



Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Final Report on the Lower Colorado River Riparian
Bird Surveys 2011



March 2012



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Abstract

This report summarizes the results of the 2011 field surveys that were completed as part of the Lower Colorado River Multi-Species Conservation Program's (LCR MSCP) Riparian Bird Survey project. The first component of this project was to conduct system-wide monitoring of riparian birds. For this component, we completed rapid area searches on 80 plots selected using a stratified random sampling approach, and completed intensive area searches on a subset of eight of these plots. We also completed rapid area searches on 60 plots within habitat creation sites, and intensive area searches on a subset of four of these plots. The rapid and intensive area search data were then analyzed using a double-sampling approach to generate an estimate for the total number of territories of five LCR MSCP covered species within 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*); and also for the most common, territorial riparian landbird species. We found 188 species within the system-wide project area, with over half being classified as migrants or other non-breeding populations. In habitat creation sites, we detected a total of 128 species. Bell's Vireo and Yellow Warbler were the most abundant of the covered species, with Summer Tanager, Vermilion Flycatcher and Gilded Flicker present in smaller numbers. The second component of this project was to perform a pre-development bird inventory of the Laguna Division Conservation Area (LDCA). We conducted rapid area searches in 35 plots in the LDCA, and intensive area searches on a subset of four of these plots, and used the double-sampling approach to generate population size estimates. Within LDCA plots, 47 breeding species and 67 non-breeding and migrant species were detected. The third component of this project was to test the assumptions of the double-sampling design. For this, we conducted a triple-sampling effort (rapid area search, intensive area search, and enhanced intensive area search) on seven randomly-selected plots. Thirty diurnal landbirds were detected and analyzed during the first year of this effort. Of these, ten species (33%) had triple-sampling detection rates that were within 20% of the detection rates generated by using double-sampling data alone (rapid and intensive area search results only). For the remaining 20 species, the differences between triple-sampling and double-sampling detection rates was greater than 20%. The species that showed the largest discrepancies were those that breed early, often breed multiple times per season, or have poorly defined territorial behaviors. Finally, for the fourth component of this project, we collected standardized habitat monitoring data, including biotic and abiotic variables, which will be used to refine habitat models for the four most abundant LCR MSCP covered bird species in future years.

Introduction

The U.S Bureau of Reclamation (Reclamation) has been conducting bird surveys within the Lower Colorado Region (LCR) since 2002. In 2007, the U.S Geological Service (USGS) designed a bird sampling plan for Reclamation that would produce density and trend estimates for six of the LCR MSCP covered riparian birds and other non-covered birds within the riparian habitat of the LCR MSCP planning area (Bart et al. 2010). USGS developed and implemented a survey design in 2007, and from 2008 to 2010 Great Basin Bird Observatory (GBBO) continued the project. During that time GBBO implemented surveys and refined the field protocols (GBBO 2008, 2009, 2010). GBBO obtained population densities of six of the LCR MSCP birds, the Gila Woodpecker (*Melanerpes uropygialis*), Vermilion Flycatcher (*Pyrocephalus rubinus*), Gilded Flicker (*Colaptes chrysoides*), Arizona Bell's vireo (*Vireo bellii arizonae*), Sonoran yellow warbler (*Dendroica petechia sonorana*), and Summer Tanager (*Piranga rubra*), and other riparian obligate birds from 2007-2010 (GBBO 2008, 2009, 2010). GBBO also conducted preliminary habitat assessments for these six covered LCR MSCP birds (GBBO 2009, 2010). GBBO and USGS produced products from this study including a final sampling design (USGS), a field methodology (GBBO), software programs to analyze the data (USGS with GBBO), Geographic Information System (GIS) tools (USGS), preliminary habitat models and preliminary population estimates (Bart et al. 2010, GBBO 2008, 2009, 2010). The final study design for the LCR Riparian Bird Survey Project "A Sampling Plan for Riparian Birds of the Lower Colorado River" (Bart et al. 2010), along with all annual reports is available on the LCR MSCP website (www.lcrmscp.gov).

GBBO continued riparian bird monitoring in 2011 using the system-wide and habitat creation site sampling plans developed in past years. In 2011 we began work on three additional components of the project which included addressing the effectiveness of the double sampling area search method and a more detailed study of the habitat requirements of LCR MSCP covered species. Specifically, of the four components of this project are the following: component 1 was to obtain population densities of six covered LCR MSCP birds and other non-covered riparian-obligate birds within the LCR MSCP boundaries and on habitat creation areas; component 2 was to obtain bird populations size estimated on pre-development habitat at the Laguna Division Conservation Area; component 3 was to test assumptions of the double sampling method; and component 4 was to define habitat characteristics of six LCR MSCP covered birds through creating species-specific bird models.

The goals of our project are 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.

System-wide monitoring of the LCR MSCP's riparian birds emphasizes six species covered under the program (hereafter: covered species), including Gilded Flicker, Gila

Woodpecker, Vermilion Flycatcher, Arizona Bell's vireo, Sonoran yellow warbler, and Summer Tanager.

The other LCR MSCP covered bird species, including Southwestern Willow Flycatcher (*Empidonax traillii extimus*), Elf Owl (*Micrathene whitneyi*), Western Yellow-billed Cuckoo (*Coccyzus americanus occidentalis*), Black Rail (*Laterallus jamaicensis*), Virginia Rail (*Rallus limicola*) and Yuma Clapper Rail (*Rallus longirostris yumanensis*) are monitored separately using species-specific protocols, and are therefore not covered in this report, except for incidental detections.

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 2011, we were once again granted access to survey the Colorado River Indian Tribes Reservation (CRIT 9 Ahakhav Preserve) habitat creation sites, which were not surveyed in 2010. 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 sampling plan description below is from GBBO (2010). The original sampling plan for system-wide avian surveys can be found in Bart (2010).

Population Estimates of Avian Species within the LCR MSCP Boundaries and on Habitat Creation Sites

Introduction

We conducted area search surveys in the LCR Riparian Bird Survey Project area and habitat conservation areas to obtain population size estimates, trends, and distribution for the six covered bird species (Gila Woodpecker, Gilded Flicker, Vermilion Flycatcher, Summer Tanager, Arizona Bell's vireo, and Sonoran yellow warbler), as well as for non-covered species, with the exception of those listed below, for which only presence/absence data was gathered: White-winged Dove, Mourning Dove, Eurasian Collared Dove, Brown-headed Cowbird, European Starling, Gambel's Quail, Greater Roadrunner, Red-winged Blackbird, Great-tailed Grackle, and House Finch. We generated population estimates using the avian double-sampling survey method developed for the LCR MSCP bird monitoring program in 2007-2010 (Bart and Manning 2008; GBBO 2009; Bart et al. 2010; GBBO 2010).

The rationale and methods for population monitoring based on double-sampling that we used in this project were developed in the first three years of riparian area search monitoring for the LCR MSCP project (Bart and Manning 2008, Bart et al. 2010, GBBO 2010). The double-sampling method requires both rapid and intensive area searches, which are described in more detail in the next section and in GBBO (2010).

Methods

Study Area and Sampling Plan

Our study area spans the mainstem of the lower Colorado River from Separation Canyon (just upstream of Lake Mead) to the Southerly International Boundary, just south of Yuma (Appendix 1a). USGS surveyed the section extending from Separation Canyon to Lake Mead in 2007; however since 2007, because of fluctuating water levels, we have excluded that area from our surveys.

We originally defined potentially-suitable habitat patches as “good/fair/poor” and further as “tall/low” (plus “unsuitable” and “marsh”) 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 so that we could adjust survey-effort distribution in order to optimize survey effectiveness for covered species (Bart et al. 2010). Our 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, we revised the sampling design to create a new plots layer. This new layer largely retaining the original grid delineation of approximately 9-ha plots. We were able to resolve several issues by creating the new plots layer, including achieving a better fit with the MSCP project boundary, addressing more appropriately the amount of non-riparian habitat, and creating plots of optimal size to maximize 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 when we (1) revised names of most habitat categories (so as not to presume suitability for covered species), and (2) joined the original six strata to form just four habitat strata: Tall Woody, Low Woody, Herbaceous, and Unsuitable. We selected habitat strata in an effort 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 to combine all other habitat strata into Unsuitable. In Table 2 we provide the crosswalk from the original Anderson and Ohmart (1976) vegetation types to the habitat strata used for re-stratification in 2010. Further details on habitat strata and plot assignments can be found in Bart et al. (2010).

Table 2. Crosswalk of 2010 habitat strata (also used in 2011) with Anderson and Ohmart (1976), from Bart et al. (2010).

Type	Habitats	
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

Type	Habitats	
Unsuitable (U)	BW-0	UD-0
	NC-0	

Furthermore, the project area was originally divided into 13 geographic regions, 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 2011 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) which we continued to use in 2011.

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

As in 2010, in 2011 we decided to continue combining the Herbaceous and Unsuitable plots into one stratum, 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 during breeding (USBR 2008), and (2) only a small proportion of plots fell into the Herbaceous category, therefore justifying a lumping with another category. In addition, with the changes in the layer in 2010, the number of plots in Region 4 fell to 25 plots. Due to the small number of plots within Region 4, we decided to combine Regions 4 and 5 for our plots selection and statistical analysis (J. Bart, *pers. comm.*).

Plot Selection: System-Wide Surveys Rapid Area Search Plots

For the 2011 system-wide area searches, we randomly selected a total of 80 ~9 ha plots from the 2010 plot delineation covering three habitat strata (Low Woody, Tall Woody, and Herbaceous/Unsuitable) in the eight geographic regions (Table 5, Appendix 1b-p). Region was not used to stratify the random site selection in 2011 because, based on plot selections in previous years, we expected a random selection to provide sufficient coverage across available regions. As in 2010, several regions were purposely excluded from sampling in 2011, 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).

Table 5. List of all regions in the LCR MSCP study area, whether they were included in the 2011 plot selection, and reasons for exclusion.

Region #	Region Name	Included in 2011 Plot Selection?	Reasons for Exclusion
1	Separation Canyon to Lake Mead	No	not accessible
2	Virgin River	No	
3	Lake Mead	No	fluctuating water levels
4	Hoover Dam to Davis Dam	Yes	Added to Region 5 in 2010
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 Tribe Land	No	permits unattainable for system-wide plots in region 9
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

We used a stratified random selection, with strata defined by habitat, to select the 2011 plots. We separated the plots into Excel spreadsheets by the three habitat 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 an initial selection of 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.

If randomly-selected plots were inaccessible we used the same sequential list for alternate plots in the same habitat and region, or closest region with the same habitat type, as alternates. The final number of plots in each region and stratum are slightly different from our original selection (Table 6) because in several cases we needed to use alternate plots. We used alternate plots when the selected plots were farther than 2 km from the nearest road, trail, or waterway, if private landowners denied us access to survey or access the site, if plots were inhabited by squatters, or because they contained wetlands that were inaccessible or otherwise unsafe.

Table 6. Number of system-wide area search plots per region and habitat stratum surveyed in 2011.

Region #	Region Name	Low Woody	Tall Woody	Herbaceous/ Unsuitable	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)	9		3	12
6	Havasu NWR (excluding Bill Williams unit)	4	2	4	10
7	Bill Williams unit of the Havasu NWR	4	11	3	18
8	Bill Williams unit to Cibola excluding the Colorado Reservation	2		2	4
9	Colorado River Indian Reservation Ahakhav Preserve	0	0	0	0
10	Cibola NWR	8	1	1	10
11	Imperial NWR	4	2	2	8
12	Colorado River from the Imperial NWR to Yuma	5	10	3	18
13	Yuma to Southerly International Boundary	0	0	0	0
Total:		36	26	18	80

Habitat Creation Site Plot Selection

Rapid Area Search Plots

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 we analyzed the data, we 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. During the LCR MSCP bird surveys of 2008-2010, all post-development habitat conservation area (= habitat creation site) plots were surveyed using the intensive area search method to obtain a complete baseline inventory, while pre-development plots were covered with rapid area searches (GBBO 2010). An overview map of all habitat creation is provided in Appendix 1b, and plot maps for each of the habitat creation sites are provided in Appendices 1c-h.

Beginning in 2011, we implemented a double-sampling protocol for habitat creation sites to provide monitoring for the increasing size (200-400 acres per year) of habitat creation sites, which necessitated a sampling plan rather than continued complete coverage using intensive surveys. This season, we surveyed all of the habitat conservation area survey plots currently delineated by Reclamation (n = 60) with the rapid area search method. A subset (n = 4) of the 60 plots was then randomly selected for intensive area searches, mirroring the approach of the system-wide sampling.

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 we subdivided the sites into plots that were a reasonable size to be surveyed in one morning (5 – 18 ha). We worked closely with the Reclamation GIS expert to prepare this plots layer in spring 2011, and the results are summarized in Table 7.

Table 7. Habitat creation sites, number of plots, habitat type, and area surveyed using rapid area searches in 2011. Asterisks indicate surveys that only included LCR-MSCP covered species.

Habitat Creation Project	# Survey plots 2011	Low Woody (ha)	Tall Woody (ha)	Total
Beal	4		41.61	41.61
Cibola Farm Unit Area 1 (research and demonstration)	6		44.27	44.27
Cibola Farm Unit Area 5 (Crane Roost)	6	38.75	19.94	58.69
CRIT 9 Ahakhav Preserve*	5		56.68	56.68
CVCA Phase 1	5		38.06	38.06

CVCA Phase 2	3		27.91	27.91
CVCA Phase 3	4		42.42	42.42
CVCA Phase 4	6	61.07		61.07
CVCA Phase 5	2	28.13		28.13
PVER Phase 1	1		8.16	8.16
PVER Phase 2	3		29.43	29.43
PVER Phase 3	3	14.77	17.15	31.91
PVER Phase 4	4	4.05	35.52	39.57
PVER Phase 5	8	84.68		84.68
Total	60	231.45	361.16	592.61

*Project not officially part of the LCR MSCP

Intensive Area Search Plots, System-Wide and Habitat Creation Sites

We surveyed a total of 12 plots with the intensive area search method in 2011, eight of which were randomly selected from the 2011 pool of system-wide plots for rapid area searches, and four of them were randomly selected from the habitat creation site plots (Table 8)

Table 8. Summary of Component 1 plots that were surveyed using the intensive area search method in 2011. Plots listed in numerical order.

Plots surveyed with intensive method 2011	System-wide intensive (n = 8)	Habitat creation site intensive (n = 4)
2119	X	
2424	X	
2549	X	
2861	X	
2878	X	
6529	X	
7960	X	
7992	X	
CRIT 9 Ahakhav Preserve Plot D		X
CVCA Phase 1 Plot C		X
CVCA Phase 1 Plot D		X
Cibola Farm Unit Area 1 Nature Trail Plot B		X

Avian Monitoring Methods

To monitor birds of the lower Colorado River in system-wide and in habitat creation plots, we conducted rapid and intensive area searches. Our goal for the rapid area search effort was to obtain the most accurate possible estimate of breeding territories while optimizing the balance between geographic survey coverage and survey effort. Our goal for 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, we can also use the data to calculate detection ratios and density of breeding birds in the study area. Further information for this approach 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. We counted separately the non-breeding birds, such as known migrants or resident LCR birds using but not breeding in a plot, such as birds that breed outside the plot but foraged in the plot post-breeding, from breeders.

