										
# Trees total (all size classes)	37.0	0	169	41	42.7	0	316	33	.64	-
# <i>Populus fremontii</i> (all sizes)	10.5	0	66	41	10.3	0	234	33	.94	
# <i>Salix gooddingii</i> (all sizes)	7.4	0	100	41	2.0	0	18	33	.09	+

Continuous Habitat Variable	Use Sites				Non-use sites				Logistic Regression	
	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size	p-value	Sign of coef.
<b># <i>Prosopis glandulosa</i> (all sizes)</b>	<b>9.0</b>	<b>0</b>	<b>64</b>	<b>41</b>	<b>2.5</b>	<b>0</b>	<b>30</b>	<b>33</b>	<b>.04</b>	<b>+</b>
# <i>Prosopis pubescens</i> (all sizes)	2.6	0	50	41	5.5	0	76	33	.40	-
# <i>Tamarix ramosissima</i> (all sizes)	6.0	0	43	41	19.3	0	304	33	.28	-
<b>Large Trees</b>										
# High canopy trees (> 10 m tall)	5.3	0	38	41	3.2	0	87	33	.47	+
# Trees >20 cm DBH	16.8	0	67	41	10.0	0	68	33	.07	+
# Large riparian trees (> 20 cm DBH and > 4 m tall)	15.9	0	57	41	9.6	0	76	33	.11	+
# Large <i>Populus fremontii</i> (> 20 cm DBH and > 4 m tall)	6.6	0	55	41	2.9	0	76	33	.21	+
# Large <i>Salix gooddingii</i> (> 20 cm DBH and > 4 m tall)	3.5	0	29	41	1.4	0	13	33	.16	+
# Large <i>Tamarix ramosissima</i> (> 20 cm DBH and > 4 m tall)	2.0	0	14	41	3.1	0	60	33	.59	-
<b>Mid Canopy and Understory Trees</b>										
# Mid canopy trees (4 - < 10 m)	20.9	0	78	41	20.1	0	119	33	.89	+
# Understory trees (1.4 - < 4 m)	10.8	0	152	41	17.9	0	160	33	.31	-
# Understory <i>Populus fremontii</i>	0.3	0	4	41	1.7	0	29	33	.29	-
# Understory <i>Salix gooddingii</i>	3.1	0	100	41	0.2	0	5	33	.26	+
# Understory <i>Prosopis glandulosa</i>	2.7	0	26	41	1.2	0	22	33	.24	+
# Understory <i>Prosopis pubescens</i>	1.7	0	50	41	2.4	0	37	33	.75	-
# Understory <i>Tamarix ramosissima</i>	1.9	0	25	41	11.0	0	160	33	.24	-
<b>Densimeter Average</b>										
Densimeter Average	<b>11.0</b>	<b>2.7</b>	<b>16.7</b>	<b>40</b>	<b>7.1</b>	<b>1.2</b>	<b>16</b>	<b>33</b>	<b>.001</b>	<b>+</b>
Proportion standing water (w/in 50 m)	2.9	0	50	40	9.7	0	95	33	.15	-

**Table 31a: Gila Woodpecker habitat associations based on categorical variables collected in field habitat assessments on territories and paired non-use sites, 2008-2010. Bold entries indicate significant relationships ( $p < 0.05$ ), with the direction (positive or negative) of the association indicated by the sign of the coefficient in the logistic regression.**

Categorical Habitat Variable	Use Sites			Non-use sites			Logistic Regression	
	# territories	% territories	Sample Size	# sites	% sites	Sample Size	p-value	Sign of coef.
<b>Landscape Features</b>								
Charcoaled stems w/in 100 m	9	24	38	8	20	41	.65	+
<b>Cliffs 30 ft or taller w/in 100 m</b>	<b>26</b>	<b>68</b>	<b>38</b>	<b>16</b>	<b>39</b>	<b>41</b>	<b>.01</b>	<b>+</b>
Water source in territory	9	24	38	8	20	41	.65	+
Water source w/in 100 m	10	26	38	9	22	41	.65	+
<b>Water source w/in 1000 m</b>	<b>32</b>	<b>84</b>	<b>38</b>	<b>26</b>	<b>63</b>	<b>41</b>	<b>.04</b>	<b>+</b>
Dry wash > 5 ft wide in territory	21	55	38	22	54	41	.89	
Dry wash > 5 ft wide w/in 100 m	24	63	38	25	61	41	.84	
Dry wash > 5 ft wide w/in 1000 m	32	84	38	38	93	41	.24	-
Upland habitat in territory	19	50	38	21	51	41	.91	
Upland habitat w/in 100 m	19	50	38	29	71	41	.07	-
Upland habitat w/in 1000 m	28	74	38	33	81	41	.47	-
<b>Large Trees and Snags</b>								
<b>Trees &gt;12 cm DBH in territory</b>	<b>32</b>	<b>84</b>	<b>38</b>	<b>15</b>	<b>37</b>	<b>41</b>	<b>.000</b>	<b>+</b>
<b>Trees &gt;12 cm DBH w/in 100 m</b>	<b>35</b>	<b>92</b>	<b>38</b>	<b>21</b>	<b>51</b>	<b>41</b>	<b>.000</b>	<b>+</b>
<b>Trees &gt;12 cm DBH w/in 1000 m</b>	<b>38</b>	<b>100</b>	<b>38</b>	<b>34</b>	<b>83</b>	<b>41</b>	<b>.012</b>	<b>+</b>
<b>Snags &gt;12 cm DBH in territory</b>	<b>13</b>	<b>34</b>	<b>38</b>	<b>4</b>	<b>10</b>	<b>41</b>	<b>.013</b>	<b>+</b>
<b>Snags &gt;12 cm DBH w/in 100m</b>	<b>15</b>	<b>40</b>	<b>38</b>	<b>4</b>	<b>10</b>	<b>41</b>	<b>.003</b>	<b>+</b>
<b>Snags &gt;12 cm DBH w/in 1000 m</b>	<b>31</b>	<b>82</b>	<b>38</b>	<b>19</b>	<b>46</b>	<b>41</b>	<b>.002</b>	<b>+</b>
<b>Branches &gt;12 cm in territory</b>	<b>24</b>	<b>63</b>	<b>38</b>	<b>10</b>	<b>24</b>	<b>41</b>	<b>.001</b>	<b>+</b>
<b>Branches &gt;12 cm w/in 100 m</b>	<b>28</b>	<b>74</b>	<b>38</b>	<b>15</b>	<b>37</b>	<b>41</b>	<b>.001</b>	<b>+</b>
<b>Branches &gt;12 cm w/in 1000 m</b>	<b>32</b>	<b>84</b>	<b>38</b>	<b>23</b>	<b>56</b>	<b>41</b>	<b>.008</b>	<b>+</b>
<b>Tree and Shrub Species (within 30m diameter circle)</b>								
<i>Populus fremontii</i> present	9	25	36	3	7	41	.06	+
Mesquite spp. present	14	39	36	13	32	41	.81	+
Mesquite spp. 4 m tall or taller present	11	31	35	6	16	41	.17	+
Saltcedar spp. present	15	422	36	17	41	41	.82	-
<b>Willow spp. present</b>	<b>9</b>	<b>25</b>	<b>36</b>	<b>1</b>	<b>2</b>	<b>41</b>	<b>.006</b>	<b>+</b>
<b>Food Sources</b>								
Anthills in territory	34	90	38	31	76	41	.14	+
Anthills w/in 100 m	37	97	38	35	85	41	.11	+
Anthills w/in 1000 m	38	100	38	41	100	41	1	
<b>Mistletoe in territory</b>	<b>16</b>	<b>42</b>	<b>38</b>	<b>5</b>	<b>12</b>	<b>41</b>	<b>.003</b>	<b>+</b>
Mistletoe w/in 100 m	20	53	38	15	37	41	.15	+
Mistletoe w/in 1000 m	33	87	38	28	68	41	.06	+

**Table 31b: Gila Woodpecker habitat associations based on continuous variables collected in field habitat assessments and measured in a 707 m<sup>2</sup> (0.17 acre) plot in the center of territories and in paired non-use sites, 2008-2010. Bold entries indicate significant relationships ( $p < 0.05$ ), with the direction (positive or negative) of the association indicated by the sign of the coefficient in the logistic regression.**

Continuous Habitat Variable	Use Sites				Non-use sites				Logistic Regression	
	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size	p-value	Sign of coef.
<b>Total Trees and Tree Species</b>										
# Trees total (all size classes)	13.4	1	85	36	94.8	0	2100	38	.25	-
# <i>Populus fremontii</i> (all sizes)	1.7	0	14	36	6.1	0	226	39	.52	-
# <i>Salix gooddingii</i> (all sizes)	1.9	0	18	36	0.1	0	4	39	.13	+
# <i>Prosopis glandulosa</i> (all sizes)	2.8	0	32	36	3.1	0	21	39	.85	-
# <i>Prosopis pubescens</i> (all sizes)	0.2	0	8	36	0.0	0	0	39	1	
# <i>Tamarix ramosissima</i> (all sizes)	3.3	0	81	36	20.5	0	355	39	.33	-
<b>Large Trees</b>										
# High canopy trees (> 10 m tall)	<b>1.8</b>	<b>0</b>	<b>13</b>	<b>36</b>	<b>0.2</b>	<b>0</b>	<b>4</b>	<b>38</b>	<b>.05</b>	<b>+</b>
# Trees >20 cm DBH	4.9	0	25	36	7.7	0	149	38	.53	-
# Large riparian trees (> 20 cm DBH and > 4 m tall)	4.6	0	30	36	7.4	0	185	38	.60	-
# Large <i>Populus fremontii</i> (> 20 cm DBH and > 4 m tall)	1.6	0	14	36	5.1	0	185	39	.54	-
# Large <i>Salix gooddingii</i> (> 20 cm DBH and > 4 m tall)	1.6	0	18	36	0.1	0	4	39	.09	+
# Large <i>Tamarix ramosissima</i> (> 20 cm DBH and > 4 m tall)	0.2	0	4	36	1.2	0	15	39	.22	-
<b>Mid Canopy and Understory Trees</b>										
# Mid canopy trees (4 - < 10 m)	5.6	0	25	36	9.3	0	185	38	.51	-
# Understory trees (1.4 - < 4 m)	6.0	0	81	36	85.1	0	2100	38	.37	-
# Understory <i>Populus fremontii</i>	0.03	0	1	36	1.1	0	41	39	.63	-
# Understory <i>Salix gooddingii</i>	0.3	0	9	36	0	0	0	39	1	
# Understory <i>Prosopis glandulosa</i>	1.5	0	14	36	2.6	0	21	39	.31	-
# Understory <i>Prosopis pubescens</i>	0.2	0	8	36	0	0	0	39	1	
# Understory <i>Tamarix ramosissima</i>	2.9	0	81	36	18.9	0	344	39	.33	-
<b>Densimeter Average</b>										
Proportion standing water (w/in 50 m)	5.1	<b>0</b>	<b>14</b>	<b>36</b>	<b>2.2</b>	<b>0</b>	<b>13.5</b>	<b>39</b>	<b>.003</b>	<b>+</b>
	2.4	0	40	38	4.6	0	90	41	.46	-

**Table 32a: Summer Tanager habitat associations based on categorical variables collected in field habitat assessments on territories and paired non-use sites, 2008-2010. Bold entries indicate significant relationships ( $p < 0.05$ ), with the direction (positive or negative) of the association indicated by the sign of the coefficient in the logistic regression.**