To conduct area searches, we visited the plot bringing an aerial photo that specified GPS coordinates (in NAD 83) of the plot corners (Appendix 2 A - C). We used a combination of a hand-held GPS unit (Garmin Etrex Legend H) and the aerial photo overlaid with a 50 m UTM grid to 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. We passed within at least 50 m of every point within the plot to assure that all sections of the plot were adequately covered. We surveyed one plot per morning and all visits to an individual plot were done by the same surveyor.

We conducted all area searches between 13 April and 17 June, 2011. These 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 we spent for each survey visit depended on difficulty of terrain, vegetation density, and the 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, our goal was to identify and record data on all birds present within the plot on each visit. Over each visit, during both rapid and intensive area searches, we spent enough time observing birds and collecting location and breeding behavior data on the plot to detect as close as possible to 100% of all individual birds present on the plot during that visit. We spent more time mapping birds' locations during intensive surveys than on rapid surveys. During intensive surveys, we worked toward generating a territory map with many individual locations throughout the territory for each breeding pair at the end of the

season, while during rapid surveys, we accurately mapped bird locations to estimate the number of territories based on bird locations and behaviors.

We recorded all bird sightings and territory boundaries 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). We also recorded birds near the edge or just outside the plot on the map in order to prevent double-counting of birds and to assess if those birds were also using the plot. At the end of the season, we classified birds that were on the edge and with partial territories in the by approximating 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).

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.

We marked all observed breeding evidence on the map using a shorthand codes (adapted from Bibby et al. 2000), and our knowledge of breeding status was recorded explicitly on the data sheet (Table 9, Appendix 2 e, g, h). If we observed confirmed breeding evidence on at least one visit, the bird was determined a breeder. If we detected an adult bird of a species known to breed in the area on the same territory in multiple consecutive visits (at least 3 consecutive visits), even if the only breeding evidence we observed was singing, it was generally 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 migrant in the southern sections of 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 non-breeders. Other exceptions included birds that defend territories during stopover migration on the LCR, such as the Yellow Warbler. Yellow Warblers both breed and migrate through the LCR each spring, so special consideration was given to this species when determining breeding status on a plot. Table 9 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 9. Behavioral information collected to determine breeding status during area searches.

Categories	Behavior
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

If we observed a flock, its location was circled on the survey map and number of individuals was recorded on the data sheet. We recorded birds 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). For non-territorial and colonial breeders, species listed in the introduction, we recorded individuals and observed breeding behaviors on the datasheet. Since Pacific-slope Flycatcher and Cordilleran Flycatcher were challenging to distinguish during migration, we grouped these species into a common name, “Western Flycatcher.” At the end of the season we did our best to estimate the number of birds using the plot, but we did not necessarily have an accurate count of breeding pairs.

Rapid Area Searches

In their implementation, rapid and intensive area searches differed primarily in the amount of data that we 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, 2011.

If we found one of the six covered species during a rapid area search, we mapped several locations where the bird/pair/family group was observed during each survey. These locations were digitized into ArcGIS at the end of the season. For all non-covered species, we focused our efforts on getting a complete count, avoiding double-counts, recording breeding evidence (Table 9), and determining the percentage of their territory that was inside the plot. In rapid area searches, we delineated territories of covered species to the best of our ability during the two visits. For some species, we only obtained one or two locations. We automatically classified all species known only as migrants in the project area (e.g., Wilson's Warbler, *Wilsonia pusilla*) as non-breeders. If we found a bird of a species that is known to breed in the project area in the same location and displayed possible, probable, or confirmed breeding behaviors on both visits, we determined it to be a "breeder". In some cases, we could not determine the breeding status of a bird in just two visits, in which case we classified it as a non-breeder. Extensive training of the field surveyors continued throughout the survey season to evaluate bird observations and breeding evidence data to determine breeding status of recorded birds. In addition, detailed reference materials were provided during training to aid in field crews' understanding of breeding bird behaviors.

We have a detailed protocol for transferring data from the field collection format to the final entered raw data. In the field, data is collected on a map with a 50m UTM grid of the plot and the grayscale aerial photography in the background (Appendix 2c). After the survey is complete, within several hours of completion surveyors are required to transfer the coded data from the field map to a paper datasheet (Appendix 2e). On the paper datasheet, each pair of birds has its own row of data, and after transferring the species, age, sex, and number, the surveyor checks boxes for observed breeding evidence. Each time a piece of data is transferred from the field map to the datasheet, it is crossed out in highlighter or colored pencil on the field datasheet: this way the surveyor is sure to get all the data transferred without missing or repeating any data. After all the data has been transferred to the paper datasheet, that datasheet is entered into a Microsoft Excel workbook that looks just like the paper datasheet. At the end of the field season, after the surveyor has completed both rapid surveys on the plot, they use all their knowledge from the surveys, both field and paper datasheets, to summarize how many breeding pairs of each species were using the plot during the season. The surveyor then fills out a rapid summary datasheet (Appendix 2f) and enters the rapid summary data into another Microsoft Excel workbook.

Intensive Area Searches

We conducted intensive area search plots weekly for a total of eight visits to each plot during the breeding season. We delineated all territories for all territorial species (covered and non-covered) to the extent possible, but with our primary focus on covered species and other riparian-obligate birds. Our 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, we 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, we could determine breeding status of individuals 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, we used our 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.

We used the highest-ranking breeding evidence (confirmed, followed by probable, followed by possible) for breeding status that we recorded during each visit (Table 9). At the end of the eight surveys, we determined breeders based on confirmed breeding evidence, if observed during any visit, or based on probable or possible breeding evidence collected during three or more consecutive visits to the same territory. Also at the end of the season, we determined the final locations and layouts of breeding territories within the plot (Appendix 2 J). For this, we combined all maps drafted during intensive area searches into final maps of territories by species using the cumulative data from all visits. In 2011, we entered our final territory maps for covered species (and many non-covered species) into ArcGIS as shape files by species and plot in order to provide a digital format for future comparisons.

We use a similar protocol for transferring data from the intensive field collection format to the final entered raw intensive data. As for the rapid surveys, in the field during intensive surveys, data is collected on a map with a 50m UTM grid of the plot and the grayscale aerial photography in the background. After each of the eight intensive surveys are complete, within several hours of completion surveyors are required to transfer the coded data from the field map to intensive paper datasheets (Appendix 2g and 2h). For intensive surveys, we have one paper datasheet for possible breeders, and another for migrant and fly-over species. As with the rapid surveys, each time a piece of data is transferred from the field map to the datasheet, it is crossed out in highlighter or colored pencil on the field datasheet: this way the surveyor is sure to get all the data transferred without missing or repeating any data. After all the data has been transferred to the paper datasheet, that datasheet is entered into a Microsoft Excel workbook that looks just like the paper datasheet. After each intensive survey, surveyors look over their past field maps to compare the locations of pairs and to use previous knowledge to determine if an individual detected on the current survey was present on past surveys. The same paper datasheet for possible breeders is used throughout the season. At the end of the field season, after the surveyor has completed all eight intensive surveys on the plot, the surveyor uses all their knowledge from the surveys, and both field and paper datasheets, to summarize how many breeding pairs of each species were using the plot during the season. The surveyor then fills out an intensive summary datasheet (Appendix 2i) and enters the intensive summary data into another Microsoft Excel workbook.

All bird data collected during the 2011 field season were entered during and immediately after field work was completed. We then combined each surveyor's excel databases into one excel file sorted by survey type (i.e., all intensive data together). To ensure that the data were entered completely and correctly (quality assurance), GBBO staff checked

100% of all the data immediately after the field season, and then spot-checked 10% of all 2011 records. A total of 1006 records were checked from intensive plots, 1233 records from enhanced-intensive plots (see Component 3, below), and 1192 records from rapid plots. Less than 1% of these records had errors that were corrected.

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, belt transects, and single rapid area searches. In addition, 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).

Population Size Analyses

For all intensive area searches, we summarized the data 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. We only included fly-overs and incidental sightings in summary species lists, and they were excluded from all quantitative analyses in this report. We summarized rapid area search data by breeders (i.e., estimated number of territories) and number of non-breeders (resident non-breeding birds and migrants). Here we report on the specific number of breeding territories in rapid and intensive plots, and a list presence for non-breeding species.

Detection ratios can be calculated using the methods of Thompson (1992), revised by Bart and Earnst (2002). A detailed explanation of the mathematical formulas is provided in Bart (2007). We only included breeders in our calculations of detection ratio and the resulting population size estimate, which were expressed in total number of breeding territories of a species. 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 and habitat creation sites.

For this report, we used 2011 data and the DS program to estimate territory numbers of the covered species and of the ten most abundant species, excluding colonial nesters and other non-territorial species. Since not all regions were surveyed in the system-wide effort (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 LCR MSCP project area.

For population size estimates, we first combined all system-wide and habitat creation site data, including LDCA, for a combined analysis after removing all non-territorial species (Red-winged Blackbird, Brown-headed Cowbird, Mourning Dove, White-winged Dove, Gambel's Quail, European Starling, Great-tailed Grackle, Eurasian Collared Dove, House Finch, and Greater Roadrunner). Although we included shorebirds and waterbirds, and raptors in our report tables, we are not including them in the detection ratio: the only species we are using in the detection ratio are common riparian passerines and our 6 LCR MSCP covered species. The resulting overall detection ratio of 0.87 was then used to calculate overall population size estimates for the species included in this analysis, using the DS program.

In the second analysis, we included only the system-wide survey data in the analysis after removing the same species groups as above (as we did for all population size analyses, as per our contract specifications). In this analysis, we also included all LDCA plots, which were added to the system-wide grid by designating them as a new region in the sampling plan. For the system-wide and LDCA plots, we obtained an overall detection ratio of 0.91.

Finally, in a third analysis we used only data from habitat creation sites, resulting in an overall detection ratio of 0.96 for all habitat creation areas, which was used to calculate population size estimates for habitat creation areas only.

Results

Overall Species Richness Patterns

We detected a total of 188 species of birds in all system-wide and habitat creation site surveys along the lower Colorado River in 2011 (Appendix 5). Of the 188 species, approximately half were species that use the lower Colorado River project area only during migration or wintering (Appendix 5). We detected all of the covered species in at least one site. The highest concentrations of covered species were recorded in the Bill Williams River riparian areas and in the Habitat Creation Sites. We also recorded Clapper Rail, Yellow-billed Cuckoo, and Willow Flycatcher, but since these species are monitored separately from this effort, we do not discuss them in detail in this report. We recorded all 188 species in system-wide surveys, compared with 128 species on habitat creation sites (Appendix 5).

The two rarest covered species were, as in previous years, Vermilion Flycatcher and Gilded Flicker. The only Gilded Flicker we detected on rapid surveys, with breeding evidence, was on plot 6985 at the eastern edge of Lincoln Ranch, on the Bill Williams River. This bird's territory was mostly outside the plot in upland habitat bordering the ranch land and the wilderness area. We found Vermilion Flycatchers breeding throughout the CRIT 9 Ahakhav Preserve habitat creation site (4 pairs) and at plot 7186 at the La Paz County Park on the "Parker Strip" (2 pairs).

System-Wide Surveys

System-Wide Rapid Area Searches

During the 80 system-wide rapid area search plots surveyed in 2011, we recorded 161 species in 2011. Of these, we identified 88 species as breeders (Table 10) and 67 as migrants or non-breeders (Table 11). The number of breeding territories varied widely among species, with the most abundant species being either riparian-associated or generalist species. Approximately half of the breeding birds were of species that were not strictly territorial (and thus excluded from the DS analyses) and some of these species were also the most numerous system-wide, with about 500 pairs of White-winged Dove, 300 pairs of Mourning Dove, 200 pairs of each Great-tailed Grackles and Brown-headed Cowbirds, and between 50-100 pairs of each Yellow-headed and Red-winged Blackbirds, House Finch, and Cliff Swallow. Additional non-territorial species found breeding include Gambel's Quail (~113 pair), Greater Roadrunner (9 pair), Eurasian Collared Dove (7 pair), and European Starling (5 pair). The most common territorial species include Song Sparrow, Common Yellowthroat, and Yellow-breasted Chat (Table 10).

We found the most common breeder of the covered species to be the Sonoran yellow warbler (108.75 territories), followed by Arizona Bell's vireo (54.75 territories), Gila Woodpecker (19.75 territories), Summer Tanager (12 territories) and Vermilion Flycatcher (2 territories). We also detected a Gilded Flicker, with one partial territory (< 25% of territory in the plot). This individual was found in plot 6985 on the private land of Lincoln Ranch in east Bill Williams River, and the territory was located on the riparian edge adjacent to a large tract of upland with large saguaro cactuses, where we recorded Gilded Flicker nesting in past years.

Table 10. Total number of breeding territories, by species that were included in population analyses, in 80 system-wide rapid area search plots in 2011. 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).

Species	Number of Territories
Song Sparrow	407
Common Yellowthroat	332
Yellow-breasted Chat	234.25
Abert's Towhee	184.75
Black-tailed Gnatcatcher	163
Verdin	151.75
Lucy's Warbler	133.95
Marsh Wren	119.5
Sonoran yellow warbler*	108.75
Lesser Nighthawk	74
Bewick's Wren	71
Arizona Bell's vireo*	54.75
American Coot	54.25
Ash-throated Flycatcher	45.75
Phainopepla	43.25
Anna's Hummingbird	42.75
Least Bittern	40
Ladder-backed Woodpecker	38.25
Black-chinned Hummingbird	33.75
Lesser Goldfinch	32.5
Blue Grosbeak	32.25
Virginia Rail	24.5
Crissal Thrasher	24
House Sparrow	21
Killdeer	20.25
Gila Woodpecker*	19.75
Western Kingbird	19.5
Pied-billed Grebe	17.25
Brown-crested Flycatcher	13
Common Moorhen	13
Summer Tanager*	12
Canyon Wren	11.25
Black Rail	9.75

Bullock's Oriole	8.75
Costa's Hummingbird	7.75
Say's Phoebe	7
Yuma Clapper rail	6
Loggerhead Shrike	5.75
Great Blue Heron	5.25
Lazuli Bunting	5.25
Black-necked Stilt	4.5
Common Ground-Dove	4.25
Northern Mockingbird	4.25
Violet-green Swallow	4
White-throated Swift	4
Black Phoebe	3.75
Great Egret	3.5
Horned Lark	3
Mallard	3
Common Raven	2.75
Black-throated Sparrow	2.25
Vermilion Flycatcher*	2
American Kestrel	1.5
Bronzed Cowbird	1.5
Green Heron	1.5
House Wren	1.5
Cactus Wren	1.25
Great Horned Owl	1.25
Blue-gray Gnatcatcher	1
Cooper's Hawk	1
Hooded Oriole	1
Spotted Sandpiper	1
Burrowing Owl	0.5
Rock Wren	0.5
Snowy Egret	0.5
Western Meadowlark	0.5
American Avocet	0.25
American Bittern	0.25
Black-crowned Night-Heron	0.25
Northern Rough-winged Swallow	0.25
Osprey	0.25
Turkey Vulture	0.25

*LCR MSCP covered species 2705.7

Table 11. Species list of all non-breeding birds detected during system-wide rapid area searches in 80 plots in 2011. 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.

Species	Detected on system-wide rapid area searches, 2011
American White Pelican	x^
Bank Swallow	x^
Barn Swallow	x*
Belted Kingfisher	x
Black-bellied Plover	x*
Black-headed Grosbeak	x*
Black-throated Gray Warbler	x*
Brewer's Sparrow	x*
Bushtit	x*
Caspian Tern	x^
Cassin's Vireo	x*
Cedar Waxwing	x*
Chipping Sparrow	x*
Cinnamon Teal	x*
Cordilleran Flycatcher	x*
Double-crested Cormorant	x^
Eared Grebe	x
Gadwall	x
Gilded Flicker*	x
Gray Flycatcher	x*
Green-tailed Towhee	x*
Hammond's Flycatcher	x*
Hermit Thrush	x*
Hermit Warbler	x*
Lark Sparrow	x*
Lawrence's Goldfinch	x
Least Sandpiper	x*
Lincoln's Sparrow	x*
Little Blue Heron	x
Long-billed Curlew	x*

MacGillivray's Warbler	x*
Nashville Warbler	x*
Northern Pintail	x*
Olive-sided Flycatcher	x*
Orange-crowned Warbler	x*
Pacific-slope Flycatcher	x*
Peregrine Falcon	x
Plumbeous Vireo	x*
Prairie Falcon	x^
Red-breasted Nuthatch	x*
Redhead	x*
Red-tailed Hawk	x^
Ring-necked Duck	x
Rock Pigeon	x
Ruby-crowned Kinglet	x*
Ruddy Duck	x*
Rufous-winged Sparrow	x*
Savannah Sparrow	x*
Solitary Sandpiper	x*
Sora	x
Swainson's Hawk	x^
Swainson's Thrush	x*
Townsend's Warbler	x*
Tree Swallow	x*
Vaux's Swift	x^
Warbling Vireo	x*
“Western” Flycatcher	x*
Western Grebe	x*
Western Sandpiper	x*
Western Screech-Owl	x
Western Tanager	x*
Western Wood-Pewee	x*
Whimbrel	x*
White-crowned Sparrow	x*
White-faced Ibis	x*
Willet	x*
Willow Flycatcher*	x
Wilson's Snipe	x
Wilson's Warbler	x*
Yellow-rumped Warbler	x*

*LCR MSCP covered species

System-Wide Intensive Area Searches

During system-wide intensive area searches (n = 8 plots) in 2011, we recorded and mapped 416 breeding territories of 46 species (Table 12). Additionally, we detected non-territorial and colonial species breeding that made up approximately 1/5 of the breeding birds (approximately 100 breeding pairs) including 20-30 pairs each of White-winged Dove, Mourning Dove, Gambel's Quail, and Brown-headed Cowbirds, and several pairs of Yellow-headed and Red-winged Blackbirds, House Finch, Great-tailed Grackle, and Greater Roadrunner. We found breeding evidence for four of the covered species, Sonoran yellow warbler (25.25 territories), Arizona Bell's vireo (6 territories), Gila Woodpecker (2.5 territories), and Summer Tanager (2.5 territories; Table 12). Forty-four additional species that were determined to be migrants or non-breeders were detected on the eight plots throughout the season (Table 13).

Table 12. Total number of breeding territories by species detected during system-wide intensive area searches, 2011. Listed in descending order of abundance. Territorial species only.

Species	Number of Territories
Song Sparrow	72.75
Common Yellowthroat	39.5
Lucy's Warbler	36.25
Abert's Towhee	28.25
Bewick's Wren	26
Sonoran yellow warbler*	25.25
Yellow-breasted Chat	25
Black-tailed Gnatcatcher	21.5
Marsh Wren	17.5
Verdin	15.5
American Coot	12
Least Bittern	8
Anna's Hummingbird	6.75
Crissal Thrasher	6.75
Arizona Bell's vireo*	6
Blue Grosbeak	5.25
Lesser Nighthawk	4.5
Ladder-backed Woodpecker	4.25
Ash-throated Flycatcher	3.25
Black-chinned Hummingbird	3
Common Moorhen	3
House Sparrow	3
Gila Woodpecker*	2.5

Summer Tanager*	2.5
Western Kingbird	2.5
Pied-billed Grebe	2
Brown-crested Flycatcher	1.75
Black Rail	1
Yuma Clapper rail	1
Lesser Goldfinch	1
Sora	1
Virginia Rail	1
Canyon Wren	0.5
Killdeer	0.5
Phainopepla	0.5
Say's Phoebe	0.5
Common Ground-Dove	0.25
<hr/>	<hr/>
Total	391.75

*LCR-MSCP covered species

Table 13. Species list of all non-breeding or migrant species on the intensive system-wide area search plots in 2011 (n=8). 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.

Species	Detected in system-wide intensive area searches, 2011
American Kestrel	x
Black Phoebe	x
Black-headed Grosbeak	x
Black-throated Gray Warbler	x*
Blue-gray Gnatcatcher	x
Bullock's Oriole	x
Cassin's Vireo	x*
Cliff Swallow	x
Common Raven	x
Cooper's Hawk	x
Elf Owl*	x
Eurasian Collared-Dove	x
Gilded Flicker*	x
Gray Flycatcher	x*

Species	Detected in system-wide intensive area searches, 2011
Great Blue Heron	X
Great Egret	X
Great Horned Owl	X
Green-tailed Towhee	X*
Hammond's Flycatcher	X*
Hermit Thrush	X*
Hooded Oriole	X
Indigo Bunting	X
Lazuli Bunting	X
Loggerhead Shrike	X
MacGillivray's Warbler	X*
Nashville Warbler	X*
Northern Mockingbird	X
Northern Rough-winged Swallow	X
Orange-crowned Warbler	X*
Redhead	X*
Red-tailed Hawk	X
Rock Pigeon	X
Ruddy Duck	X*
Swainson's Thrush	X*
Townsend's Warbler	X*
Turkey Vulture	X^
Warbling Vireo	X*
“Western” Flycatcher	X*
Western Tanager	X*
Western Wood-Pewee	X*
White-crowned Sparrow	X*
Willow Flycatcher*	X
Wilson's Warbler	X*
Yellow-rumped Warbler	X*

*LCR-MSCP covered species

Habitat Creation Sites

Rapid Area Searches

During rapid area searches on all habitat creation sites in 2011 (n = 60 plots), we recorded a total of 113 species. We recorded four of the six covered species, including Arizona Bell's vireo, Yellow Warbler, Summer Tanager, and Vermilion Flycatcher, as breeders in habitat creation sites. Gila Woodpecker and Gilded Flickers were not detected in our surveys (see Appendix 5 for a complete list of detected species). Over the course of the field season, we detected 63 species of presumed non-breeders and known migrants in habitat creation plots. Some of the most interesting species we observed included Broad-winged Hawk and Rose-breasted Grosbeak. We also observed several LCR MSCP covered species with no breeding evidence, including Bell's Vireo, Summer Tanager, Yellow Warbler, and Willow Flycatcher. All species of migrants and presumed non-breeders are listed in Table 16.

Beal Lake Riparian Habitat Creation Site

In 2011, we monitored all four Beal Lake plots (overview map in Appendix 1b) with rapid area searches. We detected over 120 breeding territories (Table 14) and 13 non-breeding species at Beal (Appendix 4a). We found Arizona Bell's vireo to be the most abundant breeder of all covered species, with partial territories in Beal A, B, and C. We found Sonoran yellow warbler nesting in Beal B, C, and D, and Summer Tanager territories in Beal A, B, and C (Table 14). As far as non-territorial species, we found Mourning and White-winged doves, Brown-headed Cowbird, and Red-winged Blackbird to be very common breeders at Beal, and Gamble's Quail, Great-tailed Grackles, and Greater Roadrunner were breeding at Beal in small numbers.

Table 14. Number of breeding territories of territorial species detected at Beal Lake during rapid area search plots in 2011. Listed in descending order of abundance.

Species	Number of Territories				Total
	Beal Plot A	Beal Plot B	Beal Plot C	Beal Plot D	
Abert's Towhee	5	8.75	4.5	1.9	20.15
Black-tailed Gnatcatcher	3.5	8	1	6	18.5
Verdin	2.2	5	5	0.5	12.7
*Arizona Bell's vireo	2.5	4.25	5.75		12.5
Lucy's Warbler	3	3.5	3		9.5
Yellow-breasted Chat	0.8	3	4	0.75	8.55
Common Yellowthroat	2	5.5	1		8.5
*Sonoran yellow warbler		1	6	1.25	8.25

Anna's Hummingbird		2	2.5	0.75	5.25
Blue Grosbeak	1	2		0	3
Bullock's Oriole	0.25	1.25	1.25	0.1	2.85
*Summer Tanager	0.2	1	1		2.2
Ash-throated Flycatcher		1.25		0.75	2
Costa's Hummingbird		1		1	2
Crissal Thrasher		1.25	0.5		1.75
Lesser Goldfinch	1.25			0	1.25
Bewick's Wren	1				1
Killdeer		0.5			0.5
Ladder-backed Woodpecker	0.25				0.25
Northern Harrier			0.25	0	0.25
Song Sparrow	0.25				0.25
Belted Kingfisher	0.25				0.25
Total	23.45	49.25	35.75	13	120.95

* LCR MSCP covered species

Colorado River Indian Tribe (CRIT 9 Ahakhav Preserve) Habitat Creation Site

In 2011, we were permitted access to the Ahakhav preserve to re-start surveys on the Colorado River Indian Tribe (CRIT 9 Ahakhav Preserve) habitat creation site (Appendix 1s). Our five rapid area search plots in the CRIT 9 Ahakhav Preserve habitat creation site resulted in 172.25 breeding territories (Tables 15) and 13 species of non-breeders (Appendix 4b). In the rapid area searches, we found one covered species classified as a breeder, Vermilion Flycatcher, with 4 territories throughout the CRIT 9 Ahakhav Preserve site. We detected no other covered species during the CRIT 9 Ahakhav Preserve rapid area searches in 2011. The most common species we found breeding CRIT 9 Ahakhav Preserve were non-territorial species including Mourning and White-winged doves, Brown-headed Cowbird, Gambel's Quail, and House Finch.

Table 15. Number of breeding territories of territorial species detected at Colorado River Indian Tribe Sites (CRIT 9 Ahakhav Preserve) during rapid area search plots in 2011. Listed in descending order of abundance.

Species	Number of Territories					Total
	CRIT 9 Ahakhav Preserve Plot A	CRIT 9 Ahakhav Preserve Plot B	CRIT 9 Ahakhav Preserve Plot C	CRIT 9 Ahakhav Preserve Plot D	CRIT 9 Ahakhav Preserve Plot E	

Abert's Towhee	1	1	4.5	3	2.5	12
Anna's Hummingbird	0.5		3.5	1.5	2	7.5
Lesser Goldfinch	1	2	2	1.5	0.5	7
Bullock's Oriole	0.5	1	2	1	1	5.5
Ladder-backed Woodpecker		0.25	1.5	1	1	3.75
Vermilion Flycatcher*	1	1	1.5	0.15		3.65
Western Kingbird	1		0.75	0.5	1	3.25
Black-chinned Hummingbird	0.25		1		0.5	1.75
Black-tailed Gnatcatcher			1	0.5		1.5
Verdin		1		0.25		1.25
Blue Grosbeak					1	1
House Wren			1			1
Ash-throated Flycatcher				0.5		0.5
Barn Owl			0.5			0.5
Total	5.25-	6.25-	21.75	12.4	11.5-	60.15

*LCR-MSCP covered species

Palo Verde Ecological Reserve (PVER)

In rapid area search plots at the Palo Verde Ecological Reserve (PVER) Phases 1-5, we detected 159 breeding territories (Table 16) and 80 species of migrants and other non-breeders (Appendix 1e, Appendix 4d). We found Sonoran yellow warblers breeding in planting phases 1, 2, and 4. No other covered species were found breeding, nor were detected, at PVER this year. The PVER sites had, again, a Northern Harrier nest that was active in 2008, 2009, and 2010 and was also active in 2011, with both parents vigorously defending the nest on the second visit to the site. Non-territorial species were common at this site including Mourning and White-winged doves, Brown-headed Cowbird, Gambel's Quail, and House Finch. A Greater Roadrunner also had a partial territory at PVER.

Table 16. Number of breeding territories of territorial species detected at Palo Verde Ecological Reserve (PVER) during rapid area search plots in 2011. Listed in descending order of abundance.

Species	Number of Territories					Total PVER
	PVER Phase 1	PVER Phase 2	PVER Phase 3	PVER Phase 4	PVER Phase 5	
Common Yellowthroat	4	8.25	9	9.75	19.5	50.5
Blue Grosbeak	1.25	7.25	3.25	11.5	5.25	28.5
Song Sparrow	9.5	6	0	5.75	0	21.25
Abert's Towhee	9	7	1.25	1.5	0.5	19.25
Sonoran yellow warbler*	5	1	0	2	0	8
Western Kingbird	0	2	1.25	2.75	1.75	7.75
Black-chinned Hummingbird	0	2.5	3	0	0	5.5
Bullock's Oriole	1	3	1	0.5	0	5.5
Anna's Hummingbird	1	0.75	1	0	0	2.75
Barn Owl	0	1.5	0	0	0	1.5
Lucy's Warbler	0	0	0	1.5	0	1.5
Verdin	0	0	0	0	1.25	1.25
Bewick's Wren	0	0	0	1	0	1
Lazuli Bunting	1	0	0	0	0	1
Loggerhead Shrike	0	0	0	1	0	1
Great Horned Owl	0.25	0	0	0.25	0	0.5
Northern Harrier	0	0	0.25	0	0.25	0.5
Ash-throated Flycatcher	0	0	0.25	0	0	0.25
Cooper's Hawk	0	0.25	0	0	0	0.25
Hooded Oriole	0	0	0	0.25	0	0.25
Red-tailed Hawk	0	0	0.25	0	0	0.25
White-tailed Kite	0	0	0	0	0.25	0.25
Yellow-breasted Chat	0	0	0.25	0	0	0.25
Total	32	39.5	20.75	37.75	29	159

* LCR MSCP covered species

Cibola Valley Conservation Area (CVCA)

At 20 plots at Cibola Valley Conservation Area (CVCA, Appendix 1u) we documented 229 breeding territories (Table 17) and a total of 79 species of migrants and other non-breeders (Appendix 4b) during rapid area searches in 2011. We found that Sonoran yellow warblers were the most common covered species breeding at CVCA, and we found Summer Tanagers breeding in CVCA Phase 1. The most abundant breeding

species in CVCA were non-territorial species including Mourning and White-winged doves, Brown-headed Cowbird, House Finch, Red-winged Blackbird, and Gambel's Quail. Other non-territorial species including Eurasian Collared-Dove, European Starling, Greater Roadrunner, and Great-tailed Grackle were also found breeding on CVCA in small numbers.