Categorical Habitat Variable	Use Sites			Non-use sites			Logistic Regression	
	# territories	% territories	Sample Size	# sites	%sites	Sample Size	p-value	Sign of coef.
<b>Landscape Features</b>								
Charcoaled stems w/in 100 m	6	32	19	5	24	21	.73	+
Cliffs 30 ft or taller w/in 100 m	9	47	19	15	71	21	.20	-
Water source in territory	7	37	19	9	43	21	.76	-
Water source w/in 100 m	11	58	19	11	52	21	.76	+
Water source w/in 1000 m	17	90	19	18	86	21	1	
Dry wash > 5 ft wide in territory	6	32	19	12	57	21	.13	-
Dry wash > 5 ft wide w/in 100 m	14	74	19	14	67	21	.74	+
Dry wash > 5 ft wide w/in 1000 m	19	100	19	20	95	21	1	
<b>Upland habitat in territory</b>	<b>2</b>	<b>11</b>	<b>19</b>	<b>12</b>	<b>57</b>	<b>21</b>	<b>.003</b>	<b>-</b>
<b>Upland habitat w/in 100 m</b>	<b>6</b>	<b>32</b>	<b>19</b>	<b>15</b>	<b>71</b>	<b>21</b>	<b>.03</b>	<b>-</b>
Upland habitat w/in 1000 m	14	74	19	16	76	21	1	
<b>Large Trees and Snags</b>								
<b>Trees &gt;12 cm DBH in territory</b>	<b>17</b>	<b>90</b>	<b>19</b>	<b>2</b>	<b>10</b>	<b>21</b>	<b>.000</b>	<b>+</b>
<b>Trees &gt;12 cm DBH w/in 100 m</b>	<b>17</b>	<b>90</b>	<b>19</b>	<b>11</b>	<b>52</b>	<b>21</b>	<b>.020</b>	<b>+</b>
<b>Trees &gt;12 cm DBH w/in 1000 m</b>	<b>19</b>	<b>100</b>	<b>19</b>	<b>16</b>	<b>76</b>	<b>21</b>	<b>.049</b>	<b>+</b>
Snags >12 cm DBH in territory	7	37	19	3	14	21	.15	+
<b>Snags &gt;12 cm DBH w/in 100m</b>	<b>14</b>	<b>74</b>	<b>19</b>	<b>6</b>	<b>29</b>	<b>21</b>	<b>.010</b>	<b>+</b>
<b>Snags &gt;12 cm DBH w/in 1000 m</b>	<b>18</b>	<b>95</b>	<b>19</b>	<b>12</b>	<b>57</b>	<b>21</b>	<b>.009</b>	<b>+</b>
<b>Branches &gt;12 cm in territory</b>	<b>14</b>	<b>74</b>	<b>19</b>	<b>1</b>	<b>5</b>	<b>21</b>	<b>.000</b>	<b>+</b>
<b>Branches &gt;12 cm w/in 100 m</b>	<b>17</b>	<b>90</b>	<b>19</b>	<b>6</b>	<b>29</b>	<b>21</b>	<b>.000</b>	<b>+</b>
<b>Branches &gt;12 cm w/in 1000 m</b>	<b>18</b>	<b>95</b>	<b>19</b>	<b>13</b>	<b>62</b>	<b>21</b>	<b>.020</b>	<b>+</b>
<b>Tree and Shrub Species (within 30m diameter circle)</b>								
<i>Populus fremontii</i> present	17	89	19	2	10	21	.000	+
Mesquite spp. present	9	47	19	13	62	21	.53	-
Mesquite spp. 4 m tall or taller present	9	47	19	12	57	21	.75	-
<b>Saltcedar spp. present</b>	<b>16</b>	<b>84</b>	<b>19</b>	<b>10</b>	<b>48</b>	<b>21</b>	<b>.02</b>	<b>+</b>
<b>Willow spp. present</b>	<b>14</b>	<b>74</b>	<b>19</b>	<b>2</b>	<b>20</b>	<b>21</b>	<b>.000</b>	<b>+</b>
<b>Food Sources</b>								
Anthills in territory	16	84	19	21	100	21	.09	-
Anthills w/in 100 m	18	95	19	21	100	21	.48	-
Anthills w/in 1000 m	19	100	19	21	100	21	1	
Mistletoe in territory	4	21	19	5	24	21	1	
Mistletoe w/in 100 m	10	53	19	8	38	21	.53	+

Categorical Habitat Variable	Use Sites			Non-use sites			Logistic Regression	
	# territories	% territories	Sample Size	# sites	% sites	Sample Size	p-value	Sign of coef.
Mistletoe w/in 1000 m	17	90	19	15	71	21	.24	+

**Table 32b: Summer Tanager habitat associations based on continuous variables collected in field habitat assessments and measured in a 707 m<sup>2</sup> (0.17 acre) plot in the center of territories and in paired non-use sites, 2008-2010. Bold entries indicate significant relationships ( $p < 0.05$ ), with the direction (positive or negative) of the association indicated by the sign of the coefficient in the logistic regression.**

Continuous Habitat Variable	Use Sites				Non-use sites				Logistic Regression	
	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size	p-value	Sign of coef.
<b>Total Trees and Tree Species</b>										
# Trees total (all size classes)	38.7	0	162	21	66.4	6	750	19	.51	-
<b># <i>Populus fremontii</i> (all sizes)</b>	<b>16.6</b>	<b>0</b>	<b>149</b>	<b>21</b>	<b>0.5</b>	<b>0</b>	<b>10</b>	<b>19</b>	<b>.007</b>	<b>+</b>
# <i>Salix gooddingii</i> (all sizes)	10.1	0	31	21	3.9	0	81	19	.24	+
# <i>Prosopis glandulosa</i> (all sizes)	1.1	0	7	21	2.5	0	16	19	.23	-
# <i>Prosopis pubescens</i> (all sizes)	0.7	0	13	21	0.3	0	6	19	.63	+
# <i>Tamarix ramosissima</i> (all sizes)	6.6	0	77	21	57.0	0	745	19	.41	-
<b>Large Trees</b>										
<b># High canopy trees (&gt; 10 m tall)</b>	<b>8.8</b>	<b>0</b>	<b>18</b>	<b>21</b>	<b>2.3</b>	<b>0</b>	<b>48</b>	<b>19</b>	<b>.03</b>	<b>+</b>
# Trees >20 cm DBH	16.3	0	162	21	6.0	1	91	19	.33	+
<b># Large riparian trees (&gt; 20 cm DBH and &gt; 4 m tall)</b>	<b>28.3</b>	<b>0</b>	<b>149</b>	<b>21</b>	<b>8.3</b>	<b>2</b>	<b>91</b>	<b>19</b>	<b>.05</b>	<b>+</b>
<b># Large <i>Populus fremontii</i> (&gt; 20 cm DBH and &gt; 4 m tall)</b>	<b>18.3</b>	<b>0</b>	<b>149</b>	<b>21</b>	<b>0.5</b>	<b>0</b>	<b>10</b>	<b>19</b>	<b>.009</b>	<b>+</b>
# Large <i>Salix gooddingii</i> (> 20 cm DBH and > 4 m tall)	8.5	0	30	21	3.9	0	81	19	.35	+
# Large <i>Tamarix ramosissima</i> (> 20 cm DBH and > 4 m tall)	1.4	0	9	21	3.6	0	41	19	.39	-
<b>Mid Canopy and Understory Trees</b>										
# Mid canopy trees (4 - < 10 m)	23.8	0	162	21	22.1	0	316	19	.92	+
# Understory trees (1.4 - < 4 m)	6.1	0	71	21	40.9	0	420	19	.37	-
# Understory <i>Populus fremontii</i>	0.3	0	6	21	0.0	0	0	19	1	

Continuous Habitat Variable	Use Sites				Non-use sites				Logistic Regression	
	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size	p-value	Sign of coef.
# Understory <i>Salix gooddingii</i>	0.7	0	6	21	0.0	0	0	19	1	
# Understory <i>Prosopis glandulosa</i>	0.2	0	3	21	1.2	0	10	19	.15	-
# Understory <i>Prosopis pubescens</i>	0.0	0	0	21	0.2	0	5	19	1	
# Understory <i>Tamarix ramosissima</i>	4.9	0	71	21	38.0	0	420	19	.35	-
<b>Densimeter Average</b>	<b>12.7</b>	<b>0</b>	<b>17</b>	<b>21</b>	<b>2.6</b>	<b>0.1</b>	<b>15.8</b>	<b>19</b>	<b>.000</b>	<b>+</b>
Proportion standing water (w/in 50 m)	1.8	0	15	21	4.3	4.5	20	19	.21	-

**Table 33a: Vermilion Flycatcher habitat associations based on categorical variables collected in field habitat assessments on territories and paired non-use sites, 2008-2010. Bold entries indicate significant relationships ( $p < 0.05$ ), with the direction (positive or negative) of the association indicated by the sign of the coefficient in the logistic regression.**

Categorical Habitat Variable	Use Sites			Non-use sites			Logistic Regression	
	# territories	% territories	Sample Size	# sites	% sites	Sample Size	p-value	Sign of coef.
<b><i>Landscape Features</i></b>								
<b>Charcoaled stems w/in 100 m</b>	<b>0</b>	<b>0</b>	<b>14</b>	<b>8</b>	<b>53</b>	<b>15</b>	<b>.002</b>	<b>-</b>
Cliffs 30 ft or taller w/in 100 m	3	21	14	5	33	15	.68	-
Water source in territory	5	36	14	4	27	15	.70	+
Water source w/in 100 m	6	43	14	8	53	15	.72	-
Water source w/in 1000 m	13	93	14	13	87	15	1	
Dry wash > 5 ft wide in territory	1	7	14	3	20	15	.60	-
Dry wash > 5 ft wide w/in 100 m	3	21	14	5	33	15	.68	-
<b>Dry wash &gt; 5 ft wide w/in 1000 m</b>	<b>6</b>	<b>43</b>	<b>14</b>	<b>14</b>	<b>93</b>	<b>15</b>	<b>.005</b>	<b>-</b>
Upland habitat in territory	0	0	14	3	20	15	.22	-
<b>Upland habitat w/in 100 m</b>	<b>0</b>	<b>0</b>	<b>14</b>	<b>5</b>	<b>33</b>	<b>15</b>	<b>.04</b>	<b>-</b>
Upland habitat w/in 1000 m	6	43	14	10	67	15	.27	-
<b><i>Large Trees and Snags</i></b>								
Trees >12 cm DBH in territory	9	64	14	6	40	15	.27	+
Trees >12 cm DBH w/in 100 m	10	71	14	11	73	15	1	
Trees >12 cm DBH w/in 1000 m	12	86	14	15	100	15	.22	-
Snags >12 cm DBH in territory	1	7	14	3	20	15	.60	-

Categorical Habitat Variable	Use Sites			Non-use sites			Logistic Regression	
	# territories	% territories	Sample Size	# sites	% sites	Sample Size	p-value	Sign of coef.
Snags >12 cm DBH w/in 100m	2	14	14	3	20	15	1	
Snags >12 cm DBH w/in 1000 m	8	57	14	10	67	15	.71	-
Branches >12 cm in territory	8	57	14	5	33	15	.27	-
Branches >12 cm w/in 100 m	8	57	14	8	53	15	1	
Branches >12 cm w/in 1000 m	10	71	14	14	93	15	.17	-
<b>Tree and Shrub Species (within 30m diameter circle)</b>								
<i>Populus fremontii</i> present	4	29	14	3	20	15	.68	+
Mesquite spp. present	9	64	14	9	60	15	1	
Mesquite spp. 4 m tall or taller present	8	62	13	4	27	15	.13	+
<b>Saltcedar spp. present</b>	<b>1</b>	<b>7</b>	<b>14</b>	<b>9</b>	<b>60</b>	<b>15</b>	<b>.005</b>	<b>-</b>
Willow spp. present	3	21	14	0	0	15	.10	+
<b>Food Sources</b>								
Anthills in territory	12	86	14	13	87	15	1	
Anthills w/in 100 m	13	93	14	14	93	15	1	
Anthills w/in 1000 m	14	100	14	15	100	15	1	
Mistletoe in territory	2	14	14	5	33	15	.39	-
Mistletoe w/in 100 m	3	21	14	7	47	15	.25	-
Mistletoe w/in 1000 m	6	43	14	11	73	15	.14	-

**Table 33b: Vermilion Flycatcher habitat associations based on continuous variables collected in field habitat assessments and measured in a 707 m<sup>2</sup> (0.17 acre) plot in the center of territories and in paired non-use sites, 2008-2010. Bold entries indicate significant relationships (p < 0.05), with the direction (positive or negative) of the association indicated by the sign of the coefficient in the logistic regression.**

Continuous Habitat Variable	Use Sites				Non-use sites				Logistic Regression	
	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size	p-value	Sign of coef.
<b>Total Trees and Tree Species</b>										
# Trees total (all size classes)	28.7	2	169	14	14.2	0	54	15	.30	+
# <i>Populus fremontii</i> (all sizes)	4.1	0	31	14	1.4	0	18	15	.33	+
# <i>Salix gooddingii</i> (all sizes)	1.1	0	12	14	0.0	0	0	15	1	

Continuous Habitat Variable	Use Sites				Non-use sites				Logistic Regression	
	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size	p-value	Sign of coef.
# <i>Prosopis glandulosa</i> (all sizes)	16.6	0	157	14	3.4	0	15	15	.39	+
# <i>Prosopis pubescens</i> (all sizes)	4.3	0	25	14	1.5	0	13	15	.29	+
# <i>Tamarix ramosissima</i> (all sizes)	0.0	0	0	14	3.6	0	19	15	1	
<b>Large Trees</b>										
# High canopy trees (> 10 m tall)	3.6	0	31	14	0.7	0	4	15	.33	+
# Trees >20 cm DBH	12.0	0	43	14	5.2	0	19	15	.11	+
# Large riparian trees (> 20 cm DBH and > 4 m tall)	12.4	0	43	14	4.7	0	22	15	.08	+
# Large <i>Populus fremontii</i> (> 20 cm DBH and > 4 m tall)	4.1	0	31	14	0.3	0	3	15	.28	+
# Large <i>Salix gooddingii</i> (> 20 cm DBH and > 4 m tall)	1.0	0	12	14	0.0	0	0	15	1	
# Large <i>Tamarix ramosissima</i> (> 20 cm DBH and > 4 m tall)	0.0	0	0	14	2.3	0	19	15	1	
<b>Mid Canopy and Understory Trees</b>										
# Mid canopy trees (4 - < 10 m)	18.4	0	110	14	6.5	0	39	15	.20	+
# Understory trees (1.4 - < 4 m)	6.8	0	59	14	6.6	0	18	15	.97	
# Understory <i>Populus fremontii</i>	0.1	0	1	14	0.9	0	14	15	.53	-
# Understory <i>Salix gooddingii</i>	0.0	0	0	14	0.0	0	0	15	1	
# Understory <i>Prosopis glandulosa</i>	4.8	0	59	14	3.1	0	11	15	.68	+
# Understory <i>Prosopis pubescens</i>	0.0	0	0	14	0.8	0	5	15	1	
# Understory <i>Tamarix ramosissima</i>	0.0	0	0	14	1.1	0	6	15	1	
<b>Densimeter Average</b>										
Densimeter Average	8.7	1.3	16	14	3.2	0.3	8.8	15	.006	+
Proportion standing water (w/in 50 m)	0.0	0	0	14	2.3	0	30	15	1	

**Table 34a: Yellow Warbler habitat associations based on categorical variables collected in field habitat assessments on territories and paired non-use sites, 2008-2010. Bold entries indicate significant relationships ( $p < 0.05$ ), with the direction (positive or negative) of the association indicated by the sign of the coefficient in the logistic regression.**

Categorical Habitat Variable	Use Sites			Non-use sites			Logistic Regression	
	# territories	% territories	Sample Size	# sites	% sites	Sample Size	p-value	Sign of coef.
<b><i>Landscape Features</i></b>								
Charcoaled stems w/in 100 m	8	18	45	4	9	46	.23	+
Cliffs 30 ft or taller w/in 100 m	12	26	47	18	39	46	.19	-
Water source in territory	19	41	46	17	37	46	.83	+
Water source w/in 100 m	27	61	44	28	61	46	1	
Water source w/in 1000 m	44	100	44	44	96	46	.50	+
<b>Dry wash &gt; 5 ft wide in territory</b>	<b>3</b>	<b>7</b>	<b>46</b>	<b>11</b>	<b>24</b>	<b>46</b>	<b>.04</b>	<b>-</b>
Dry wash > 5 ft wide w/in 100 m	14	30	47	18	39	46	.39	-
Dry wash > 5 ft wide w/in 1000 m	30	65	46	32	70	46	.82	-
<b>Upland habitat in territory</b>	<b>2</b>	<b>4</b>	<b>47</b>	<b>15</b>	<b>33</b>	<b>45</b>	<b>.001</b>	<b>-</b>
<b>Upland habitat w/in 100 m</b>	<b>7</b>	<b>15</b>	<b>47</b>	<b>18</b>	<b>40</b>	<b>45</b>	<b>.01</b>	<b>-</b>
Upland habitat w/in 1000 m	19	41	46	26	58	45	.14	-
<b><i>Large Trees and Snags</i></b>								
<b>Trees &gt;12 cm DBH in territory</b>	<b>38</b>	<b>83</b>	<b>46</b>	<b>27</b>	<b>59</b>	<b>46</b>	<b>.02</b>	<b>+</b>
<b>Trees &gt;12 cm DBH w/in 100 m</b>	<b>40</b>	<b>91</b>	<b>44</b>	<b>32</b>	<b>70</b>	<b>46</b>	<b>.02</b>	<b>+</b>
Trees >12 cm DBH w/in 1000 m	42	98	43	40	87	46	.11	+
<b>Snags &gt;12 cm DBH in territory</b>	<b>18</b>	<b>38</b>	<b>47</b>	<b>3</b>	<b>7</b>	<b>46</b>	<b>.000</b>	<b>+</b>
<b>Snags &gt;12 cm DBH w/in 100m</b>	<b>24</b>	<b>52</b>	<b>46</b>	<b>3</b>	<b>7</b>	<b>46</b>	<b>.000</b>	<b>+</b>
<b>Snags &gt;12 cm DBH w/in 1000 m</b>	<b>36</b>	<b>78</b>	<b>46</b>	<b>25</b>	<b>54</b>	<b>46</b>	<b>.03</b>	<b>+</b>
<b>Branches &gt;12 cm in territory</b>	<b>30</b>	<b>64</b>	<b>47</b>	<b>16</b>	<b>36</b>	<b>45</b>	<b>.012</b>	<b>+</b>
Branches >12 cm w/in 100 m	33	73	45	25	56	45	.12	+
Branches >12 cm w/in 1000 m	40	89	45	35	78	44	.26	+
<b><i>Tree and Shrub Species (within 30m diameter circle)</i></b>								
<b><i>Populus fremontii</i> present</b>	<b>27</b>	<b>59</b>	<b>46</b>	<b>8</b>	<b>21</b>	<b>39</b>	<b>.000</b>	<b>+</b>
<b>Mesquite spp. present</b>	<b>11</b>	<b>24</b>	<b>46</b>	<b>19</b>	<b>49</b>	<b>39</b>	<b>.02</b>	<b>-</b>
Mesquite spp. 4 m tall or taller present	11	24	45	12	27	43	.81	-
Saltcedar spp. present	26	57	46	18	46	39	.34	+
<b>Willow spp. present</b>	<b>30</b>	<b>65</b>	<b>46</b>	<b>9</b>	<b>23</b>	<b>39</b>	<b>.000</b>	<b>+</b>
<b><i>Food Sources</i></b>								
Anthills in territory	35	75	47	26	57	46	.08	+
Anthills w/in 100 m	43	94	45	38	83	46	.20	+
Anthills w/in 1000 m	45	100	45	46	100	46	1	
Mistletoe in territory	1	2	47	4	9	45	.20	-
Mistletoe w/in 100 m	7	15	47	7	16	45	1	
Mistletoe w/in 1000 m	15	33	46	20	44	45	.29	-

**Table 34b: Yellow Warbler habitat associations based on continuous variables collected in field habitat assessments and measured in a 707 m<sup>2</sup> (0.17 acre) plot in the center of territories and in paired non-use sites, 2008-2010. Bold entries indicate significant relationships ( $p < 0.05$ ), with the direction (positive or negative) of the association indicated by the sign of the coefficient in the logistic regression.**

Continuous Habitat Variable	Use Sites				Non-use sites				Logistic Regression	
	Average	Minimum	Maximum	Sample Size	Average	Minimum	Maximum	Sample Size	p-value	Sign of coef.
<b>Total Trees and Tree Species</b>										
# Trees total (all size classes)	84	0	804	46	80.6	0	708	39	.92	+
# <i>Populus fremontii</i> (all sizes)	12.3	0	169	46	16.8	0	199	39	.61	-
# <i>Salix gooddingii</i> (all sizes)	52.5	0	635	46	15.1	0	293	39	.19	+
# <i>Prosopis glandulosa</i> (all sizes)	1.5	0	15	46	3.2	0	30	39	.14	-
# <i>Prosopis pubescens</i> (all sizes)	0.0	0	0	46	0.3	0	6	39	1	
# <i>Tamarix ramosissima</i> (all sizes)	11.7	0	120	46	25.1	0	700	39	.49	-
<b>Large Trees</b>										
# High canopy trees (> 10 m tall)	<b>12.5</b>	<b>0</b>	<b>108</b>	<b>46</b>	<b>0.4</b>	<b>0</b>	<b>5</b>	<b>39</b>	<b>.005</b>	<b>+</b>
# Trees >20 cm DBH	26.4	0	264	46	31.8	0	606	39	.75	-
# Large riparian trees (> 20 cm DBH and > 4 m tall)	<b>16.3</b>	<b>0</b>	<b>53</b>	<b>46</b>	<b>5.1</b>	<b>0</b>	<b>105</b>	<b>39</b>	<b>.004</b>	<b>+</b>
# Large <i>Populus fremontii</i> (> 20 cm DBH and > 4 m tall)	6.2	0	45	46	3.1	0	104	39	.29	+
# Large <i>Salix gooddingii</i> (> 20 cm DBH and > 4 m tall)	<b>7.7</b>	<b>0</b>	<b>32</b>	<b>46</b>	<b>0.3</b>	<b>0</b>	<b>4</b>	<b>39</b>	<b>.004</b>	<b>+</b>
# Large <i>Tamarix ramosissima</i> (> 20 cm DBH and > 4 m tall)	<b>2.3</b>	<b>0</b>	<b>39</b>	<b>46</b>	<b>0.4</b>	<b>0</b>	<b>5</b>	<b>39</b>	<b>.036</b>	<b>+</b>
<b>Mid Canopy and Understory Trees</b>										
# Mid canopy trees (4 - < 10 m)	30.2	0	367	46	12.7	0	157	39	.23	+
# Understory trees (1.4 - < 4 m)	41	0	804	46	64.9	0	708	39	.41	-
# Understory <i>Populus fremontii</i>	4.2	0	169	46	7.0	0	92	39	.60	-
# Understory <i>Salix gooddingii</i>	22.8	0	635	46	14.2	0	293	39	.61	+
# Understory <i>Prosopis glandulosa</i>	0.8	0	12	46	2.3	0	22	39	.08	-
# Understory <i>Prosopis pubescens</i>	0.0	0	0	46	0.3	0	6	39	1	
# Understory <i>Tamarix ramosissima</i>	8.5	0	120	46	23.2	0	700	39	.46	-
<b>Densimeter Average</b>										
Densimeter Average	<b>12.3</b>	<b>0.9</b>	<b>72</b>	<b>46</b>	<b>4.3</b>	<b>0</b>	<b>16</b>	<b>38</b>	<b>.000</b>	<b>+</b>
Proportion standing water (w/in 50 m)	11.4	0	90	40	5.4	0	90	35	.14	+

# Discussion

## Species Richness Patterns

When reviewing the species lists (Appendix 5), we note that the covered species Bell's Vireo, Yellow Warbler, and Gila Woodpecker continue to be regularly found throughout the project area, while the Summer Tanager and Vermilion Flycatcher remain uncommon breeders with a spotty distribution in the study area. Also, while the Gilded Flicker had not been detected in any surveys throughout project area prior to this year, one individual was found along the main stem of the Colorado River in June 2010, and several family groups were detected late in the season along the Bill Williams River. The birds at the Bill Williams River were detected both during late-season surveys and as incidental observation in the refuge and in the desert near Lincoln Ranch (outside the LCR MSCP project area) during the same time period. Three of the incidental observations included a family group moving from the uplands into the riparian area at Bill Williams River NWR and one nest with chicks in a saguaro cactus south of the Bill Williams River and near Lincoln Ranch (outside the LCR MSCP project area). We also received reports from other researchers (Alex McDonnell, *pers. comm.*) of a family group of Gilded Flickers in the Bill Williams River NWR in July and August, 2010.

Both the Bill Williams River region and the habitat creation sites emerged as particular hot spots for covered species. While the habitat creation sites do not (yet) support species such as Gila Woodpecker and Gilded Flicker that require old-growth riparian gallery forest, they have already attracted many species associated with the desired riparian habitats in substantial numbers (Appendix 5; see also Results).