Table 17. Number of breeding territories of territorial species detected in Cibola Valley Conservation Area (CVCA) during rapid area search plots in 2011. Listed in descending order of abundance.

Species	Number of Territories					Total CVCA
	CVCA Phase 1	CVCA Phase 2	CVCA Phase 3	CVCA Phase 4	CVCA Phase 5	
Abert's Towhee	14	7.5	6	8.75	6.75	43
Sonoran yellow warbler*	3.75	2	0	0	0	5.75
Blue Grosbeak	14	6	4.75	3.25	6.5	34.5
Song Sparrow	4	9	0	0	1	14
Western Kingbird	0.5	1	5.5	2.25	2.25	11.5
Bullock's Oriole	5.25	2.5	2.25	0.75	0	10.75
Common Yellowthroat	0	2	0	8	0	10
Northern Harrier	0	0	0	0	5	5
Lucy's Warbler	0	0	0	0	4	4
Black-chinned Hummingbird	2.5	1	0	0.25	0	3.75
Black-tailed Gnatcatcher	0	0	0.25	3.5	0	3.75
Ladder-backed Woodpecker	2	0.5	1	0	0	3.5
Lazuli Bunting	0	0	0	0	3	3
Summer Tanager*	2.5	0	0	0	0	2.5
Common Raven	0	0	0	0	2	2
Indigo Bunting	1.25	0	0	0.75	0	2
Great Horned Owl	1	0.5	0.25	0	0	1.75
Anna's Hummingbird	1.5	0	0	0	0	1.5
Common Ground-Dove	0	0	0	0.5	1	1.5
Lesser Goldfinch	0.75	0	0	0.75	0	1.5
Ash-throated Flycatcher	0.5	0	0.25	0.25	0	1
Crissal Thrasher	0.25	0	0	0.75	0	1
Verdin	0.25	0	0.5	0	0	0.75
Killdeer	0	0	0	0.5	0	0.5
Hooded Oriole	0	0	0	0.25	0	0.25
Loggerhead Shrike	0	0	0	0	0.25	0.25

Northern Mockingbird	0.25	0	0	0	0	0.25
Red-tailed Hawk	0.25	0	0	0	0	0.25
Total	55.75	33	21.25	46.25	72.75	229

* LCR MSCP covered species

Cibola Farm Unit 1 Site

In the rapid area search plots at the Cibola Farm Unit 1 site (Appendix 1v), we documented 102 breeding territories (Tables 18) and a total of 47 species of migrants and other non-breeders (Appendix 4e). Sonoran yellow warblers had territories in both Nature Trail plots. Arizona Bell's vireos were found breeding on the south end of the Nature Trail. We also detected individuals of Bell's Vireos, Yellow Warblers, and Willow Flycatchers without sufficient breeding evidence in other parts of Unit 1, which were thus classified as non-breeders. The most common species breeding at the Nature Trail site were territorial species including Mourning and White-winged doves, Brown-headed Cowbird, and Red-winged Blackbird. We also found several other non-territorial species breeding in smaller numbers including House Finch and European Starlings. All results from the surveys are presented in Table 18 and Appendix 4c.

Table 18. Number of breeding territories of territorial species detected in Cibola Farm Unit 1 during rapid area search plots in 2011. Listed in descending order of abundance.

Species	Number of Territories			Total
	Nature Trail North Plot A	Nature Trail South Plot B	Cibola Farm Unit 1 plots A, B, C, and D	
Abert's Towhee	3	7.5	5.75	16.25
Western Kingbird	5	3.5	6.5	15
Common Yellowthroat		1.5	11	12.5
Bullock's Oriole	4	4.5	2.5	11
Blue Grosbeak	2	2.75	4.25	9
Anna's Hummingbird	1	4.5	2	7.5
Sonoran yellow warbler*	4.5	2.25		6.75
Verdin	3	1		4
Yellow-breasted Chat	1	2.5		3.5
Lucy's Warbler	3			3
Arizona Bell's vireo*		2		2
Black-chinned	1	1		2

Hummingbird				
Black-tailed Gnatcatcher	1	1		2
Ladder-backed Woodpecker				
Lesser Goldfinch	1	0.5		1.5
Ash-throated Flycatcher		1	0.5	1.5
Gambel's Quail	1	0.25		1.25
Song Sparrow		1		1
Killdeer			1	1
Say's Phoebe		0.25		0.25
Total	31.5	37.5	33.5	102.5

* LCR MSCP covered species

Cibola Farm Unit 5: Crane Roost

In 2011, we surveyed the Cibola Farm Unit 5, the Crane Roost site at Cibola NWR, for the first time (Appendix 1w). During our rapid surveys at the site, divided into six survey plots, we recorded 42 territories of breeding species (Table 19) and 19 species of migrants and other non-breeders (Appendix 4f). We found no covered species breeding at the site, but we found several other riparian-obligate species breeding including Abert's Towhee, Song Sparrow, and Yellow-breasted Chat. We also observed that several cavity nesters had partial territories including Lucy's Warbler, Ladder-backed Woodpecker, and Ash-throated Flycatcher. These species were observed foraging in the Crane Roost site, but it is likely that their nests were in relic trees around the perimeter of the plots (Table 19).

The most common species breeding at Unit 5 included Mourning Dove (7 pairs), White-winged Dove (16 pairs), Brown-headed Cowbirds (80 pairs), and Red-winged Blackbird (colony of ~160 pairs), all of which were excluded from the population size estimates due to poorly defined territory boundaries in these species. We also found other non-territorial species including Great-tailed Grackles, Gambel's Quail, and Greater Roadrunner breeding at Crane Roost in small numbers.

Table 19. Number of breeding territories of territorial species detected in Cibola Farm Unit 5: Crane Roost during rapid area search plots in 2011. Listed in descending order of abundance.

Species	Number of Territories						Total
	Plot A	Plot B	Plot C	Plot D	Plot E	Plot F	
Blue Grosbeak	2.5	1.5	1	2.5	1	1	9.5
Song Sparrow	5.5			4			9.5
Abert's Towhee	2.25			0.75	1.5	0.75	5.25
Yellow-breasted Chat	2					1	3
Common Yellowthroat	1			1			2
Lucy's Warbler				2			2
Ladder-backed Woodpecker	1			0.5			1.5
Loggerhead Shrike		0.5		0.5	0.5		1.5
Ash-throated Flycatcher	0.25		0.25	0.25	0.5		1.25
Black-tailed Gnatcatcher				1			1
Bullock's Oriole	1						1
Verdin	1						1
Western Kingbird	0.5	0.25			0.25		1
Bewick's Wren	0.5						0.5
Black-chinned Hummingbird				0.5			0.5
Lesser Goldfinch		0.25			0.25		0.5
Barn Owl	0.25						0.25
Crissal Thrasher					0.25		0.25
Great Horned Owl				0.25			0.25
Hooded Oriole					0.25		0.25
Killdeer				0.25			0.25
Total	17.75	2.5	1.25	13.5	4.5	2.75	42.25

*LCR MSCP covered species

Intensive Area Searches

During intensive area searches on four habitat creation site plots, we detected 74 bird species including 24 breeding birds with 204.25 territories, and 43 non-breeders and migrants. We found three covered species breeding in these plots: Sonoran yellow warbler at CVCA Phase 1 Plot D and the Nature Trail South, Arizona Bell's vireo at the Nature Trail South, and Vermilion Flycatcher at CRIT 9 Ahakhav Preserve Plot D.

Approximately 60% of the breeding birds on these plots were non-territorial species not included in our population size estimates, including White-winged and Mourning Doves, Brown-headed Cowbird, Red-winged Blackbird, Gambel's Quail, and House Finch (~140 pair total). Of the territorial species included in our estimates, Abert's Towhee was the most common, followed by Anna's Hummingbird, Blue Grosbeak, and Bullock's Oriole. We found Blue Grosbeak and Ladder-backed Woodpecker using at least part of three of the four plots for breeding.

Table 20. Total number of breeding territories by species detected during intensive area searches at a subset of 4 habitat creation sites, 2011. Listed in descending order of abundance. Territorial species only.

Species	CRIT 9 Ahakhav Preserve	CVCA Phase 1 Plot C	CVCA Phase 1 Plot D	Nature Trail South Plot B	Total
Abert's Towhee	6.75	1	2	4.5	14.25
Anna's Hummingbird	1.5			4.25	5.75
Blue Grosbeak		2	1	0.75	3.75
Bullock's Oriole	1	0.75	0.25	1.75	3.75
Western Kingbird	0.75			3	3.75
Black-chinned Hummingbird	2			1.5	3.5
Verdin				3.25	3.25
Black-tailed Gnatcatcher				3	3
Sonoran yellow warbler*			1.75	1	2.75
Ladder-backed Woodpecker	1.25	0.25		0.25	1.75
Vermilion Flycatcher*	1.5				1.5
Ash-throated Flycatcher	0.5			0.75	1.25
Arizona Bell's vireo*				1	1
Common Yellowthroat				1	1
Lesser Goldfinch	1				1
Lucy's Warbler				1	1
Yellow-breasted Chat				1	1
Lawrence's Goldfinch				0.75	0.75
Total	16.25	4	5	28.75	54

*LCR-MSCP covered species

Table 21. Migrants and non-breeding species detected during intensive area searches at a subset of 4 habitat creation sites, 2011. 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. Listed in alphabetical order.

Species	CRIT 9 Ahakhav Preserve Plot D	CVCA Phase 1 Plot C	CVCA Phase 1 Plot D	Nature Trail South Plot B
Bank Swallow				X
Barn Owl			X^	
Bewick's Wren				X
Black Phoebe				X
Black-headed Grosbeak			X*	X*
Black-throated Gray Warbler			X*	
Chipping Sparrow				X*
Cliff Swallow				X
Common Raven	X			
Dusky Flycatcher	X*	X*		X*
Great Egret				X
Greater Roadrunner	X			
Great-tailed Grackle	X			X
Hermit Warbler	X*		X*	
Hooded Oriole				X
Killdeer				X
MacGillivray's Warbler				X*
Nashville Warbler	X*	X*	X*	X*
Northern Mockingbird	X			
Olive-sided Flycatcher	X*	X*		
Orange-crowned Warbler				X*
Pacific-slope Flycatcher	X*	X*	X*	X*
Phainopepla				X
Northern Rough-winged Swallow				X
Say's Phoebe				X
Song Sparrow		X		
Summer Tanager*		X	X	
Swainson's Thrush				X*
Townsend's Warbler	X*			
Tree Swallow	X*			X
Turkey Vulture			X^	X^

Vaux's Swift				X [^]
Violet-green Swallow				X*
Virginia's Warbler	X*			
Warbling Vireo	X*	X*	X*	
Western Tanager	X*	X*		X*
Western Wood-Pewee	X*	X*	X*	X*
White-crowned Sparrow	X*			X*
White-tailed Kite				X
Willow Flycatcher*				X
Wilson's Warbler	X*	X*	X*	X*
Yellow-billed Cuckoo*		X		
Yellow-rumped Warbler	X*			X*

*LCR-MSCP covered species

Overall Population Size Estimates

We analyzed all population data from this project several different ways, including data from the randomly-selected system-wide plots and data from all (non-random) habitat creation sites together, including LDCA. For all of these data sets combined, the overall detection ratio was 0.87. When broken out by system-wide (including LDCA plots) and Habitat Creation plots, we obtained overall detection ratios of 0.91 and 0.96 respectively for riparian territorial species. Since the detection rates were better with the separate analyses, and the population size estimates were similar either way, we will report results using the two analyses, system-wide and habitat creation, below.

System-Wide Population Size Estimates

Using the DS program on system-wide random plots and LDCA plots combined, we obtained an overall detection ratio of 0.91 for riparian territorial species. With this detection ratio, the 2011 system-wide minimum population size estimates for LCR MSCP covered species (not including habitat creation sites) resulted in almost 1,900 Arizona Bell's vireo territories, more than 1,000 Sonoran yellow warbler territories, more than 400 Gila Woodpecker territories, more than 200 Summer Tanager territories, and more than 500 Vermilion Flycatcher territories (Table 25).

As in past survey years in 2011, we found that the Arizona Bell's vireo had the highest estimated population size system-wide of all covered species, occurring in five of the 22 habitat-region combinations surveyed. We recorded Yellow Warbler as the second most abundant of the covered species, occurring in eight habitat-region combinations. We determined that Vermilion Flycatchers were occurring in the lowest number of combinations (1), compared with Summer Tanager (5) and Gila Woodpecker (7). Our

surveys showed that Region 7 (Bill Williams River NWR) had the largest number of covered species of all regions, followed by Region 11 (Imperial NWR; Table 26).

Table 22. Estimated number of territories of covered species, by region-habitat combinations, based on system-wide surveys and Laguna Division Conservation Area data completed in 2011. 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 2011.

Region. Habitat	Arizona Bell's vireo	Sonoran yellow warbler	Gila Woodpecker	Summer Tanager	Vermilion Flycatcher	Gilded Flicker
5.1	-	-	-	-	-	-
5.2	0	0	0	0	0	0
5.3	0	0	0	0	0	0
5.4	0	0	0	0	0	0
6.1	0	13	0	5	0	0
6.2	0	0	0	0	0	0
6.3	0	189	0	0	0	0
6.4	-	-	-	-	-	-
7.1	73	198	25	20	0	1
7.2	1165	633	101	76	0	0
7.3	-	-	-	-	-	-
7.4	265	0	38	38	0	0
8.1	-	-	-	-	-	-
8.2	0	0	0	0	0	0
8.3	-	-	-	-	-	-
8.4	0	0	203	0	542	0
10.1	0	1	0	0	0	0
10.2	0	0	0	0	0	0
10.3	-	-	-	-	-	-
10.4	0	0	0	0	0	0
11.1	0	2	0	0	0	0
11.2	342	17	17	68	0	0
11.3	0	0	0	0	0	0
11.4	0	0	0	0	0	0
12.1	8	3	9	0	0	0
12.2	0	0	0	0	0	0
12.3	0	0	15	0	0	0
12.4	0	0	0	0	0	0
Total	1853	1056	409	208	542	1

For the ten most abundant riparian species detected system-wide in 2011, 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 11,000 territories estimated to be present, followed by Black-tailed Gnatcatcher, Verdin, Lucy's Warbler and Yellow-breasted Chat (Table 26). Red-winged Blackbird, White-winged and Mourning doves, European Starling, Gambel's Quail, and Brown-headed Cowbird may have been even more numerous (as they often were, see results above); however, we did not include them in our analysis due to their clustered distributions or relative lack of territoriality, which confounds our methods of population size estimation. We determined that the ten most abundant species were relatively widespread throughout the project area, with detections in most region-habitat combinations.

Table 23. Estimated number of breeding pairs of ten of the most abundant species breeding along the lower Colorado River, by region-habitat combination, based on system-wide surveys and Laguna Division Conservation Area surveys completed in 2011. For details on strata definitions, see methods. Dashes indicate that no plots were surveyed in that Region. Habitat combination during 2011.

Region.Habitat	Common Yellowthroat	Abert's Towhee	Black-tailed Gnatcatcher	Verdin	Lucy's Warbler	Song Sparrow	Yellow-breasted Chat	Lesser Nighthawk	Marsh Wren	Phainopepla
5.1	-	-	-	-	-	-	-	-	-	-
5.2	93	2410	2055	990	2593	0	75	149	0	75
5.3	75	29	34	0	0	67	0	0	34	0
5.4	0	929	929	825	413	0	0	413	0	206
6.1	29	19	40	13	1	12	5	0	0	0
6.2	72	484	556	0	646	0	72	287	18	0
6.3	388	5	38	0	9	397	132	5	737	0
6.4	-	-	-	-	-	-	-	-	-	-
7.1	173	81	17	30	126	547	336	2	2	27
7.2	835	506	633	177	1392	1646	1494	0	0	2329
7.3	-	-	-	-	-	-	-	-	-	-
7.4	76	378	227	341	189	568	0	0	0	0
8.1	-	-	-	-	-	-	-	-	-	-
8.2	1045	1175	1567	1480	0	261	0	348	0	0
8.3	-	-	-	-	-	-	-	-	-	-

8.4	0	813	0	271	813	0	0	136	0	0
10.1	3	1	1	1	1	1	3	0	1	0
10.2	486	1134	720	342	738	270	288	810	234	522
10.3	-	-	-	-	-	-	-	-	-	-
10.4	0	0	0	0	0	0	0	0	0	0
11.1	86	12	9	2	0	89	26	0	12	0
11.2	2016	683	1042	735	137	1162	1196	683	478	0
11.3	459	0	51	51	0	102	51	0	51	0
11.4	480	315	60	270	30	360	510	180	180	0
12.1	103	47	54	106	3	61	20	35	18	0
12.2	251	404	711	697	0	28	0	892	251	0
12.3	377	91	75	45	0	15	0	15	513	0
12.4	4804	1544	1716	1716	0	686	686	686	1373	0
Total	11,852	11,061	10,535	8093	7092	6272	4895	4642	3903	3159

Habitat Creation Site Population Size Estimates

Based on DS analyses including only data from habitat creation site plots, we determined an overall detection ratio of 0.96. Of the four covered species detected in habitat creation sites, Sonoran yellow warbler was the most abundant with an estimated 62 territories (Table 27), in contrast with results from system-wide surveys, where Arizona Bell's vireo was the most abundant covered species. We found that the three most common riparian breeding species on the habitat creation sites were Abert's Towhee, Blue Grosbeak, and Common Yellowthroat with more than 80 territories each (Table 28).

Table 24. Estimated number of breeding pairs of covered species breeding in habitat creation sites along the lower Colorado River, by site, based on double-sampling surveys completed in 2011. For details on habitat strata definitions, see methods.

Region	Habitat	Sonoran yellow warbler	Arizona Bell's vireo	Summer Tanager	Vermilion Flycatcher
BEAL	1	8.56	12.97	2.28	0
BEAL	2	-	-	-	-
CRIT 9 Ahakhav Preserve	1	0	0	0	3.79
CRIT 9 Ahakhav Preserve	2	-	-	-	-
PVER	1	8.3	0	0	0
PVER	2	0	0	0	0
CVCA	1	5.97	0	2.59	0
CVCA	2	32.18	0	0	0
CIBOLA UNIT 1	1	7.01	2.08	0	0
CIBOLA UNIT 1	2	-	-	-	-
Total		62.02	15.05	4.88	3.79

Table 25. Estimated number of breeding pairs of the most common riparian species breeding in habitat creation sites along the lower Colorado River, by habitat type, based on double-sampling surveys completed in 2011. For details on habitat strata definitions, see methods.

Region	Habitat	Abert's Towhee	Blue Grosbeak	Common Yellowthroat	Sonoran yellow warbler*	Song Sparrow	Western Kingbird	Bullock's Oriole	Black-tailed Gnatcatcher	Anna's Hummingbird	Verdin
BEAL	1	20.91	3.11	8.82	8.56	0.26	0	2.96	19.2	5.45	13.18
BEAL	2	-	-	-	-	-	-	-	-	-	-
CRIT 9 Ahakhav Preserve	1	12.46	1.04	0	0	0	3.37	5.71	1.56	7.78	1.3
CRIT 9 Ahakhav Preserve	2	-	-	-	-	-	-	-	-	-	-
PVER	1	17.9	21.28	28.8	8.3	22.06	4.93	5.45	0	2.85	0
PVER	2	2.08	8.3	23.61	0	0	3.11	0.26	0	0	1.3
CVCA	1	28.54	25.69	2.08	5.97	13.49	7.27	10.38	0.26	1.56	0.78
CVCA	2	16.09	10.12	8.3	32.18	1.04	4.67	1.04	3.63	0	0
CIBOLA UNIT 1	1	19.98	14.53	15.05	7.01	10.9	16.09	12.45	3.12	7.79	5.19
CIBOLA UNIT 1	2	2.34	4.67	0	0	0	0.52	0	0	0	0
Total		120.3	88.74	86.67	62.02	47.74	39.96	38.25	27.76	25.43	21.74

Discussion

Species Richness Patterns

Upon review of the species lists and other survey results, Arizona Bell's vireo, Sonoran 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. We found that two types of sites continue to be hotspots for covered species, (1) the Bill Williams River region, and (2) the habitat creation sites. While the habitat creation sites may not feature many species of old-growth riparian gallery forest, such as Gila Woodpecker and Gilded Flicker, we found that they are attracting some species, such as the Summer Tanager and Ladder-

backed Woodpecker, that can be associated with the desired mid-successional habitats (Appendix 5; see also Results).

System-Wide Surveys

Our population size estimates for several LCR MSCP-covered species were overall slightly lower in 2011 than in previous years (GBBO 2010), which may be due to the random plot selection representing a lower proportion of covered species, or to annual variation in migration arrival times, reproductive schedule, or population variation. Upon review of 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 very least, we can conclude that large (> 5-10 ha) patches of Tall Woody are rare along the main stem of the river, which explain the relative rarity of “old-growth” bird species such as Summer Tanager and Gilded Flicker. Species such as Arizona Bell’s vireo and Sonoran 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. Together, our findings suggest that big benefits can be achieved for covered species, if the proportion of Tall Woody areas can be increased through habitat creation.

Our system-wide surveys showed that the lower Colorado River corridor was occupied by a large variety of both breeding birds and migrants. Our protocols tend to err on the side of classifying a bird as a presumed non-breeder, if insufficient evidence of nesting was found during the surveys, so the estimates of territory numbers need to be viewed as minimum breeding population size estimates. Reflecting both the wide variety of habitat types and habitat quality present system-wide, we found the overall abundance to be greatest in both generalist species, such as Mourning and White-winged doves, Brown-headed Cowbird, and Great-tailed Grackle, all of which were excluded from our population size estimates due to their relative lack of territorial behavior, and in riparian specialists, such as Abert’s Towhee, Yellow-breasted Chat, Song Sparrow, and Common Yellowthroat. The system-wide distribution of all covered species indicates that even the fairly common ones, Arizona Bell’s Vireo and Sonoran Yellow Warbler, were clearly more abundant in some region-habitat combinations than in others. Generally, the more geographically connected and widespread subpopulations become, the more local and regional stability is found in bird populations based on general metapopulation dynamics.

One reason that our surveys resulted in only one Gilded Flicker record is likely because this species is truly very rare in the system and, where it occurs, it often breeds just outside of the riparian corridor. We found that individuals and family groups use the riparian habitat in the winter or for foraging during the breeding season. Because this is a very rare species, we recommend that survey techniques to increase detection rates be

explored, such as call playback or species-specific opportunistic discovery surveys along the entire project area.

Post-fire surveys would also be interesting to pursue in 2012 or thereafter. The PRATT habitat creation site (which we have not monitored) was surveyed by USBR in 2002-2005, and again after 2005 by the BLM (B. Sabin, *pers. comm.*). We also have data from 2008 and 2009 on several plots that were partially, or completely, burned just south of the Laguna Dam in 2011. Finally there was a large fire at the Island Unit of Cibola NWR in later summer, 2011. Returning to plots we have surveyed in previous years in that area could be interesting. Impact size of fires in riparian areas on the birds that were breeding in these sites could be estimated with post-fire surveys.

Habitat Creation Sites

This was the first year that we implemented the double-sampling protocol at the habitat creation sites on the LCR. Based on the large amount of habitat created as of spring 2011 (60 plots at 6 sites), coverage of all areas with rapid area searches became more feasible than covering all sites with intensive area searches, and the survey coverage will need to continue to increase in the future as more habitat is being created.

Similar to our findings in 2008, 2009, and 2010 (GBBO 2010), the habitat creation sites that were older than two years supported breeding populations of four of the six covered species, including Bell's Vireo, Yellow Warbler, Vermilion Flycatcher and Summer Tanager. We also surveyed the CRIT 9 Ahakhav Preserve habitat creation sites in 2011 and updated information particularly about Vermilion Flycatchers there. Gila Woodpecker and Gilded Flicker were not detected in habitat creation sites, most likely because the sites are still too young to produce sufficient numbers of trees that are large enough for woodpecker cavities or enough decadent vegetation with snags. We believe that continued monitoring of the habitat creation sites will be particularly useful to determine whether or not populations of riparian bird species associated with old-growth forests can be restored, specifically given how uncommon Tall Woody vegetation is in the current landscape of the lower Colorado River.

In 2011, several old-growth associated species had at least partial territories in the habitat creation plots. We found Ladder-backed Woodpecker partial territories at all the habitat creation sites, except PVER, in 2011. We found numerous Ash-throated Flycatcher pairs using habitat creation sites as part of their territories, although we found no nests in our rapid surveys. Other cavity nesters also have begun to set up breeding territories in habitat creation sites, including a partial territory of an American Kestrel pair at the Cibola Farm Unit 1. American Kestrels currently use nest boxes along the road near the site, but they forage in the habitat creation site. We also found Lucy's Warblers using many of the habitat creation sites, including Beal, Crane Roost, CVCA, Nature Trail, and PVER. Overall, we found an increase in partial and complete territories of cavity nesters in habitat creation sites, suggesting that the sites are continually becoming more suitable for cavity-nesters.

At the habitat creation sites, we also found some of the expected raptor species of the region (Short-eared Owl, White-tailed Kite, and Northern Harrier), which mostly occurred in the lower scrubby habitat classified as Low Woody. We recorded Great Horned Owl, Barn Owl, Cooper 's Hawk, and Red-tailed Hawk setting up territories in Tall Woody Habitat in the habitat creation sites.

In 2012 we will be collecting tree/shrub phenology data on a volunteer basis for the project; because we believe that much of the bird breeding and migration timing and activity is a result of tree and shrub phenology. As part of the contracted work, we are already collecting valuable data on the migrants using the Colorado River system as a flyway and stopover location. Research has shown that Neotropical migrants use visual cues to choose locations where they are likely to find food and shelter during stopovers. Vegetative phenology, including leaf out, flowering and fruiting, may be a cue migrants use to predict food availability i.e. insects. We will also explore options for additional data analyses that may lead to peer-reviewed publications on the project.

Pre-Development Monitoring at Laguna Division Conservation Area

Introduction

Our goal for pre-development monitoring at Laguna Division Conservation Area was to conduct rapid and intensive area searches to create a pre-development baseline inventory for the Laguna Division Conservation Area (LDCA), using the same survey techniques and analysis approaches as used for system-wide and conservation area surveys. The LDCA includes 800 acres of land with marsh, low woody, tall woody and open sand covers. The pre-development population estimates generated by our surveys can in future years be compared to post-development inventory data from the LDCA. This component therefore addresses the need for before-after-control-impact data to evaluate the bird responses to future habitat creation activities.

Methods

For LDCA survey coverage, we used the same double-sampling area search method described in the above section, including the same methods for rapid and intensive area searches, plot selection, data management, and data analysis.

Plot selection

We used the same 2010 plots layer as described in the first component for our LDCA sampling unit. Before plots could be randomly selected for surveys, we first had to determine the boundary of the LDCA in ArcGIS. Within ArcGIS we then used the “clip” tool to clip the 2010 plots layer to the LDCA project area boundary. From this newly created layer, we determined that there are 57 plots within the LDCA boundary, some of which are completely inside, and others partially on the edge of the boundary. We discussed with Reclamation Biologists how to proceed and decided that if a plot was at least 50% within the boundary, or if it contained habitat that we wanted to survey, we would include that plot in the random selection for the double sampling. The 57 plots at LDCA were classified as either “Low Woody” or “Unsuitable” according to the original classification scheme for system-wide sampling (Bart et al. 2009).

Table 26. Total number of plots at the Laguna Division Conservation Area, from the plots layer of 2010, by habitat type.

Habitat	# plots	Hectares
Low Woody	51	497.639
Unsuitable	6	54
Total	57	551.639

We selected 35 plots for rapid area searches using random selection. Of the 35 plots, 32 were classified as “Low Woody” and 3 were classified as “Unsuitable” (Table 30). We were unable to survey 3 of the initially selected plots because of significant difficulties in access. These plots were replaced with three new randomly selected plots from the same habitat types. Other plots presented significant logistical challenges, but were included in the sampling. The final plot selection for 2011 is illustrated in Figure 1.

Table 27. Number and area of plots selected, by habitat type, at the Laguna Division Conservation Area for surveys in 2011 (from the plots later 2010, clipped to the Laguna Division Habitat Conservation project area).