## System-Wide Surveys

Population size estimates of several LCR MSCP-covered species were lower for 2010 compared with the 2007-2009 combined estimates. This drop may be partly attributable to the smaller sample size contributing to the 2010 estimate ( $n = 80$  in 2010, compared with  $n = 240$  for 2007-2009) and, as a result, a lower representation of covered species in the 2010 sample based on random site selection. Other possible reasons for this pattern include not being able to access several sites on the Bill Williams River (which is a traditional stronghold for most of the covered landbirds), or a true decrease in population size in 2010 compared to previous years. We conducted this comparison to explore whether a one-year sample from system-wide plots can provide a reasonable estimate of system-wide population sizes, and future analyses involving a larger number of survey years are needed to answer this question conclusively. Continued monitoring over the years will also be necessary to determine population trends.

When reviewing the 2010 plot delineation, most of the available system-wide survey plots fall into the Low Woody (55%) and Unsuitable (40%) habitat categories, while few plots fall into the Tall Woody (3%) and Herbaceous (2%) categories (Table 4). We believe that this reflects (or at least approximates) the true distribution of these habitat

types in the LCR MSCP project area, even though many plots classified as one habitat type can also have small patches of other habitats. At the least, it can be concluded that large (> 5-10 ha) patches of Tall Woody are rare along the main stem of the river, which explains the relative rarity of “old-growth” bird species such as Summer Tanager and Gilded Flicker. This is in agreement with vegetation mapping efforts and other bird surveys conducted on the LCR in the past 25 years (Rosenberg 1991, USBR vegetation maps, various Ohmart and Anderson reports). Species such as Bell’s Vireo and Yellow Warbler readily nest in riparian shrub habitats and, therefore, may fair better overall even though they may prefer Tall Woody habitat types as well (Table 29). Together, these findings suggest that populations of covered species should increase, if the proportion of Tall Woody areas continues to increase through habitat creation.

Indications of system-wide species recovery that can be monitored with the methods used in this project include an increase in abundance of breeders and a stabilization in the distribution of the breeding population. The Bill Williams River NWR region (Region 7) held overall the largest proportion of covered species (Table 9a). Due to spring flooding, we were not able to survey plots in the interior of the Bill Williams River riparian area this year, but those plots should be added to the random site selection for 2011.

## **Habitat Creation Sites**

Similar to our findings in 2008 and 2009 (GBBO 2009), the habitat creation sites that were greater than two years old supported breeding populations of three of the six covered species, including Bell’s Vireo, Yellow Warbler, and Summer Tanager. Since we were not able to survey the CRIT habitat creation sites in 2010, we have not been able to update information about Vermilion Flycatchers, as this data was from only the habitat creation sites located on CRIT. The Gila Woodpecker was not detected in habitat creation sites, and likely will not be until the habitat develops into a mature stand with snags. Given how uncommon Tall Woody vegetation is in the current landscape of the lower Colorado River, continued monitoring of the habitat creation sites will be particularly useful to determine whether populations of riparian bird species associated with old-growth can be restored.

One primary cavity-nester, the Ladder-backed Woodpecker, was detected at the Cibola Valley Conservation Area in 2009, but this individual was associated with a relic tree that was just outside the habitat creation site. One was also detected nesting within the created habitat at CRIT in 2009. In 2010, several old-growth associated species had partial territories in the habitat creation plots. A pair of Ladder-backed Woodpeckers was again detected in the CVCA habitat creation site nesting in the same relic tree immediately outside the site, and another Ladder-backed Woodpecker breeding territory was recorded at the Nature Trail. Other cavity nesters also have begun to set up breeding territories in habitat creation sites, including a partial territory of an American Kestrel pair (0.5 territory in 2010) and one Ash-throated Flycatcher territory in the Nature Trail plots in each 2009 and 2010. The American Kestrels currently use nest boxes along the road near the plot, but forage in the plots. The nest locations of the Ash-throated Flycatchers remain

unknown, but based on behavioral observations were assumed to be inside the plot. At the Beal habitat creation site (Tables 17 and 18), 7.5 territories of Lucy's Warblers were found in 2010, while two were found in both 2008 and 2009. This increase in partial and complete territories in habitat creation sites suggests that the sites are becoming more suitable for cavity-nesters.

## **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 absence of bird species. While such habitat modeling efforts are, by nature, correlative, we feel that important habitat requirements were documented by both the habitat strata associations and microhabitat use determined by this study. Some riparian birds can be extraordinarily selective for habitat, as our results indicate, and we suggest that correlative analyses are appropriately informative to describe their selectivity for the purpose of habitat creation planning. In our results, we present all habitat variables measured as part of this study (Tables 30-34), and we recommend that these be used as basic guidelines for habitat creation even if some variables came out to be "non-significant" in a technical sense. For instance, other Bell's Vireo data (GBBO 2010) showed a significant association of the species with nearby (< 1 km) surface water, a pattern not detected in this study. This is most likely a result of the non-use sites that were paired with Bell's Vireo territories being at similar distances from surface water (as much of the MSCP project area is adjacent to the river), and we would maintain that this species is a riparian-obligate species that is unlikely to colonize isolated stands far from water. Other non-significant differences may be the result of low sample size, which can reduce the power to detect the more subtle patterns of habitat selection. This effect is more likely to influence Vermilion Flycatcher and Summer Tanager results than the other three species, which are more common throughout the project area than the former.

Some variables may be correlates of other bird-habitat requirements (e.g., apparent selection against upland vegetation, which may be a correlate of reduced food resources with reduced riparian shrub cover), but we provide the full set of habitat variables for each species in this report in order to accommodate planning that aims to create habitat conditions that meet the covered species' habitat requirements regardless of causal relationships. While some variables are selected clearly to meet a resource need of species (e.g., selection of snags by Gila Woodpecker to meet the requirement of cavity nests), other selective behavior is more speculative. For instance, we found that Vermilion Flycatcher appears to select sites that have on average more cover by riparian woodlands than other sites, which is slightly in contrast to the general view of this species being an open woodland associate (e.g., Wolf and Jones 2000). We suspect that this pattern reflects that the species selects the highest-quality (denser-canopy) sites among locally available sites that may overall be too open. We also caution that the lower sample size of Vermilion Flycatcher territories (n = 14) and their overall rarity in the project area may lead to more spurious results than those of other, more common species. In future planning efforts and with additional data collection on system-wide population

monitoring of the covered species, we recommend that the results of this habitat modeling effort be examined to determine areas of uncertainty in terms of true resource requirements by each of the covered species, and to further clarify threshold habitat requirements.

Our field habitat assessments and findings in the Bill Williams River region suggest that all five covered species for which we have adequate data, including Yellow Warbler, Bell's Vireo, Summer Tanager, Gila Woodpecker, and Vermilion Flycatcher, are associated with habitat variables that are addressed in habitat creation efforts of the LCR MSCP. Habitat stratum 1 (Tall Woody) of the system-wide sampling plan appears to be suitable for a large number of covered species, but curiously, so do habitat strata 2 (Low Woody) and 4 (Unsuitable). As we concluded in our 2009 report (GBBO 2009), the example of the Bill Williams River suggests that a patchy landscape may be more typical in a southwestern riparian setting than solid tall canopy cover over large expanses. Regardless of the patch configuration at the local scale, though, we re-emphasize our findings that overall, tall canopy cover in the project area is less abundant than it was historically and significant habitat creation benefits are expected from increasing the presence of patches of tall riparian trees.

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

In 2010, we used the revised grid map of survey plots for system-wide surveys, which was created in collaboration with USGS (Bart et al. 2010) and the Bureau of Reclamation (see Appendix 6 for more detail). We recommend continuing to use this plot map for future system-wide monitoring for maximal data compatibility. If major changes in vegetation cover occur over time, other revisions may be done to optimize survey effort. The work on map revisions and plot delineations for a project area this size is substantial, which is why we recommend to carefully weigh the necessity of a revision once it appears to be time for one. We also added a GIS component to our data collection by recording all bird locations for covered species over all rapid and intensive searches conducted at habitat creation sites in ArcGIS. With this effort, territory density, size, and exact location of covered species can be monitored more precisely in the habitat creation sites from year to year than was possible prior to using spatial data tools. Further habitat use analyses based on size, age, species composition, and success of plantings are also possible with the use of these data.

Although we have been surveying all habitat creation sites with at least two years of growth in the past three years, there will come a time when more habitat is being created than can reasonably be completely surveyed each year. A monitoring plan may be developed for the next stage of the project that allows for random sampling rather than complete surveys of all habitat creation sites.

In conclusion, we want to emphasize that this survey effort had the primary goal of establishing a solid framework for monitoring riparian birds along the lower Colorado

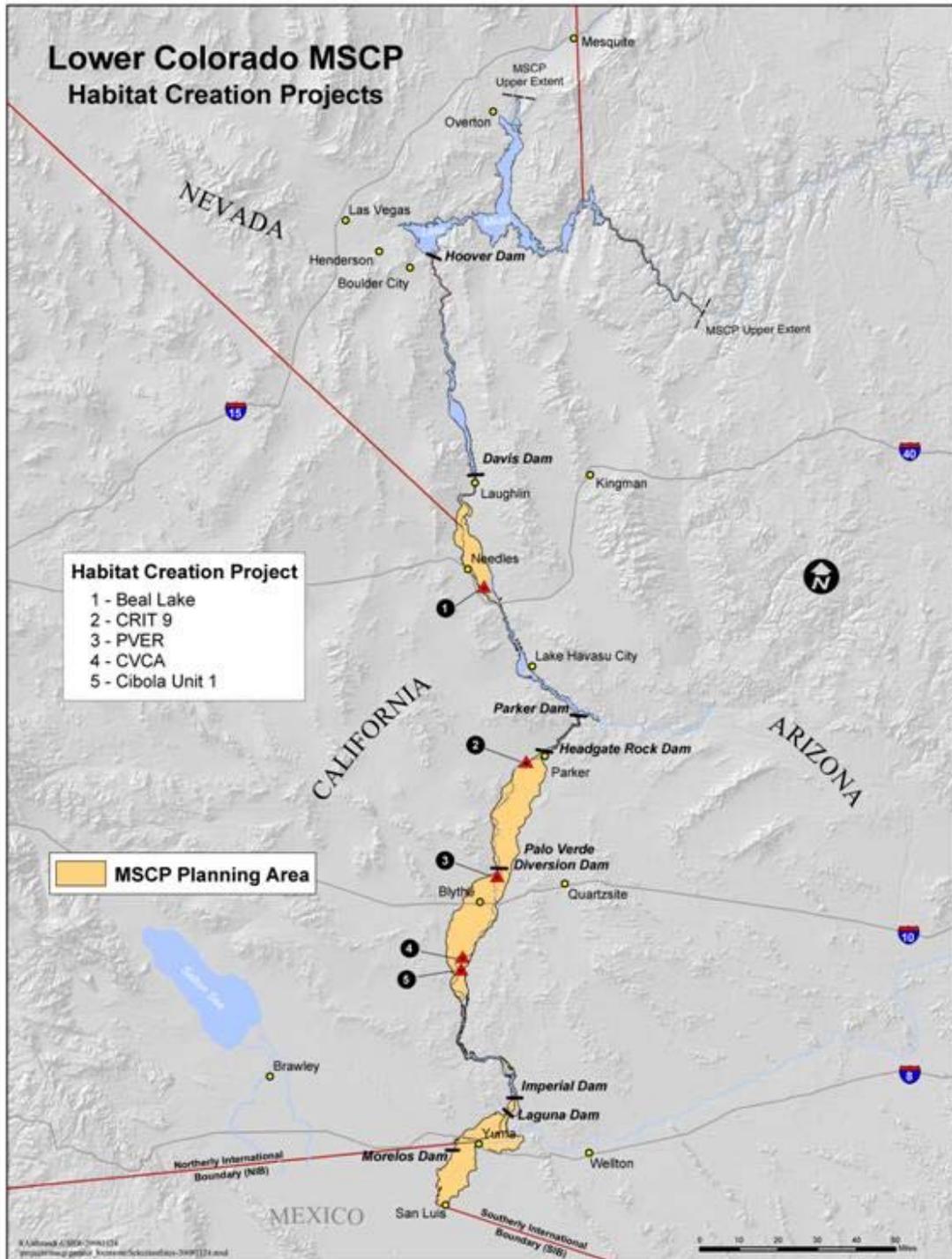
River, with particular emphasis on covered species, within the system-wide project area and in habitat creation sites. We addressed the component of habitat requirements of covered species based on the best current knowledge of their natural history with our field habitat assessments. We feel that additional knowledge on habitat requirements on the less common covered species, such as Vermilion Flycatcher and possibly Gilded Flicker, may be gained by obtaining data from outside the project area, but within the same habitat types in future studies. Given the LCR MSCP goals, such efforts may specifically address the issue of threshold habitat requirements of each covered species. Additional research may also address how other resource requirements of covered species influence their presence, such as food resources, surface water availability, and thermal and moisture requirements for successful breeding.

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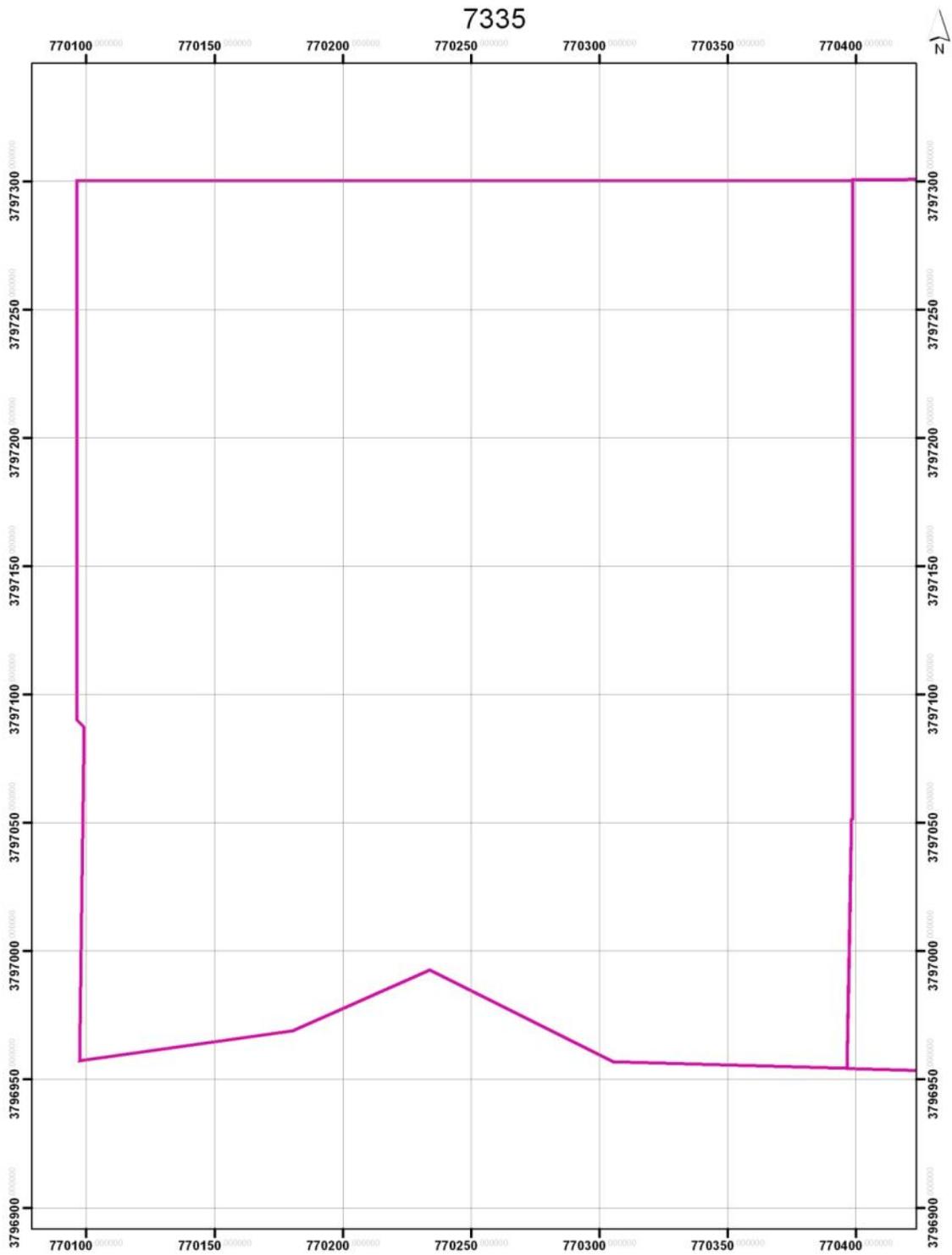
Appendix 1. Overview of habitat creation sites of the LCR MSCP in 2009. Map provided by the U.S. Bureau of Reclamation, Lower Colorado River Region.



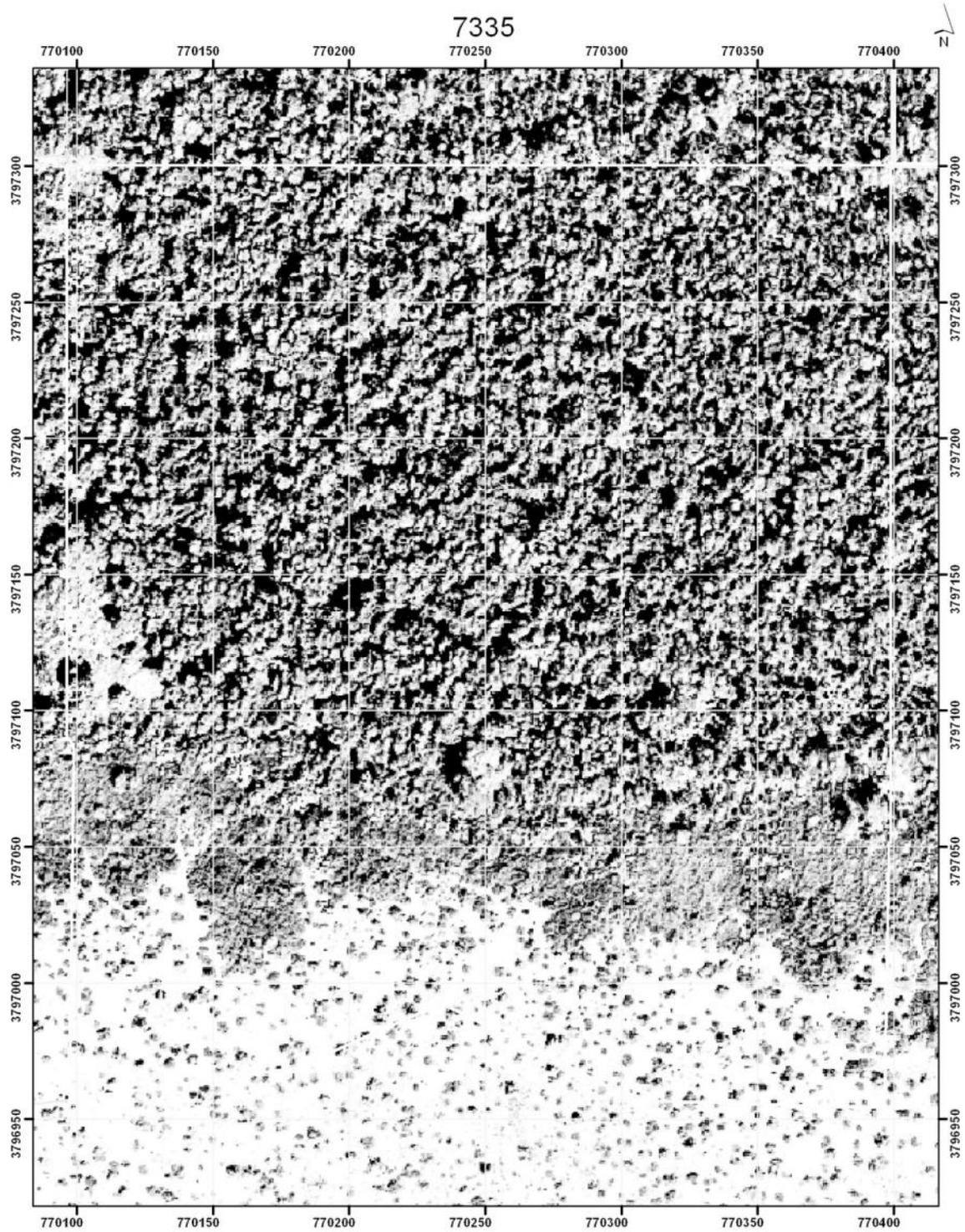
Appendix 2a. Example of a system-wide monitoring plot.



Appendix 2b. Example of a grid plot (when no aerial photo coverage is available).



Appendix 2c. Example of a plot map with grid, including grayscale imagery for reference.





Appendix 2e. Example of the first page of a six-page filled-out rapid area search data sheet for plot 7335 in 2010.

Lower Colorado River: Rapid Area Search Data Sheet (use 1 row per individual/group)

Date: 12 June 2010 Observer: A. Leach Page 5 of 6

Plot Number: 7335 Start Time: 5:20 End Time: 6:00 Sky Code: 3

Wind Code: 0

Map Reference Code	Species	# Male	# Female	# Unknown	# Juv	Obs Possible			Probable			Confirmed			Incidental	Comments			
						seen/heard only	Singing	Pair	Territorial display	Pair in suitable nesting habitat	Courtship/mate guarding	Agitated behavior	Nest building/carrying nest material	Prolonged distraction behavior			Occupied nest	Food carrying	Dependent young
BEW01	Brewer's Wren	1		1	3	X	X	X											
3		1				X	X	X											
4		1				X	X	X											
5		1				X	X	X											
6		1				X	X	X											
7		1				X	X	X											
8		1				X	X	X											
9		1				X	X	X											
10		1				X	X	X											
11		1				X	X	X											
12		1				X	X	X											
13		1				X	X	X											
14		1				X	X	X											
15		1				X	X	X											
16		1				X	X	X											
17		1				X	X	X											
18		1				X	X	X											
19		1				X	X	X											
20		1				X	X	X											
21		1				X	X	X											
22		1				X	X	X											
23		1				X	X	X											
24		1				X	X	X											
25		1				X	X	X											
26		1				X	X	X											
27		1				X	X	X											
28		1				X	X	X											
29		1				X	X	X											
30		1				X	X	X											
31		1				X	X	X											
32		1				X	X	X											
33		1				X	X	X											
34		1				X	X	X											
35		1				X	X	X											
36		1				X	X	X											
37		1				X	X	X											
38		1				X	X	X											
39		1				X	X	X											
40		1				X	X	X											
41		1				X	X	X											
42		1				X	X	X											
43		1				X	X	X											
44		1				X	X	X											
45		1				X	X	X											
46		1				X	X	X											
47		1				X	X	X											
48		1				X	X	X											
49		1				X	X	X											
50		1				X	X	X											
51		1				X	X	X											
52		1				X	X	X											
53		1				X	X	X											
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59		1				X	X	X											
60		1				X	X	X											
61		1				X	X	X											
62		1				X	X	X											
63		1				X	X	X											
64		1				X	X	X											
65		1				X	X	X											
66		1				X	X	X											
67		1				X	X	X											
68		1				X	X	X											
69		1				X	X	X											
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79		1				X	X	X											
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87		1				X	X	X											
88		1				X	X	X											
89		1				X	X	X											
90		1				X	X	X											
91		1				X	X	X											
92		1				X	X	X											
93		1				X	X	X											
94		1				X	X	X											
95		1				X	X	X											
96		1				X	X	X											
97		1				X	X	X											
98		1				X	X	X											
99		1				X	X	X											
100		1				X	X	X											

Appendix 2f. Example of a filled-out rapid area search end-of-season summary datasheet (first page). All species found in the plot over both rapid surveys during the season are listed on this sheet, and the number of partial territories is tallied for use in the DS program. If a bird was not found breeding in the plot, or if it was a flyover, it is listed on the datasheet with a zero in the territories column. The "Average date of Incubation Peak" and the "Peak date for sightings of Non-breeding Individuals" are only filled out if the surveyor has that information from their rapid surveys.