Habitat	# plots	Hectares
Low Woody	32	311.564
Unsuitable	3	27
Total	35	338.564

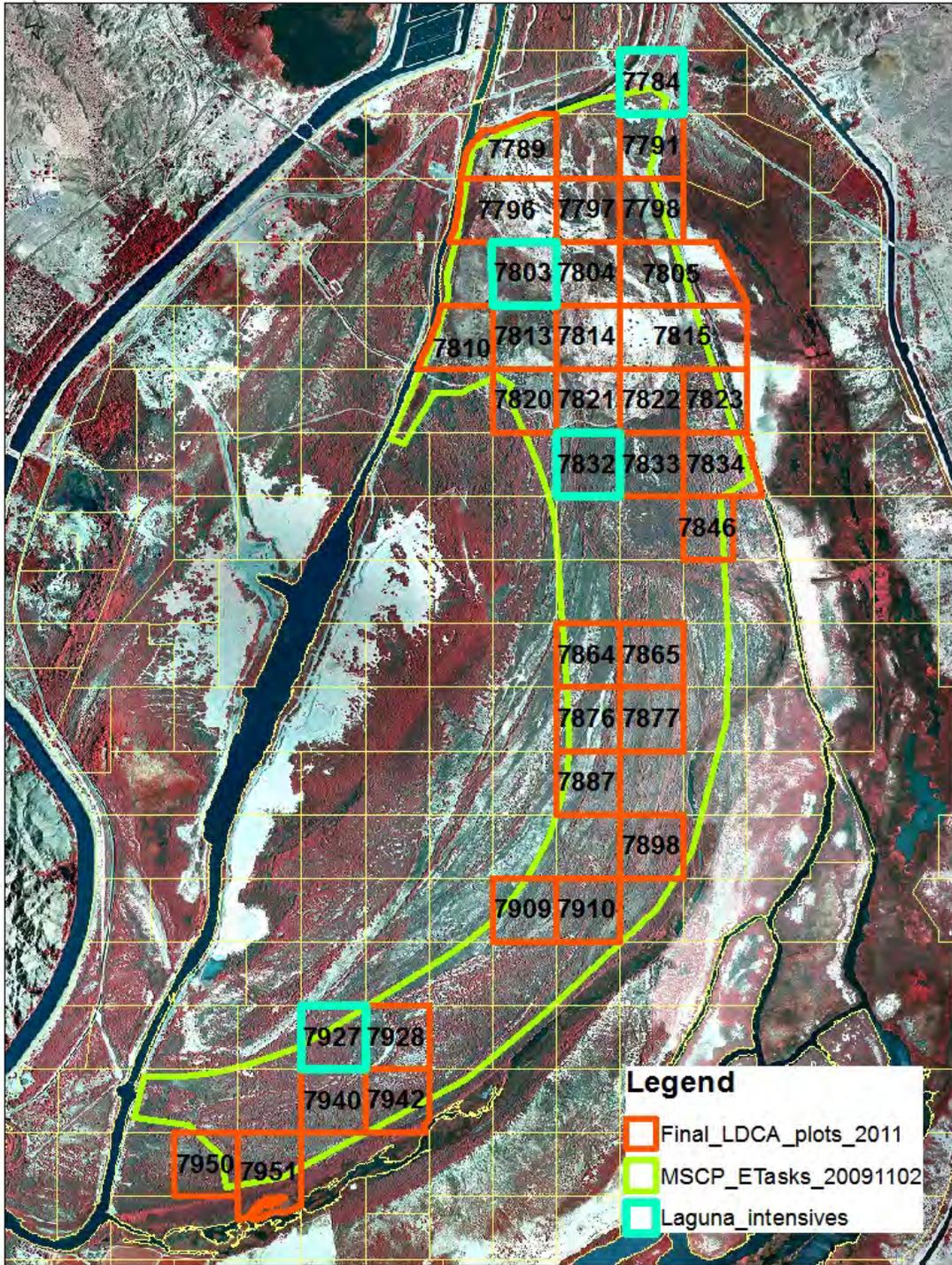


Figure 1. Map of the Laguna Division Conservation Area surveyed plots (n = 35) in 2011. The four light-blue plots are the randomly selected intensive plots. The green polygon is the MSCP Project area for the Laguna Division Conservation Area.

Survey Methods

From the 35 rapid area search plots, we randomly selected four plots for our intensive area searches. All survey methods used for rapid and intensive area searches, including timing, replication, observer independence, data collection, data management, and data analyses were identical to the methods used above.

Results

Overall Species Richness Patterns

A total of 114 species of birds were detected in all surveys on all surveys conducted in the LDCA in 2011 (Appendix 5). Of the 114 species, almost half were classified as breeders ($n = 47$) and the remaining were non-breeders and migrants ($n = 67$). Of the covered species, we only detected Arizona Bell's vireos breeding within the LDCA. We also detected Gila Woodpecker and Yellow Warbler using the sites, but we found no evidence of breeding for these species. Gilded Flicker, Vermilion Flycatcher, and Summer Tanager were not detected during any surveys. Other species of note that we detected using the site included Black Rail, Willow Flycatcher, and Common Ground-Dove (which are rarely found breeding on the LCR although they are common in the winter).

Rapid Area Searches

During two rapid area search visits of the 35 LDCA plots in 2011, we recorded 89 species. Of these, we identified 45 species as breeders (Table 31) and 44 as migrants or non-breeders (Table 32). The number of breeding territories varied widely among species, with the most abundant species being either riparian-obligate (Yellow-breasted Chat, Song Sparrow, Marsh Wren) or more generalist species (Mourning Dove, White-winged Dove, Verdin, Abert's Towhee; Table 31).

We found that the most common species breeding at LDCA were White-winged Dove (~175 pairs), Mourning Dove (~107 pairs), Gambel's Quail (~35 pair), Greater Roadrunner (.5 pair), and Brown-headed Cowbird (~90 males), which were all excluded from Table 31, because they display unclear territory boundaries. The most common territorial breeding birds we documented included Black-tailed Gnatcatcher, Common Yellowthroat, Abert's Towhee, and Verdin (Table 31). We also found small numbers of other non-territorial species including the Great-tailed Grackle, House Finch, European Starling, Eurasian Collared-Dove, and Red-winged Blackbird breeding at LDCA.

Table 28. Total number of breeding territories in 35 LDCA rapid area search plots in 2011. 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).

Species	# Territories
Black-tailed Gnatcatcher	74
Common Yellowthroat	59.5
Abert's Towhee	58.5
Verdin	57.5
Lesser Nighthawk	53.25
Cliff Swallow	50
Yellow-breasted Chat	29.25
Song Sparrow	23.75
Marsh Wren	22.75
Ash-throated Flycatcher	19.5
Blue Grosbeak	15.75
Crissal Thrasher	14.5
Lucy's Warbler	13.75
Ladder-backed Woodpecker	9.1
American Coot	7
Black-chinned Hummingbird	6.5
Anna's Hummingbird	6
Pied-billed Grebe	2.5
Bewick's Wren	2
Virginia Rail	2
Blue-gray Gnatcatcher	1.75
Indigo Bunting	1.75
Killdeer	1.5
Black-necked Stilt	1
Yuma Clapper rail	1
Common Ground-Dove	1
Phainopepla	1
Say's Phoebe	1
Western Kingbird	1
Black Phoebe	0.75
Bullock's Oriole	0.5
Green Heron	0.5
Loggerhead Shrike	0.5
*Arizona Bell's vireo	0.25
*Black Rail	0.25

Species	# Territories
----------------	--------------------------

*LCR MSCP covered species

Table 29. Species list of all species classified as non-breeders in LDCA rapid area search plots in 2011. 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.

Species	Detected during rapid area searches
Bank Swallow	x
Barn Swallow	x
Black-headed Grosbeak	x*
Brewer's Sparrow	x*
Chipping Sparrow	x*
Costa's Hummingbird	x
Double-crested Cormorant	x^
Gadwall	x
*Gila Woodpecker	x
Gray Flycatcher	x*
Great Blue Heron	x
Great Egret	x
Hermit Warbler	x*
Lazuli Bunting	x
Lesser Goldfinch	x
MacGillivray's Warbler	x*
Mallard	x
Nashville Warbler	x*
Northern Mockingbird	x
Northern Rough-winged Swallow	x
Olive-sided Flycatcher	x*
Orange-crowned Warbler	x*
Osprey	x^
Scott's Oriole	x
Short-billed Dowitcher	x*
Snowy Egret	x
Spotted Sandpiper	x
Townsend's Warbler	x*

Species	Detected during rapid area searches
Tree Swallow	x
Turkey Vulture	x
Violet-green Swallow	x*
Virginia's Warbler	x*
Warbling Vireo	x*
“Western” Flycatcher	x*
Western Tanager	x*
Western Wood-Pewee	x*
White-crowned Sparrow	x*
White-faced Ibis	x^
Willow Flycatcher	x
Wilson's Warbler	x*
*Yellow Warbler	x
Yellow-headed Blackbird	x
Yellow-rumped Warbler	x*

*LCR MSCP covered species

Intensive Area Searches

During intensive area searches of four LDCA plots in 2011, we recorded and mapped 405.75 breeding territories of 26 species (Table 33). We found no evidence of covered species breeding in these plots. Of the 406 breeding territories we recorded, over half (n = 250) were from Cliff Swallows breeding under a bridge in one intensive plot. The other most common breeders we documented were species excluded from our population analyses, including White-winged Dove (20 pairs), Mourning Doves (16 pairs), and Brown-headed Cowbird (16 pairs). We also found that several riparian species were relatively common breeders in the four plots, including Song Sparrow, Common Yellowthroat, Verdin, and Abert's Towhee. We also recorded Gila Woodpecker and Yellow Warbler using the plots, but we found no breeding evidence for these species. We had no detections of Gilded Flicker, Vermilion Flycatcher, Bell's Vireo, or Summer Tanager in any of the intensive surveys (Table 34).

Table 30. Total number of breeding territories by species detected during intensive area searches of the LDCA, 2011. Listed in descending order of abundance.

Species	Number of Territories
Lesser Nighthawk	15
Song Sparrow	13.75
Common Yellowthroat	11.5

Species	Number of Territories
Verdin	11
Abert's Towhee	9.75
Black-tailed Gnatcatcher	9.25
Black-chinned Hummingbird	4.5
Gambel's Quail	4
Blue Grosbeak	3.75
Yellow-breasted Chat	3.25
American Coot	3
Marsh Wren	3
Anna's Hummingbird	1.5
Ladder-backed Woodpecker	1.5
Common Moorhen	1
Crissal Thrasher	1
Ash-throated Flycatcher	0.75
Black Phoebe	0.75
Killdeer	0.75
Loggerhead Shrike	0.5
Black-necked Stilt	0.25

Table 31. Species list of all non-breeding birds in LDCA intensive area search plots in 2011. 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.

Species	Detected during intensive area searches
American Avocet	x
American Kestrel	x
Barn Swallow	x
Bewick's Wren	x
Black-headed Grosbeak	x*
Black-throated Gray Warbler	x*
Bullock's Oriole	x
Chipping Sparrow	x*
Cinnamon Teal	x
Common Goldeneye	x*
Cooper's Hawk	x
Eurasian Collared-Dove	x

Species	Detected during intensive area searches
*Gila Woodpecker	x
Great Horned Owl	x
Greater Roadrunner	x
Great-tailed Grackle	x
Green Heron	x
Green-tailed Towhee	x*
Green-winged Teal	x*
Hermit Thrush	x*
Hermit Warbler	x*
Indigo Bunting	x
Lazuli Bunting	x
Least Bittern	x
Least Sandpiper	x*
Lesser Goldfinch	x
Lincoln's Sparrow	x*
Long-billed Dowitcher	x*
Lucy's Warbler	x
MacGillivray's Warbler	x*
Nashville Warbler	x*
Northern Mockingbird	x
Northern Rough-winged Swallow	x
Olive-sided Flycatcher	x*
Orange-crowned Warbler	x*
Osprey	x
Phainopepla	x
Pied-billed Grebe	x
Ruby-crowned Kinglet	x*
Savannah Sparrow	x*
Say's Phoebe	x
Short-billed Dowitcher	x*
Snowy Egret	x
Spotted Sandpiper	x
Swainson's Thrush	x*
Townsend's Warbler	x*
Turkey Vulture	x^
Vaux's Swift	x^
Virginia Rail	x
Warbling Vireo	x*
“Western” Flycatcher	x*

Species	Detected during intensive area searches
Western Kingbird	x
Western Tanager	x*
Western Wood-Pewee	x*
White-crowned Sparrow	x*
White-faced Ibis	x^
Willow Flycatcher	x
Wilson's Warbler	x*
*Yellow Warbler	x
Yellow-headed Blackbird	x
Yellow-rumped Warbler	x*

*LCR MSCP covered species

Laguna Division Conservation Area Population Size Estimates

As with all DS results, results from the DS analysis for Laguna Division Conservation Area (LDCA) should be considered minimum population size estimates for breeding species. As the abundance data above already indicated, the species with the largest breeding populations at LDCA were Black-tailed Gnatcatcher, Common Yellowthroat, Abert's Towhee, and Verdin (Table 35). Many of the species that were most common at LDCA were also among the most common species system-wide (see Results of Component 1). Arizona Bell's vireo was the only covered species for which population size estimate could be calculated for LDCA (Table 35), with less than one territory in Low Woody plots.

Table 32. Estimated number of territories of all species, by region-habitat combinations, based on LDCA surveys completed in 2011. 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 2011.

Species	Population Size Estimates				Total LDCA
	Tall Woody	Low Woody	Herbaceous	Unsuitable	
Black-tailed Gnatcatcher	-	125.9	-	5.5	131.4
Common Yellowthroat	-	104.8	-	0	104.8
Abert's Towhee	-	100.4	-	3.3	103.7
Verdin	-	97.7	-	4.4	102.2
Lesser Nighthawk	-	88.9	-	6.1	95.0
Cliff Swallow	-	88.1	-	0	88.1

Population Size Estimates

Species	Tall Woody	Low Woody	Herbaceous	Unsuitable	Total LDCA
Yellow-breasted Chat	-	51.5	-	0	51.5
Song Sparrow	-	41.8	-	0	41.8
Marsh Wren	-	40.1	-	0	40.1
Ash-throated Flycatcher	-	32.1	-	2.8	34.9
Blue Grosbeak	-	23.3	-	5.5	28.8
Crissal Thrasher	-	24.7	-	1.1	25.8
Lucy's Warbler	-	24.2	-	0	24.2
Ladder-backed Woodpecker	-	16.0	-	0	16.0
American Coot	-	12.3	-	0	12.3
Black-chinned Hummingbird	-	11.4	-	0	11.4
Anna's Hummingbird	-	10.6	-	0	10.6
Pied-billed Grebe	-	4.4	-	0	4.4
Blue-gray Gnatcatcher	-	1.3	-	2.2	3.5
Bewick's Wren	-	3.5	-	0	3.5
Virginia Rail	-	3.5	-	0	3.5
Indigo Bunting	-	3.1	-	0	3.1
Killdeer	-	2.6	-	0	2.6
Black-necked Stilt	-	1.8	-	0	1.8
Yuma Clapper rail	-	1.8	-	0	1.8
Common Ground-Dove	-	1.8	-	0	1.8
Phainopepla	-	1.8	-	0	1.8
Say's Phoebe	-	1.8	-	0	1.8
Black Phoebe	-	1.3	-	0	1.3
Bullock's Oriole	-	0.9	-	0	0.9
Loggerhead Shrike	-	0.9	-	0	0.9
*Arizona Bell's vireo	-	0.4	-	0	0.4
*Black Rail	-	0.4	-	0	0.4

*LCR MSCP covered species

Discussion

We found a surprising number of breeding and non-breeding birds during the pre-development monitoring of the LDCA. The most productive areas for birds included the marsh on the eastern edge of the site, as well as several small wet areas with legacy Fremont cottonwood and Gooding's willow trees and snags in the center of the site. Part of the marsh was outside the LDCA, but several plots included some of this habitat. During the surveys, we observed many birds leaving the LDCA to forage in the adjoining

marsh. Small marshes (up to 50 m x 50 m) of cattails and bulrush that we did not detect in the pre-season review of aerial photography were also found on site in some low spots. These likely attracted both local breeders and migrating birds for foraging in the insect-rich marsh fragments.