**Rapid Area Search End-of-Season Summary Sheet 2010**

(send to GBBO, 1755 E. Plumb Ln #256, Reno, NV 89502)

Plot Name: 7225 - Tipack Year: 2010  
 UTM's of Plot Corner: 1785450 13831950  
 Surveyor Name(s): John Diener

Full Species Name	Number of Territories in Plot (decimals o.k. for partial territories)	Avg. Date of Incubation Peak (first and second brood, approximate based on survey data)	Peak Date for Sightings of Non-breeding Individuals (if applicable)
Abert's Towhee	4.5		Will fill in later with all data
Black-tailed Gnatcatcher	4		
Common Yellowthroat	0.75		
Marsh Wren	.75		
Least Bittern	.50		
Green Heron	.50		
Northern Mockingbird	.50		
Yellow-breasted Chat	1		
Verdin	2.5		
Cornbel's Quail	4		
Ladder-backed Woodpecker	1		
Pied-billed Grebe	1		
Ash-throated Flycatcher	.50		
American Coot	2		
White-winged Dove	1		
Great-tailed Grackle	2		
Brown-headed Cowbird	3		
Mourning Dove	3		
Lesser Nighthawk	0		
Great Egret	0		
Red-winged Blackbird	0		
American Kestrel	0		
House Finch	1.5		
Turkey Vulture	0		
Clark's Grebe	.5		
UNK Western Grebe	.5		
Song Sparrow	1		
Lazuli Bunting	0		
Phainopepla	1		
Black-throated Sparrow	.50		

Appendix 2g. Example of end-of-season intensive area search data sheet, filled out after eight visits.

GBBO Area Search / Spot-Mapping Data Sheet:

Enter number of individuals detected on each date and best evidence for nesting (remit to GBBO, 1755 E. Plumb Lane #256A, Reno, NV 89502)

Plot Name: Beal A UTM of corner: 726275 385095D Datum: Nad 83 Year: 2010

Surveyor Names: Lizzie Goodnick

Species Name	Terr./Ind. Code	Date 1: ✓	Date 2: ✓	Date 3: ✓	Date 4: ✓	Date 5: ✓	Date 6: ✓	Date 7: ✓	Date 8: ✓	Date 9:	Date 10:	Pr (terr in plot)	In/Out
Greater Road Runner	GR001	April 13	April 20	April 27	May 3 Seen foraging	May 10 Seen foraging	May 18 not seen	May 27 not seen	June 7 not seen			0	OUT
"	GR002				Seen foraging	not seen	not seen	not seen	not seen			0	OUT
Song Sparrow	SOSP1							♂ singing	not seen			100	IN
	SOSP2								♂ singing			0	OUT
	SOSP3								♂ singing			0	OUT
	SOSP4								♂ singing			0	OUT

construction: nest being constructed (evidence: nest material carried or construction observed)  
 eggs: nest being incubated (evidence: adult observed incubating eggs, or nest with eggs found)  
 nestlings: young present in nest (evidence: food carried to nest, fecal sacs carried away from nest, begging calls, young seen in nest)  
 fledglings: dependent young present outside a nest (evidence: young begging from adults, downy plumage, short tail, difficulty flying)  
 singing/silent: individual bird singing or observed silent, no other signs of nesting  
 pair: mated pair observed, no other signs of nesting

copulation/mate guarding: see protocol  
 nest guarding: see protocol  
 territorial displays: boundary disputes of males (usually), consisting of aggressive calling, singing, physical interactions between owners of adjacent territories -- excellent evidence for territory boundaries

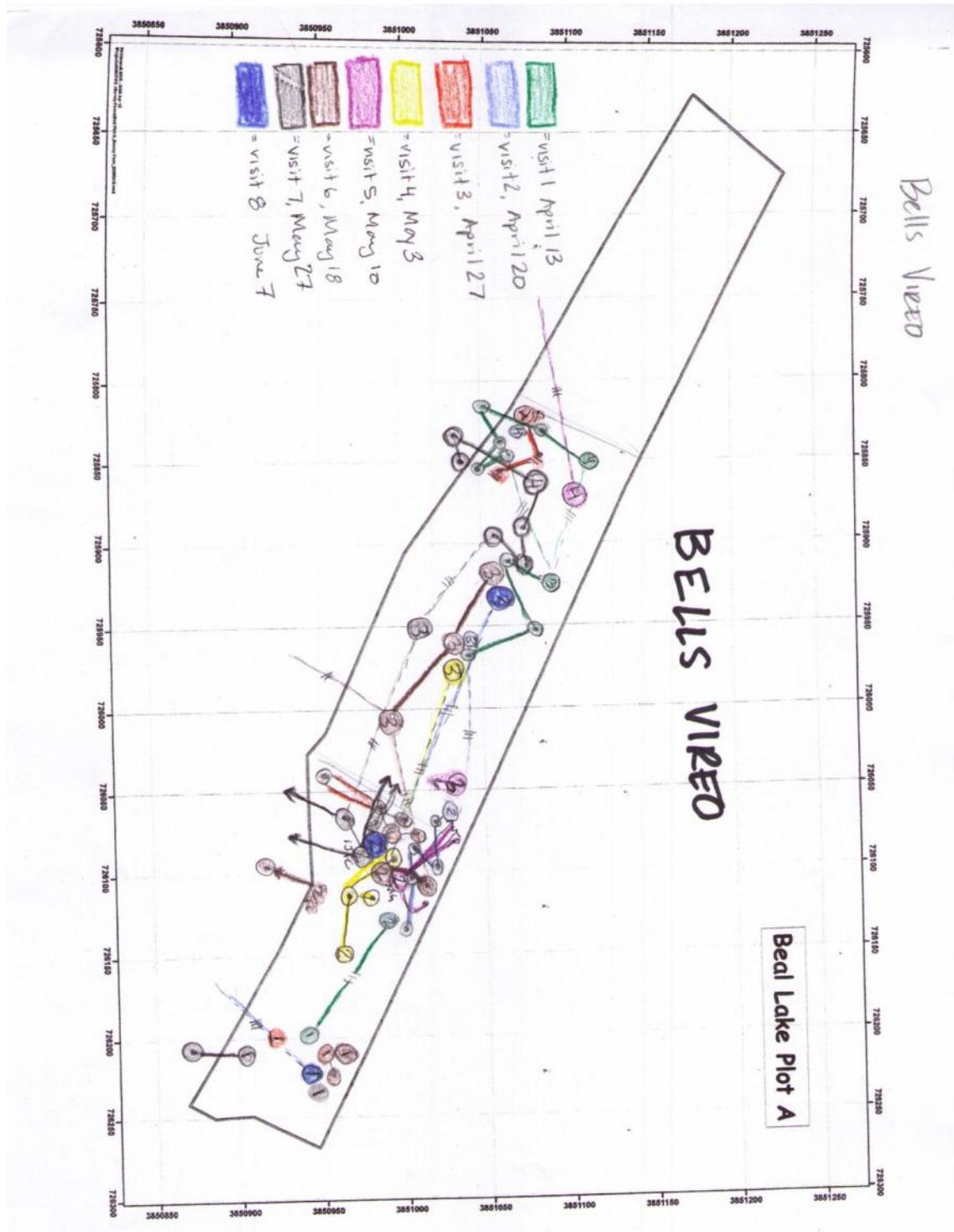
Pr(terr in plot): proportion of territory within area search plot (0.1-1.0)  
 In/Out: is the nest or center of territory inside or outside of area search plot

Proofed JPD 5-30-2010





Appendix 2j. Example of a species territory map (Bell's Vireo) compiled at the end of an intensive survey effort for each species on the plot.



### **Appendix 3. Rapid Area Search Protocol.**

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 1<sup>st</sup> half of the season and once in the 2<sup>nd</sup> 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. The final call will be made by the surveyor immediately after the 2<sup>nd</sup> survey based on personal knowledge of the plot and bird species' natural history.
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 1<sup>st</sup> 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 covered 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 to avoid 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 4a. Presence of migrants and other non-breeders, by species, detected during intensive area searches at Beal Lake habitat creation plots in 2010. Fly-overs are included in this list, but incidental birds that were not in or above the plot during the survey are not included. Listed in alphabetical order.**

<u>Species</u>	<u>BEAL A</u>	<u>BEAL B</u>	<u>BEAL C</u>	<u>BEAL D</u>
American Bittern		X		
American Robin		X		
American White Pelican		X		
Anna's Hummingbird				X
Ash-throated Flycatcher				X
Audubon's Warbler	X	X		X
Bank Swallow		X		X
Barn Swallow	X	X		X
Black-crowned Night-Heron				X
Black-headed Grosbeak		X		X
Black-throated Gray Warbler	X			
Brewer's Blackbird				X
Broad-tailed Hummingbird		X		
Brown-crested Flycatcher			X	
Brown-headed Cowbird			X	X
Bullock's Oriole	X			X
Cedar Waxwing		X		
Chipping Sparrow		X		
Cliff Swallow	X	X	X	X
Common Yellowthroat	X		X	
Crissal Thrasher	X			
Double-crested Cormorant	X	X	X	X
Dusky Flycatcher		X	X	
<i>Empidonax</i> spp.	X			X
Eurasian Collared-Dove		X		X
Forster's Tern	X		X	
Gray Flycatcher		X		
Great Blue Heron	X	X	X	
Great Crested Flycatcher		X		
Great Egret		X	X	
Greater Roadrunner	X			
Great-tailed Grackle	X		X	X
Green Heron		X		
Hammond's Flycatcher		X	X	
House Finch	X			
Hummingbird spp.	X			

<b>Species</b>	<b>BEAL A</b>	<b>BEAL B</b>	<b>BEAL C</b>	<b>BEAL D</b>
Indigo Bunting		X	X	X
Killdeer	X	X	X	X
Ladder-backed Woodpecker			X	X
Lazuli Bunting	X	X		X
Lesser Goldfinch		X		
Lincoln's Sparrow		X		
MacGillivray's Warbler		X	X	
Mallard		X		X
Mourning Dove	X		X	X
Myrtle Warbler	X			
Nashville Warbler	X	X	X	X
Northern Mockingbird		X		X
Northern Rough-winged Swallow	X	X		X
Olive-sided Flycatcher		X		
Orange-crowned Warbler		X	X	X
Osprey		X	X	
Pacific-slope Flycatcher		X	X	
Phainopepla				X
Plumbeous Vireo		X		
Red-winged Blackbird	X	X	X	X
Ruby-crowned Kinglet		X		
Rufous Hummingbird		X	X	
Snowy Egret	X			
Song Sparrow		X	X	X
Swainson's Thrush		X		
Townsend's Warbler		X		
Tree Swallow	X	X	X	X
Turkey Vulture	X	X	X	X
Vaux's Swift	X			
Warbling Vireo		X		X
Western Kingbird	X	X	X	X
Western Tanager		X		X
Western Wood-Pewee			X	
White-crowned Sparrow	X	X		
White-faced Ibis			X	X
White-winged Dove	X		X	X
Willet	X			
Wilson's Warbler	X	X	X	X
Yellow Warbler	X			X
Yellow-headed Blackbird	X	X	X	X

<b>Species</b>	<b>BEAL A</b>	<b>BEAL B</b>	<b>BEAL C</b>	<b>BEAL D</b>
Yellow-rumped Warbler			X	

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\* LCR MSCP covered species

**Appendix 4b. Presence of migrants and other non-breeders, by species, detected during intensive area searches at CVCA habitat creation plots in 2010. Fly-overs are included in this list, but incidental birds that were not in or above the plot during the survey are not included. Listed in alphabetical order.**

<b>Species</b>	<b>CVCA 1 CD</b>	<b>CVCA 1A</b>	<b>CVCA 1B</b>	<b>CVCA3 AB</b>	<b>CVCA3 CD</b>
American Kestrel	X		X		
American Robin	X				
Anna's Hummingbird		X		X	
Ash-throated Flycatcher	X				
Barn Owl	X				
Barn Swallow		X	X	X	X
Bendire's Thrasher				X	
Black-chinned Hummingbird				X	
Black-headed Grosbeak	X		X		
Black-tailed Gnatcatcher					X
Black-throated Gray Warbler	X	X			
Brewer's Blackbird		X		X	
Brown-headed Cowbird			X		
Bullock's Oriole					X
Cassin's Vireo				X	X
Chipping Sparrow	X		X		
Cliff Swallow	X	X	X	X	X
Common Ground-Dove			X		
Common Raven			X		
Common Yellowthroat		X	X	X	X
Cordilleran Flycatcher				X	
Costa's Hummingbird					X
Double-crested Cormorant					X
Eurasian Collared-Dove			X		
European Starling	X			X	X
Great Blue Heron					X
Great Egret			X		X
Great Horned Owl				X	X
Great-tailed Grackle		X			
Green-tailed Towhee		X			
Harris's Hawk	X				
Hermit Thrush	X				
House Finch	X				
Killdeer	X	X			X
Ladder-backed Woodpecker					X
Lazuli x Indigo Bunting Hybrid				X	
Lesser Goldfinch			X	X	

Species	CVCA 1 CD	CVCA 1A	CVCA 1B	CVCA3 AB	CVCA3 CD
Lesser Nighthawk			X	X	
Lincoln's Sparrow		X	X		
Lucy's Warbler			X		
MacGillivray's Warbler		X			
Nashville Warbler	X		X		
Northern Harrier				X	X
Northern Mockingbird			X		
Northern Parula		X			
Northern Rough-winged Swallow	X		X	X	X
Olive-sided Flycatcher				X	
Orange-crowned Warbler					X
Phainopepla			X		
Red-winged Blackbird	X	X	X		
Ruby-crowned Kinglet				X	X
Say's Phoebe	X				
Swainson's Hawk				X	
Townsend's Warbler	X			X	
Tree Swallow	X	X	X	X	X
Turkey Vulture		X			X
Vaux's Swift					X
Violet-green Swallow				X	
Warbling Vireo	X	X	X	X	X
Western-type Flycatcher		X	X	X	X
Western Kingbird	X		X	X	X
Western Tanager		X			X
Western Wood-Pewee	X	X	X	X	X
White-crowned Sparrow		X		X	
White-faced Ibis	X		X	X	X
White-throated Swift				X	
Willow Flycatcher*				X	X
Wilson's Warbler	X	X	X	X	X
Yellow Warbler*		X	X	X	X
Yellow-breasted Chat		X	X		
Yellow-headed Blackbird	X	X	X	X	
Yellow-rumped Warbler		X			X

\*LCR-MSCP covered species

**Appendix 4c. Presence of migrants and other non-breeders, by species, detected during intensive area searches at Nature Trail habitat creation plots in 2010. Fly-overs are included in this list, but incidental birds that were not in or above the plot during the survey are not included. Listed in alphabetical order.**

<b>Species</b>	<b>Nature Trail North</b>	<b>Nature Trail South</b>
American Kestrel	X	
Barn Owl		X
Barn Swallow	X	X
Black-chinned Hummingbird	X	
Black-headed Grosbeak	X	X
Black-tailed Gnatcatcher		X
Brewer's Blackbird	X	
Cassin's Vireo		X
Cliff Swallow	X	X
Common Ground-Dove	X	X
<i>Empidonax</i> Flycatcher spp.	X	
Eurasian Collared-Dove	X	
European Starling	X	X
Gray Hawk	X	
Great Egret	X	
Great-tailed Grackle	X	X
Green Heron		X
House Finch	X	
Killdeer		X
Lesser Nighthawk	X	X
Lincoln's Sparrow		X
MacGillivray's Warbler		X
Northern Mockingbird		X
Northern Parula	X	X
Northern Rough-winged Swallow	X	X
Orange-crowned Warbler	X	
Plumbeous Vireo	X	
Red-winged Blackbird	X	X
Ruby-crowned Kinglet	X	X
Swainson's Thrush	X	
Tree Swallow	X	X
Turkey Vulture	X	X
Violet-green Swallow	X	
Warbling Vireo	X	X
Western-type Flycatcher	X	X
Western Tanager	X	X
Western Wood-Pewee		X

<b>Species</b>	<b>Nature Trail North</b>	<b>Nature Trail South</b>
White-tailed Kite	X	X
Willow Flycatcher*	X	X
Wilson's Warbler	X	X
Yellow-headed Blackbird	X	X
Yellow-rumped Warbler	X	X

\* LCR MSCP covered species

**Appendix 4d. Presence of migrants and other non-breeders, by species, detected during intensive area searches at PVER habitat creation plots in 2010. Fly-overs are included in this list, but incidental birds that were not in or above the plot during the survey are not included. Listed in alphabetical order.**

<b>Species</b>	<b>PVER 2A</b>	<b>PVER 2B</b>	<b>PVER 3</b>
American Kestrel	X		X
Baltimore Oriole			X
Barn Owl	X		
Barn Swallow	X		X
Bell's Vireo*		X	X
Black-headed Grosbeak			X
Black-throated Gray Warbler		X	
Brown-headed Cowbird			X
Bullock's Oriole			X
Cassin's Kingbird		X	
Cassin's Vireo		X	X
Chipping Sparrow			X
Cliff Swallow	X	X	X
Common Raven	X	X	X
Cooper's Hawk			X
Eurasian Collared-Dove	X		
Gambel's Quail		X	
Great Blue Heron	X	X	X
Great Egret	X		
Great Horned Owl	X		
Great-tailed Grackle	X		X
Hermit Warbler		X	
House Finch	X		X
Indigo Bunting	X		
Killdeer		X	
Ladder-backed Woodpecker	X	X	X
Lesser Goldfinch			X
Lucy's Warbler	X		
MacGillivray's Warbler	X	X	
Mallard			X
Mourning dove	X		X
Northern Harrier		X	X
Northern Rough-winged Swallow			X
Olive-sided Flycatcher		X	
Orange-crowned Warbler		X	
Plumbeous Vireo	X	X	
Red-winged Blackbird	X	X	X
Ruby-crowned Kinglet	X		

<b>Species</b>	<b>PVER 2A</b>	<b>PVER 2B</b>	<b>PVER 3</b>
Summer Tanager*		X	
Swainson's Hawk			X
Tree Swallow	X	X	X
Turkey Vulture	X	X	X
Warbling Vireo	X	X	X
Western-type Flycatcher	X		X
Western Kingbird			X
Western Wood-Pewee			X
White-faced Ibis	X		X
White-tailed Kite			X
White-winged Dove			X
Willow Flycatcher*		X	
Wilson's Warbler	X	X	X
Yellow Warbler*			X
Yellow-headed Blackbird	X	X	X

\* LCR MSCP covered species

**Appendix 4e. Presence of migrants and presumed non-breeders, by species, detected during intensive area searches at the Cibola Mass Planting site in 2010. Fly-overs are included in this list, but incidental birds that were not in or above the plot during the survey are not included. Listed in alphabetical order.**

<b>Species</b>	<b>Presence</b>
Anna's Hummingbird	X
Barn Owl	X
Black-crowned Night-Heron	X
Black-headed Grosbeak	X
Blue Grosbeak	X
Bullock's Oriole	X
Cliff Swallow	X
Common Yellowthroat	X
Gambel's Quail	X
Great Egret	X
Great-tailed Grackle	X
Lesser Nighthawk	X
Northern Harrier	X
Pacific-slope Flycatcher	X
Red-winged Blackbird	X
Swainson's Thrush	X
Townsend's Warbler	X
Tree Swallow	X
Turkey Vulture	X
Warbling Vireo	X
Western-type Flycatcher	X
Western Tanager	X
Wilson's Warbler	X
Yellow-headed Blackbird	X

\* LCR MSCP covered species

**Appendix 4f. Presence of migrants and other non-breeders, by species, detected during rapid area searches at the PVER 2 habitat creation plot in 2010. Fly-overs are included in this list, but incidental birds that were not in or above the plot during the survey are not included. Listed in alphabetical order.**

<u>Species</u>	<u>Presence</u>
Abert's Towhee	X
Bullock's Oriole	X
Song Sparrow	X
Yellow-headed Blackbird	X
Burrowing Owl	X
Yellow Warbler*	X

\*LCR-MSCP covered species

**Appendix 4g. Presence of migrants and other non-breeders, by species, detected during rapid area searches at the CVCA4 habitat creation plot in 2010. Fly-overs are included in this list, but incidental birds that were not in or above the plot during the survey are not included. Listed in alphabetical order.**

<b>Species</b>	<b>Presence</b>
Common Raven	X
Common Yellowthroat	X
Great Egret	X
Great-tailed Grackle	X
Mallard	X
Merlin	X
Song Sparrow	X
Turkey Vulture	X
Verdin	X
White-crowned Sparrow	X
White-faced Ibis	X
Yellow-headed Blackbird	X

**Appendix 5. Comprehensive species list from avian surveys conducted along the lower Colorado River in 2010. \* indicate species that are only present as migrants and are not known to breed in the project area. ^ indicate species that were flying over but not actually using plots.**

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>Melospiza aberti</i>	X	X		X	
American Avocet*	<i>Recurvirostra americana</i>	X				
American Bittern*	<i>Botaurus lentiginosus</i>	X				X
American Coot	<i>Fulica americana</i>	X				
American Goldfinch*	<i>Spinus tristis</i>	X				
American Kestrel	<i>Falco sparverius</i>	X		X	X	X
American Pipit*	<i>Anthus rubescens</i>			X		
American Robin*	<i>Turdus migratorius</i>	X				X
American White Pelican*^	<i>Pelecanus erythrorhynchos</i>					X
Anna's Hummingbird	<i>Calypte anna</i>	X	X		X	X
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>	X	X		X	X
Audubon's Warbler*	<i>Dendroica c. auduboni</i>	X		X		X
Baird's Sandpiper*	<i>Calidris bairdii</i>	X				
Baltimore Oriole*	<i>Icterus galbula</i>					X
Bank Swallow*	<i>Riparia riparia</i>	X		X		X
Barn Owl	<i>Tyto alba</i>				X	X
Barn Swallow*	<i>Hirundo rustica</i>	X		X		X
Bell's Vireo	<i>Vireo bellii</i>	X	X		X	X

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
Belted Kingfisher	<i>Megaceryle alcyon</i>	X				
Bendire's Thrasher	<i>Toxostoma bendirei</i>	X				X
Bewick's Wren	<i>Thryomanes bewickii</i>	X		X		
Black Phoebe	<i>Sayornis nigricans</i>	X				
Black Rail	<i>Laterallus jamaicensis</i>	X				
Black Swift*^	<i>Cypseloides niger</i>	X				
Black-chinned Hummingbird	<i>Archilochus alexandri</i>	X			X	X
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>	X				X
Black-headed Grosbeak*	<i>Pheucticus melanocephalus</i>	X				X
Black-necked Stilt*	<i>Himantopus mexicanus</i>	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
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	X				
Brewer's Blackbird*	<i>Euphagus cyanocephalus</i>	X		X		X
Brewer's Sparrow*	<i>Spizella breweri</i>	X		X		
Broad-tailed Hummingbird*	<i>Selasphorus platycercus</i>					X
Bronzed Cowbird*	<i>Molothrus aeneus</i>	X				
Brown-crested Flycatcher	<i>Myiarchus tyrannulus</i>	X				X
Brown-headed Cowbird	<i>Molothrus ater</i>	X	X		X	X
Bufflehead*^	<i>Bucephala albeola</i>	X				

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
Bullock's Oriole	<i>Icterus bullockii</i>	X		X	X	X
Burrowing Owl	<i>Athene cunicularia</i>	X				
Cactus Wren	<i>Campylorhynchus brunneicapillus</i>	X				
California Gull*^	<i>Larus californicus</i>			X		
Canyon Towhee*	<i>Melospiza fusca</i>			X		
Canyon Wren	<i>Catherpes mexicanus</i>	X				
Caspian Tern*^	<i>Hydroprogne caspia</i>	X				
Cassin's Kingbird*	<i>Tyrannus vociferans</i>	X				X
Cassin's Vireo*	<i>Vireo cassinii</i>	X				X
Cedar Waxwing*	<i>Bombycilla cedrorum</i>	X				X
Chipping Sparrow*	<i>Spizella passerina</i>	X		X		X
Cinnamon Teal*	<i>Anas cyanoptera</i>	X				
Clapper Rail	<i>Rallus longirostris</i>	X				
Clark's Grebe	<i>Aechmophorus clarkii</i>	X				
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	X		X		X
Common Black-Hawk*^	<i>Buteogallus anthracinus</i>	X				
Common Ground-Dove	<i>Columbina passerina</i>	X		X	X	X
Common Moorhen	<i>Gallinula chloropus</i>	X	X			
Common Poorwill	<i>Phalaenoptilus nuttallii</i>			X		
Common Raven	<i>Corvus corax</i>	X		X		X
Common Yellowthroat	<i>Geothlypis trichas</i>	X	X		X	X