Toward the end of the survey season, a wildfire occurred in the riparian areas that burned into the plots and in areas adjacent to the LDCA. Although the majority of the fire was outside of the LDCA, it affected the surveys. In addition to having to interrupt the surveys briefly for a period of days, we also observed after the fire that some birds appeared to have been displaced into unburned parts of the site, which likely affected the number of adult birds in the southern LDCA plots.

The species richness of breeding birds was fairly high in the LDCA (see comparison with system-wide richness). We found several riparian-obligate species breeding in small marshes within the site as well as in more extensive marshes on the eastern edge, including species such as Common Yellowthroat, Yellow-breasted Chat, Song Sparrow, and Marsh Wren. Also associated with marsh habitat were species such as American Coot, Pied-billed Grebe, Virginia Rail, Yuma Clapper rail, and Black Rail, all of which were classified as breeders in the site. In areas with decadent Goodding's willow, honey mesquite, and tamarisk trees, we found cavity-nesting birds such as Ladder-backed Woodpecker, Lucy's Warbler, and Ash-throated Flycatcher, all of which were classified as breeders in the site. Bullock's Orioles, a species associated with large riparian trees, were also found in areas with old relic trees. These relic habitat features appear important in sustaining several of the riparian species we detected, and future habitat creation activities may focus on increasing these habitat elements.

Testing the Assumptions of the Double Sampling Method

Introduction

The double-sampling area search method that was developed for LCR MSCP riparian bird surveys (Bart et al. 2010; GBBO 2010b; see also Component 1) is based on three important assumptions:

- Random selection of intensive area search plots from the random set of rapid area search plots
- Uniformity in the implementation of rapid and intensive area searches
- Unbiased estimates of bird numbers during intensive area searches

There is no reason to doubt that the first two assumptions of random sampling and uniform sampling implementation are met in the current implementation of the LCR MSCP monitoring plan. The goal was therefore to test the third assumption of unbiased estimation during intensive surveys. Factors that could bias the estimates, or may differentially affect detection probability during intensive area searches, include (see also Farnsworth et al. 2005):

- Secretive species that are difficult to detect
- Density of vegetation
- Density of birds

We tested the assumption that intensive area searches generate unbiased estimates by performing a third, even more intensive survey effort on a set of plots in order to quantify what, if anything is missed by our standard intensive area searches. For the purpose of this project, we refer to this approach as a “triple-sampling” or “enhanced intensive” method.

In 2011, we selected a set of triple-sampling plots that we surveyed with three different types of area searches within the field season: 1) the standard rapid area search, 2) the standard intensive area search, and 3) an enhanced intensive (EI) area search, which is described in more detail below. In brief, the EI area search allowed us significantly more time to devote to delineating territories and detecting more secretive individuals than is possible during our standard intensive area search. For each plot, we conducted these three types of area searches by using three independent surveyors, with stringent controls established to ensure that no communication occurred between surveyors regarding their respective findings during the field season. After three years of data collection and by comparing the results of the three types of searches across multiple plots that exhibit variation in vegetation and population density, we will provide a quantitative estimate of

the potential bias associated with our intensive and rapid area search methods as well as determine the bias associated with each species.

We also gathered data for other riparian-obligate bird species, aside from data for the four more common covered species, Gila Woodpecker, Summer Tanager, Arizona Bell's vireo, and Yellow Warbler. We have found that Gilded Flickers and Vermilion Flycatchers are present on very few, if any LCR MSCP plots in a given year therefore we may not have enough data to include these two species in our final analysis.

The three-year goals for this component include the following:

- Evaluate the assumption that unbiased estimates are being obtained during intensive area searches.
- Estimate the average error rate being made during intensive area search surveys and determine if differences in error rate exist between species or habitats
- Suggest improvements to the intensive area search survey methods to achieve higher accuracy, if any are needed.

After three years of data collection, the following outputs can be generated:

- A quantitative assessment of the assumption that intensive area searches generate unbiased estimates
- A detection probability for standard intensive area searches for the four more common covered species, possibly for the two rarer covered species, and for additional riparian-obligate species
- Detailed suggestions to improve the double-sampling area search protocol to achieve greater accuracy
- Details on breeding phenology, territory use, and seasonal behaviors of high-priority species that will be valuable in refining riparian bird monitoring methods for the LCR MSCP project area, with regional applications

In this report, we conduct a preliminary data analysis using the 2011 data from rapid, intensive, and enhanced-intensive surveys to estimate any biases based on the first year of surveys.

Methods

Plot Selection

To select our triple-sampling plots, we created a new stratum in ArcGIS. Of the eight selected plots, two were part of Component 1 and the other six were selected as part of Component 3 only. In the end, only seven of the eight randomly-selected plots could be completed during the 2011 season due to unforeseen circumstances, and the eighth plot will be added to the 2012 EI sampling effort. The new GIS-based “EI layer” was based on the knowledge GBBO has acquired in the past three years of work on the LCR MSCP Riparian Bird Survey Project regarding the actual distributions, areas of concentration, and habitat requirements of the covered species. This triple-sampling (EI) layer is comprised of some of the most difficult habitats to survey on the river that are composed of mostly tall woody vegetation and dense understory. Because the covered species are concentrated in these habitat types, the EI layer by no means represents the landscapes of much of the current lower Colorado River corridor.

After creating the new EI layer, we first examined the eight plots already selected for intensive area searches as part of the system-wide monitoring effort in Component 1. If these plots were located in the new EI layer, they were automatically included in the triple-sampling effort. This was done to ensure that some random coverage of the entire LCR MSCP study area is associated with the Component 3 effort. Once we assigned two of the system-wide intensive plots to triple sampling, additional plots for the triple sampling effort were randomly selected from the new EI layer to reach a total of eight plots. Because the selection of triple sampling plots is not fully random for the system-wide sampling area, we did not use these plots for system-wide population size estimates and did not analyze them using the DS program. We only used them for testing the assumption of the double-sampling effort that unbiased counts can be achieved in standard intensive area searches. Appendices 6 and 7 present summaries of all plots selected for each of the three components.

Survey Techniques

The triple-sampling plots received rapid, standard intensive, and enhanced intensive (EI) area searches, using independent observers for each method. Each of our surveyors conducted at least rapid and intensive surveys during the season, and some surveyors conducted all three survey types. We mixed up the surveyors and the survey types in this way to reduce our observer bias. Our methods for this component were largely the same as described in Component 1, except the EI area searches (see below). For a given plot,

the rapid, intensive, and EI observers were not allowed to communicate their findings for the entire course of the field season. No plot received more than one type of area search on a given day (i.e. there was never more than one surveyor on the plot per day). The surveys were scheduled as regularly as possible given the constraints of our field season: rapid surveys occurred once in the first month of the season and again in the second month, intensive surveys were approximately once a week for 8 weeks, and EI surveys were approximately twice a week for 8 weeks.

For the EI area searches, we delineated every territory within a plot with the highest level of precision possible. The surveyor visited the plot a minimum of 16 times during the season, and on each visit recorded one or multiple bird locations of all observed individuals. These extra days also allowed the surveyor to range outside the plot boundary for better delineation, focus on particular birds or species that are more difficult to delineate (such as Gila Woodpeckers and Summer Tanagers), map multiple singing perches, and make any other adjustments needed to ensure that all territories of birds that are fully or partially located within the plot were as completely delineated as possible. As with other area searches, we were limited by the amount of time that birds were active on a given day (mornings until it got very hot). In particularly difficult plots, surveyors therefore often spent most of one survey day on half of the plot for the most thorough data collection, and then switched to the other half on the next survey day.

Data Analysis

All EI data were recorded using our standardized intensive area search data sheets (but clearly labeled for the triple-sampling effort), and using the same data recording techniques and standards described in Component 1. We processed the data in a task-specific triple-sampling Excel datasheet and Access database that allows for additional data fields besides those needed for other bird monitoring efforts. We then compared the EI data to the standard intensive area search data collected on the same plots to calculate species-specific estimates of the error rates associated with standard intensive area searches. We calculated the ratio of the average number of territories determined by the intensive surveyor compared to the average number of territories determined by the extra intensive surveyor at the end of the season. The goal of these analyses was to determine whether the additional visits during EI surveys resulted in a different estimate of absolute breeding densities.

Results

The results of the triple sampling effort varied notably by species. Several species showed relatively low error rates (75-100%) when comparing the EI area searches to the standard intensive area searches, including the common riparian species Common Yellowthroat, Yellow-breasted Chat, Black-tailed Gnatcatcher, Bullock's Oriole, Song Sparrow, and Gila and Ladder-backed woodpeckers, and the covered species Yellow Warbler, Arizona Bell's vireo and Gila Woodpecker. Other species, such as the Crissal Thrasher and Summer Tanager, had low detection rates (< 50%) when comparing the two

methods. Several flycatcher species, on the other hand, were overestimated in the standard intensive surveys (132-163%, Table 36).

These percentages are the ratio of the average number of territories determined by the intensive surveyor at the end of the season compared to the average number of territories determined at the end of the season by the extra intensive. If the percentage is 100%, that means that the intensive and extra intensive surveyors calculated the same number of breeding pairs of that species in the EI plots in 2011. If the percentage is less than 100%, then the intensive surveyor missed some of the territories that the extra intensive surveyor detected. If the percentage is greater than 100%, then the extra intensive surveyor missed some of the territories that the intensive surveyor detected.

Table 33. Ratio of the average number of territories determined by the intensive surveyor compared to the average number of territories determined by the enhanced intensive surveyor at the end of the season, 2011 (n = 7 plots).

Species	Percentage of territories detected during standard intensive surveys from territories detected in EI surveys
Least Bittern*	20
Marsh Wren	33
Pied-billed Grebe	40
Crissal Thrasher	47
Summer Tanager*	48
Lawrence's Goldfinch	50
Lesser Goldfinch	54
Black Rail*	57
Lesser Nighthawk	67
Verdin	68
Lucy's Warbler	72
Abert's Towhee	73
Common Yellowthroat	75
Ladder-backed Woodpecker	75
Gila Woodpecker*	75
Yellow-breasted Chat	76
Sonoran yellow warbler*	78
American Coot	80
Arizona Bell's vireo*	85
Black-chinned Hummingbird	89
Black-tailed Gnatcatcher	89

Bullock's Oriole	91
Song Sparrow	98
Black Phoebe	100
Great Horned Owl	100
Virginia Rail	100
Western Kingbird	106
Blue Grosbeak	117
Canyon Wren	120
Bewick's Wren	123
Brown-crested Flycatcher	132
Anna's Hummingbird	143
Phainopepla	143
Ash-throated Flycatcher	146
Vermilion Flycatcher*	163
Yuma Clapper rail*	200

*LCR-MSCP covered species

In addition to examining the overall percentages of detection (Table 36), we also examined the change in detected territories throughout the survey season for all three survey types. For this we plotted the number of territories reported by each of the three surveyors against the number of days into the survey season (starting with April 15) for the two most common covered species, Bell's Vireo and Yellow Warbler, and one of the most common other riparian-obligate species, Song Sparrow.

In Figure 2, we show the Bell's Vireo results from the three survey types, which indicate that the EI surveyor and standard intensive surveyor reported fairly consistent numbers of breeding Bell's Vireos after the first few weeks of the season, but the EI surveyor showed leveling numbers that were higher than similarly-leveling numbers reported by the standard intensive surveyor. In the end, the final estimates of territories were similar between the two intensive methods, because some territories were only partially in the plot, which was adjusted at the end of the season for the final tally. The standard intensive surveys resulted in fairly consistent territory counts and final tally, perhaps indicating that the surveyor counted less of the boundary territories throughout the season. The rapid surveyor's territory number estimates were also fairly consistent with the EI surveyor's number throughout the season, and the larger estimate at the end of the season may be a result of our instructing the field crew to take the maximum number of pairs observed during any survey for a final estimate of territories from rapid area searches. If this results in a significant overestimate of territories in all species examined, this year's and past years' data may be reanalyzed using the average number of breeding pairs observed in rapid surveys.

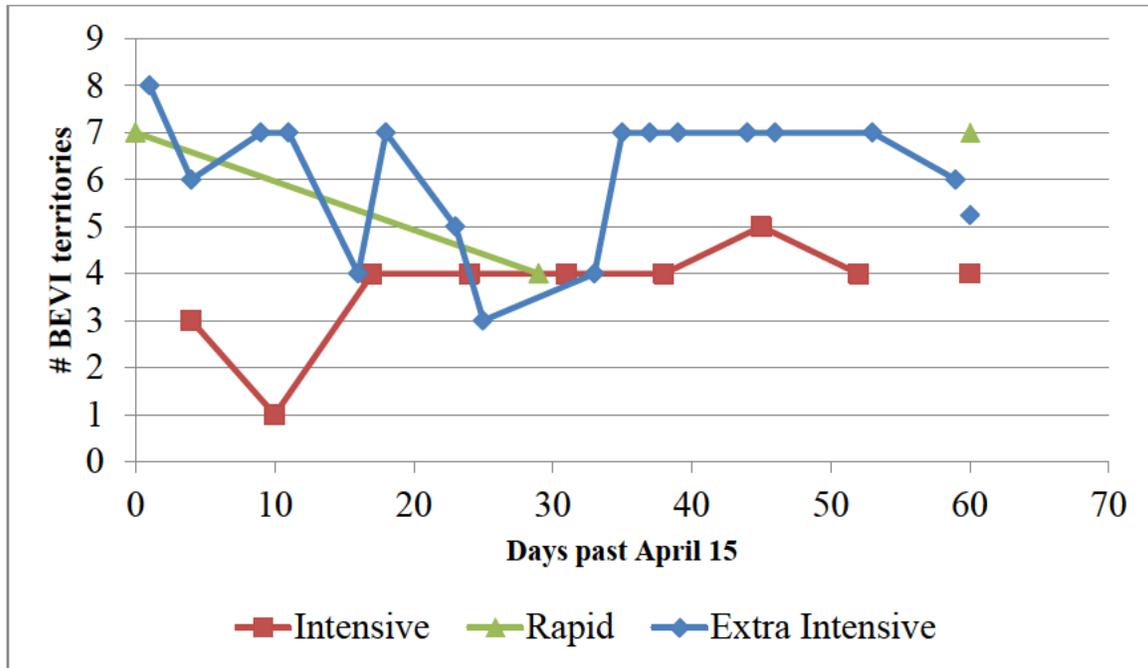


Figure 2. Comparison of estimated numbers of Arizona Bell's vireo territories using three different survey methods (rapid, standard intensive, extra intensive area searches) in 7 EI plots in 2011.

In the second example, we examined results from the three survey methods for Yellow Warbler (Figure 3). Yellow Warblers, unlike Bell's Vireos, are present in significant numbers for both breeding and migration stopover throughout the study area in the spring. Migrating Yellow Warblers, like breeding pairs, are known to sing, defend territories, and copulate during stopovers in their migration. Early in the season (April and early May) it is therefore nearly impossible to tell a migrant from a breeder, unless nest building is observed. We thus rely on repeated surveys of individuals maintaining a territory for weeks at a time, as well as breeding evidence such as nest building or food carrying to call a Yellow Warbler a breeder. In our analysis, the EI surveyor reported a high number of Yellow Warbler breeding pairs early in the season, and decreasing numbers in the first month, which and leveled out in the second month (Figure 3). The standard intensive surveyor reported more consistent numbers throughout the breeding season. The rapid surveyor reported higher numbers, but their two surveys both occurred in the first half of the survey season when many migrants were still likely to be present.