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
Cooper's Hawk	<i>Accipiter cooperii</i>			X		X
Cordillaren Flycatcher*						X
Costa's Hummingbird	<i>Calypte costae</i>	X				X
Crissal Thrasher	<i>Toxostoma crissale</i>	X	X		X	X
Double-crested Cormorant^	<i>Phalacrocorax auritus</i>	X		X		X
Dusky Flycatcher*	<i>Empidonax oberholseri</i>	X		X		X
Eared Grebe	<i>Podiceps nigricollis</i>	X				
Empidonax Flycatcher spp.		X		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		X		X
Gambel's Quail	<i>Callipepla gambelii</i>	X	X		X	X
Gila Woodpecker	<i>Melanerpes uropygialis</i>	X		X		
Gilded Flicker	<i>Colaptes chrysoides</i>	X				
Golden-crowned Sparrow*	<i>Zonotrichia atricapilla</i>	X				
Gray Flycatcher*	<i>Empidonax wrightii</i>	X		X		X
Gray Hawk*^	<i>Buteo nitidus</i>					X
Gray Vireo*	<i>Vireo vicinior</i>	X				
Great Blue Heron	<i>Ardea herodias</i>	X		X		X
Great Crested Flycatcher*	<i>Myiarchus crinitus</i>					X
Great Egret	<i>Ardea alba</i>	X		X		X
Great Horned Owl	<i>Bubo virginianus</i>	X				X

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
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
Green-winged Teal*	<i>Anas crecca</i>	X		X		
Hammond's Flycatcher*	<i>Empidonax hammondii</i>	X		X		X
Harris's Hawk*^	<i>Parabuteo unicinctus</i>					X
Hermit Thrush*	<i>Catharus guttatus</i>	X				X
Hermit Warbler*	<i>Dendroica occidentalis</i>	X		X		X
Hooded Oriole*	<i>Icterus cucullatus</i>	X		X		
Horned Lark	<i>Eremophila alpestris</i>	X	X			
House Finch	<i>Carpodacus mexicanus</i>	X		X	X	X
House Sparrow	<i>Passer domesticus</i>	X				
Inca Dove	<i>Columbina inca</i>	X				
Indigo Bunting	<i>Passerina cyanea</i>	X		X	X	X
Killdeer	<i>Charadrius vociferus</i>	X		X		X
Ladder-backed Woodpecker	<i>Picoides scalaris</i>	X	X		X	X
Lark Sparrow*	<i>Chondestes grammacus</i>	X		X		
Lawrence's Goldfinch	<i>Spinus lawrencei</i>	X				
Lazuli Bunting*	<i>Passerina amoena</i>	X		X		X
Lazuli/Indigo Bunting Hybrid						X
Least Bittern	<i>Ixobrychus exilis</i>	X		X		

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
Least Sandpiper*	<i>Calidris minutilla</i>	X		X		
Lesser Goldfinch	<i>Spinus psaltria</i>	X		X	X	X
Lesser Nighthawk	<i>Chordeiles acutipennis</i>	X	X			X
Lesser Scaup*^	<i>Aythya affinis</i>	X				
Lincoln's Sparrow*	<i>Melospiza lincolnii</i>	X				X
Loggerhead Shrike	<i>Lanius ludovicianus</i>	X		X		
Long-billed Curlew*	<i>Numenius americanus</i>	X				
Lucy's Warbler	<i>Oreothlypis luciae</i>	X	X		X	X
MacGillivray's Warbler	<i>Oporornis tolmiei</i>	X		X		X
Mallard	<i>Anas platyrhynchos</i>	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
Myrtle Warbler*	<i>Dendroica c. coronata</i>	X				X
Nashville Warbler*	<i>Oreothlypis ruficapilla</i>	X		X		X
Northern Harrier	<i>Circus cyaneus</i>	X		X	X	X
Northern Mockingbird	<i>Mimus polyglottos</i>	X		X		X
Northern Parula*	<i>Parula americana</i>					X
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	X		X		X
Olive-sided Flycatcher*	<i>Contopus cooperi</i>	X		X		X
Orange-crowned Warbler*	<i>Oreothlypis celata</i>	X		X		X
Osprey	<i>Pandion haliaetus</i>	X		X		X

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
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
Pied-billed Grebe	<i>Podilymbus podiceps</i>	X	X			
Plumbeous Vireo*	<i>Vireo plumbeus</i>					X
Red-tailed Hawk	<i>Buteo jamaicensis</i>			X		
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	X	X		X	X
Ring-billed Gull*^	<i>Larus delawarensis</i>	X				
Rock Pigeon	<i>Columba livia</i>	X				
Rock Wren	<i>Salpinctes obsoletus</i>	X				
Ruby-crowned Kinglet*	<i>Regulus calendula</i>	X		X		X
Ruddy Duck*	<i>Oxyura jamaicensis</i>	X				
Rufous Hummingbird*	<i>Selasphorus rufus</i>	X		X		X
Savannah Sparrow*	<i>Passerculus sandwichensis</i>	X		X		
Say's Phoebe	<i>Sayornis saya</i>	X	X		X	X
Semipalmated Plover*	<i>Charadrius semipalmatus</i>			X		
Sharp-shinned Hawk	<i>Accipiter striatus</i>	X		X		
Snowy Egret	<i>Egretta thula</i>	X		X		X
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 macularius</i>	X	X			

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
Summer Tanager	<i>Piranga rubra</i>	X			X	X
Swainson's Hawk*	<i>Buteo swainsoni</i>					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		X
Turkey Vulture^	<i>Cathartes aura</i>	X		X		X
Vaux's Swift*	<i>Chaetura vauxi</i>	X				X
Verdin	<i>Auriparus flaviceps</i>	X	X		X	
Vermilion Flycatcher	<i>Pyrocephalus rubinus</i>	X				
Violet-green Swallow*	<i>Tachycineta thalassina</i>	X		X		X
Virginia Rail	<i>Rallus limicola</i>	X	X			
Virginia's Warbler*	<i>Oreothlypis virginiae</i>	X				
Warbling Vireo*	<i>Vireo gilvus</i>	X		X		X
Western Flycatcher*	<i>Empidonax difficilis/occid.</i>	X			X	X
Western Grebe	<i>Aechmophorus occidentalis</i>	X				
Western Kingbird*	<i>Tyrannus verticalis</i>	X	X		X	X
Western Meadowlark	<i>Sturnella neglecta</i>	X	X			
Western Sandpiper	<i>Calidris mauri</i>			X		
Western Screech-Owl	<i>Megascops kennicottii</i>	X				
Western Tanager*	<i>Piranga ludoviciana</i>	X		X		X
Western Wood-Pewee*	<i>Contopus sordidulus</i>	X		X		X
White-crowned Sparrow*	<i>Zonotrichia leucophrys</i>	X		X		X

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
White-faced Ibis^	<i>Plegadis chihi</i>	X		X		X
White-tailed Kite	<i>Elanus leucurus</i>	X				X
White-throated Swift	<i>Aeronautes saxatalis</i>	X				X
White-winged Dove	<i>Zenaida asiatica</i>	X	X		X	X
Willet*	<i>Tringa semipalmata</i>					X
Willow Flycatcher	<i>Empidonax traillii</i>	X				X
Wilson's Phalarope*	<i>Phalaropus tricolor</i>			X		
Wilson's Warbler*	<i>Wilsonia pusilla</i>	X		X		X
Yellow Warbler	<i>Dendroica petechia</i>	X		X	X	X
Yellow-billed Cuckoo	<i>Coccyzus americanus</i>	X				
Yellow-breasted Chat	<i>Icteria virens</i>	X		X	X	X
	<i>Xanthocephalus</i>					
Yellow-headed Blackbird	<i>xanthocephalus</i>	X	X			X
Yellow-rumped Warbler*	<i>Dendroica coronata</i>	X		X		X

**Appendix 6: Methods for creating the revised plots layer for 2010. Email correspondence from November 2009.**

17 November 2009

To: Beth Sabin, Amy Leist  
 From: Jon Bart, Leah Dunn  
 Re: Plots for 2010

We have finally finished working on the new plots layer. Here are the results, starting with some comments on the marsh plots.

Eleven plots with at least 30% marsh and no good (tall) or good (low) were surveyed. None of them had any poor habitat. Results of the surveys are shown below (Table 1). It may be seen (lower table) that when there was little Fair habitat, few if any covered birds were present. As the amount of Fair habitat increased above 5%, so did the number of birds present. This suggests that marsh bordering unsuitable habitat has few birds. We could leave such plots assigned to an unsuitable stratum but then surveyors would be traveling all the way to a plot just to survey a tiny unsuitable area. This seems wasteful. We therefore eliminated plots that were largely marsh and unsuitable. Specifically, we eliminated from the study area, plots that were >70% marsh and <5% woody or herbaceous. The number of plots eliminated was 94. The number remaining, once we had selected an assignment rule (see below) was 63. This seemed like too few to form strata so we combined the marsh codes with the other herbaceous codes.

Table 1: Results for surveys of marsh plots

Fair	Unsuit	Marsh	BEVI	GIWO	SUTA	YWAR
0.00	0.00	1.00				
0.00	0.17	0.83				
0.04	0.21	0.75				
0.05	0.12	0.82				
0.09	0.35	0.56				2
0.09	0.27	0.64	1			
0.10	0.33	0.57				
0.13	0.55	0.32				
0.18	0.11	0.71	2			6
0.21	0.30	0.49			1	
0.50	0.06	0.44				4

Fair	Birds	Plots	Birds/plot
<0.051	0	4	0.0
<0.101	3	7	0.4
>0.10	13	4	1.9

We experimented with numerous rules for assigning plots to habitat groups. The goals were to isolate plots with good (tall) habitat, obtain a fairly even distribution of plots across strata, and achieve as much difference in density as possible between strata. The best rule we could find involved calculating the proportions of the plot covered by (1) tall cottonwood-willow (T), (2) other woody plants (W), (3) herbaceous plants (including agriculture and marsh vegetation; H), and (4) unvegetated areas (U). Table 2 lists which habitats were assigned to each category.

Table 2. Assignment of detailed habitats to types

Type	Habitats	
Tall	CW-1	CW-3
CW (T)	CW-2	
Other	CR-0	SC-5
woody	CW-4	SC-6
(W)	CW-5	SH-1
	CW-6	SH-3
	HM-3	SH-4
	HM-4	SH-5
	HM-5	SH-6
	HM-6	SM-3
	SC-1	SM-4
	SC-2	SM-5
	SC-3	SM-6
	SC-4	
Herba-	AG-0	MA-3
ceous	ATX-0	MA-4
(H)	AW-0	MA-5
	MA-1	MA-6
	MA-2	MA-7
Unvege-	BW-0	UD-0
tated		
(U)	NC-0	

The best rule set we could identify involved the following series of steps

1. If  $T > 0.05$  then assign the plot to habitat group 1; otherwise continue to step 2
2. If  $T + W > 0.50$ , then assign the plot to habitat group 2; otherwise continue to step 3
3. If  $H > 0.30$ , then assign the plot to habitat group 3; otherwise continue to step 4
4. If  $U > 0.30$ , then assign the plot to habitat group 4; otherwise continue to step 5
5. Assign the plot to the habitat group with the highest value.

The results of applying this rule set are shown in Table 3. Good separation of densities (for covered species) occurs between the habitats. A less-than ideal result is that 50% of the plots in the new GIS layer are assigned to one stratum (2), however we could not find a way to avoid this while maintaining good separation between densities.

Table 3. Densities and stratum sizes with the rule set above.

Plot type	Surveyed plots			All plots (new GIS layer)			
	Birds	Plots	Bds/plot	N plots	P(plots)	Est'd birds	P(birds)
1-Tall woody	549	73	7.5	260	0.03	1955	0.08
2-Low woody	249	70	3.6	4526	0.51	16100	0.70
3-Herbaceous	104	58	1.8	2804	0.32	5028	0.22
4-Unvegetated	13	36	0.4	0	0.00	0	0.00
Totals	915	237		7590		23083	

The next step was to create a pivot table with regions as rows and habitat groups as columns, and the number of plots in each stratum as the entries. As usual with analyses of this type, some of the resulting strata had just a few plots and were thus unsuitable. We elected to absorb all initial strata with 20 or fewer plots into surrounding regions. Following this procedure, we obtained the numbers of plots shown in Table 4.

Table 4. Stratum sizes for the 2010 plots layer

Region	Habitat group			
	1	2	3	4
1	61	244	30	75
2		183	44	
3		625	93	570
5		586	274	184
6	29	271	126	
7	41	275	178	162
8		224	385	52
9		938	874	31
10		569	200	
11	27	279	143	
12	53	229	315	
13	53	142	169	32

Table 4 may be used to select your plots. Just decide how many plots you want from each stratum and use the attached Excel worksheet to randomly select them. If you want our help on deciding how many plots to survey or on selecting, just let me know.