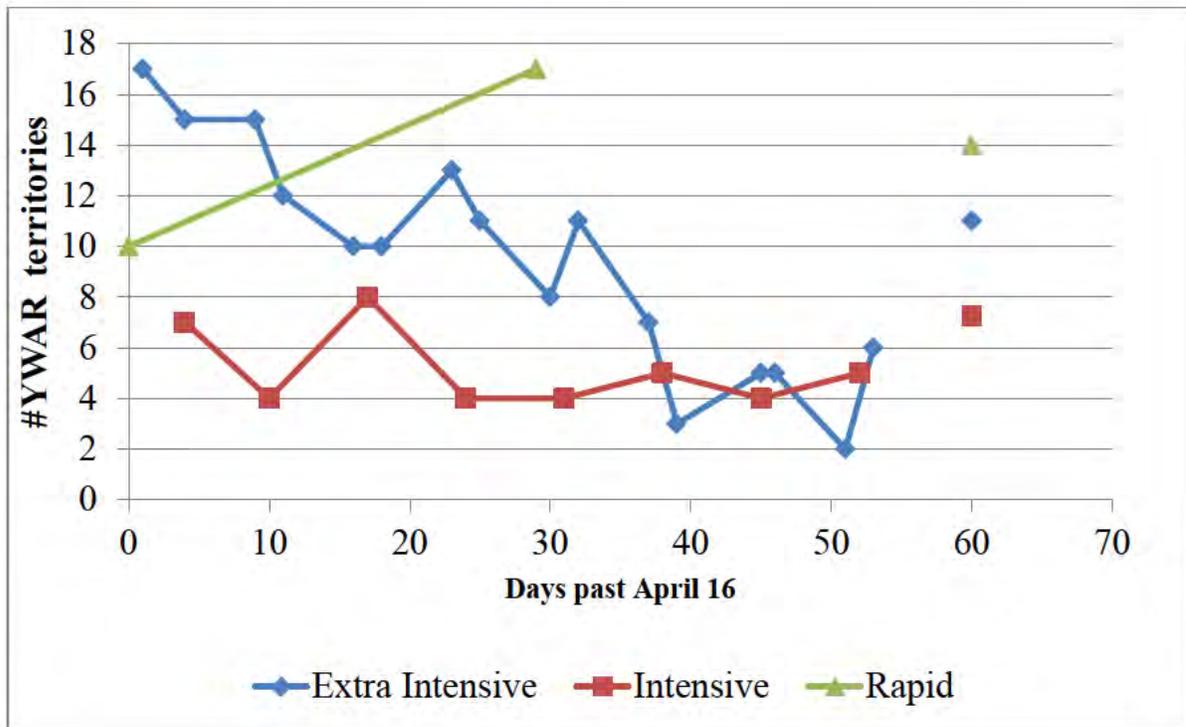


Figure 3. Comparison of estimated numbers of Sonoran yellow warbler territories using three different survey methods (rapid, standard intensive, extra intensive area searches) in 7 EI plots in 2011.

In our last example, the Song Sparrow, approximately the same numbers of territories were recorded on the plot by all surveyors early in the season (Figure 4). The standard intensive surveyor reported, similar to the previous examples, consistent territory numbers throughout the season. The EI surveyor reported a large jump in detections from approximately day 35 to day 45 after the start of the survey season, but later reported leveling numbers and ultimately reported a final territory tally similar to that of the standard intensive surveyor. The rapid surveyor, interestingly, reported a similar jump in the middle of the season as did the EI surveyor. This jump in detections of territories after the middle of the survey season may be a result of Song Sparrows fledglings being mistaken for additional breeding pairs during dispersal, or else adult birds shifting territory boundaries as re-nesting begins. The very high breeding densities of Song Sparrows in the study area (as many as 20 pairs using a 300 m x 300 m plot) creates very difficult survey conditions for a surveyor at this time in the season.

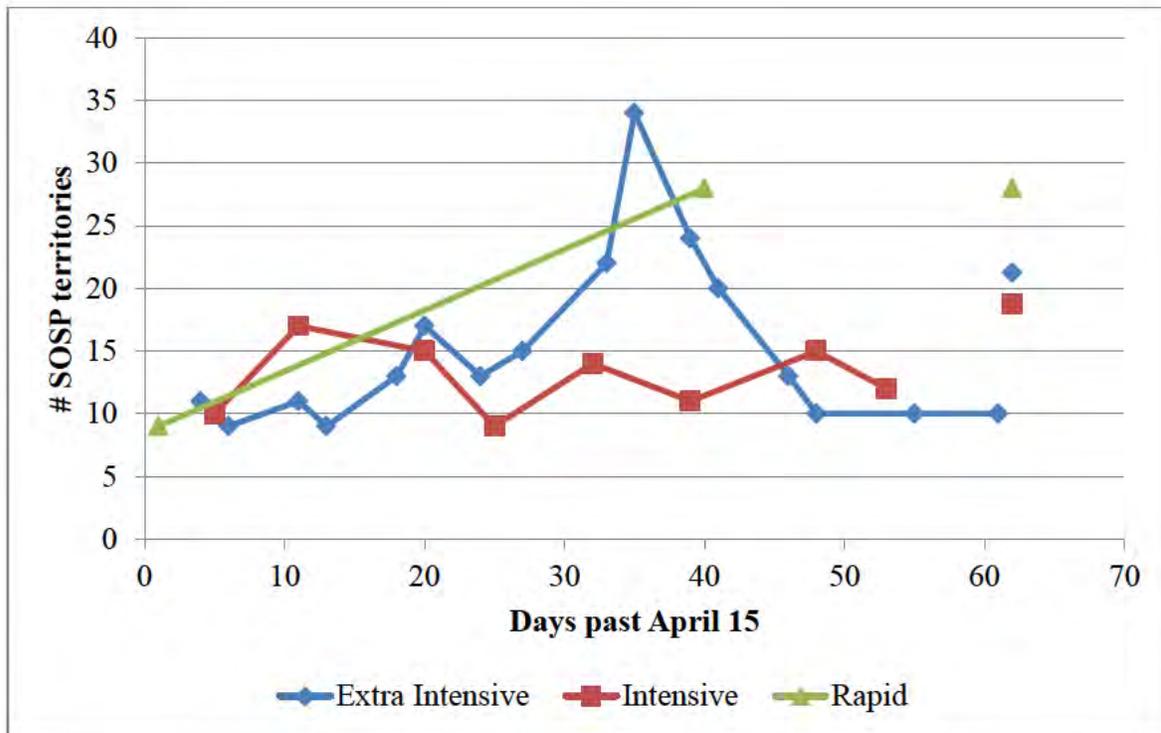


Figure 4. Comparison of estimated numbers of Song Sparrow territories using three different survey methods (rapid, standard intensive, extra intensive area searches) in 7 EI plots in 2011.

Discussion

Above we have reported results from the first year of a three-year study. We have a small sample size from this season ($n=7$). Our discussion below is based on information gained from this first year, and should not be considered as conclusions for this study. Although we think that this is good information, parts of this discussion may change as we add more data and new analyses in the next two years.

The first year of triple-sampling plots with high concentrations of covered species showed some expected results, but also some surprising ones. Of the 30 diurnal landbirds examined with the first year of triple-sampling results, 10 species (33%) fell within 20% of the respective detection rates when comparing EI surveys with standard intensive surveys (Table 36). Some of the species with the greatest discrepancies between survey methods include secretive marshbirds and waterbirds, e.g., Least Bittern, Black Rail, Clapper Rail, and Pied-billed Grebe, and the crepuscular species Lesser Nighthawk. If they were important species for our monitoring efforts, they would typically be monitored using field protocols specifically designed to detect their presence, which a landbird area search protocol such the one used here is not.

The landbirds with the greatest discrepancies between survey results included species such as Crissal Thrasher, Summer Tanager, Lesser Goldfinch, Verdin, Lucy's Warbler, and several species of flycatchers (Table 36). For these species, the discrepancies are, upon first review, more surprising as these species are not secretive. These results also show that the triple sampling effort is an important element for refining our detection ratio estimates. The reasons for the discrepancies in the landbird results are likely related to (1) migration status of the species and individuals present in the plot, (2) species-specific territorial habits and singing phenology, or (3) habitat use patterns that make them particularly difficult species for territory delineation. For instance, Summer Tanagers are known to vocalize only during early stages of mating and nesting, and are mostly silent during incubation and brood-rearing. They are therefore difficult for a surveyor to detect in plots with very dense vegetation, which reduces the surveyor's ability to rely on visual clues or to closely examine potential nesting trees. Summer Tanagers are also rare enough in the project area that even a moderate number of overlooked territories may result in a significantly lower population size estimate than true population size. Of the songbirds, Summer Tanagers is therefore among the most challenging for any standard landbird monitoring program, and options may be explored to develop a species-specific protocol for Summer Tanagers. For instance, during fledging, their detectability increases significantly again, as family groups are extraordinarily easy to observe, which is a circumstance that could be used to develop a post-fledging survey protocol. Or detectability of this species may also be improved, if they respond to call playback methods, which would need to be tested.

The other species with the largest discrepancies in survey methods are predominantly species that are year-round residents in the region, such as Crissal Thrasher, the goldfinches and Verdin, or very early breeders, such as Lucy's Warbler and Marsh Wren. These species often have multiple nesting attempts, which may already be underway by the time the regular landbird breeding season begins. They are therefore notoriously difficult to fully address in a multi-species monitoring program that is designed primarily for migrant landbirds that have migration peaks approximately in April. At that time, several of the species with large discrepancies in our triple-sampling results, have either already started nesting, or may not even be close to nesting, if their breeding is timed differently than most other songbirds, or even opportunistically based on local availability of specific resources (e.g., goldfinches). Several species of flycatchers, including the covered species Vermilion Flycatcher, were also overestimated by standard intensive surveyors (Table 36), likely because many flycatchers are also known to have non-standard migration timing compared to other songbird species groups and they often have very large territories (especially Ash-throated and Brown-crested flycatchers). For instance, Vermilion Flycatcher routinely uses the lower Colorado River corridor for wintering, and they are, in fact, significantly more common in the project area in winter than during the breeding season. Therefore, we suspect that the standard intensive surveyors overestimated their breeding population based on the presence of late migrants. All flycatchers are also very subtle in their territorial behaviors compared with most other songbirds, and a territorial bird is often very difficult to distinguish from a non-territorial migrant individual that is vocalizing, particularly in very densely vegetated plots.

The plots selected for the triple-sampling effort are some of the most challenging plots we survey and are not representative of the entire project area. This was done in order to increase coverage for covered species, which tend to occur in highest concentrations in plots that are very difficult to survey. Therefore, we attribute much, if not the majority, of the discrepancies between the two intensive survey types to the inherent logistical difficulties of surveying very difficult plots. For instance, the detection ratios reported in our first component showed very little discrepancy between rapid and intensive surveys for habitat creation site surveys, which are very easy to thoroughly cover during area searches, and a larger discrepancy in system-wide surveys (although both were > 0.9), which typically consist of plots with widely varying difficulties. We therefore suspect that the discrepancies reported for the first year of the triple-sampling effort represent the “worst case scenario” for detectability estimation for most species, reflecting the densest vegetation settings that were included in the EI layer, which are in contrast with relatively open habitat types that predominate most of the riparian corridor of the Colorado River. We therefore believe that the true detection ratios for covered species and most other riparian landbirds are closer to 1 in a typical Colorado River plot that is most often less densely vegetated than the EI layer plots.

To mitigate this problem in the future, we began to classify the EI plots layer into two strata, including medium and difficult for a survey difficulty ranking. Plots will be assigned to these strata based on aerial photography, habitat, and previous knowledge of the study area. In 2012, we will have stratified random selection to select four plots from each stratum. In addition, we will also conduct EI surveys on the one plot from the 2011 selection that was dropped due to unforeseen circumstances. After the third year of EI surveys, we will develop recommendations about modifications to the double-sampling method that would further improve effectiveness and efficiency of the LCR MSCP Riparian Bird Survey Project. For instance, crew training for specific species (e.g., Yellow Warbler, Figure 3) can be improved with further knowledge of species-specific difficulties for delineating territories accurately.

Component 4: Habitat Surveys

The goal of Component 4 is to perform a detailed habitat assessment for four LCR MSCP covered species, Gila Woodpecker, Bell’s Vireo, Yellow Warbler, and Summer Tanager. For each species, this assessment is conducted in known territories and paired non-use sites. The assessment is comprised of a wide range of variables measured that describe vegetation structure, plant species composition, and abiotic factors. Surveyors collected habitat data at ten use and ten non-use territories for each of the four covered species in September and October, 2011. Surveyors also deployed HOBO units at six of the ten use and non-use territory centers for each of the four species. The data collected in 2011 will be processed along with the data collected in 2012, and then summarized together in the 2012 annual report.

Literature Cited

- Anderson, B.W., and R.D. Ohmart. 1976. Vegetation type maps of the lower Colorado River from Davis Dam to the southerly international boundary: U.S. Department of the Interior, Bureau of Reclamation, Boulder City, Nevada.
- Bart, J. 2007. Lower Colorado River Riparian Bird Surveys. Unpublished Report Submitted to the Bureau of Reclamation, Lower Colorado Region, May 2008.
- Bart, J., and D. Hartley. 2010. DS - software for analyzing data collected using double-sampling: User manual for program DS. In Review.
- Bart, J., and S.L. Earnst. 2002. Double sampling to estimate density and population trends in birds. *Auk* 119:36-45.
- Bart, J., L. Dunn, and A. Leist. 2010. A sampling plan for riparian birds of the Lower Colorado River—Final Report: U.S. Geological Survey Open-File Report 2010–1158, 20 pp.
- Bart, J., and A. Manning. 2008. Lower Colorado River Riparian Bird Surveys 2007. Unpublished report submitted to the Bureau of Reclamation, Lower Colorado Region, May 2008.
- Bibby, C.J., N.D. Burgess, D.A. Hill, and S.H. Mustoe. 2000. *Bird Census Techniques*, 2nd ed. Academic Press, London.
- McLeod, M.A., and T.J. Koronkiewicz. 2010. Southwestern Willow Flycatcher surveys, demography, and ecology along the Lower Colorado River and tributaries, 2009. Annual report submitted to U.S. Bureau of Reclamation, Boulder city, NV, by SWCA Environmental Consultants, Flagstaff, AZ. 165 pp.
- Halterman, M.D., E.T. Rose, S.E. McNeil, and D. Tracy. 2009. Yellow-billed Cuckoo distribution, abundance and habitat use on the lower Colorado River and tributaries, 2008 annual report. Bureau of Reclamation, Lower Colorado River Multi-Species Conservation Program, Boulder City, NV.
- Thompson, W.L. 2002. Towards reliable bird surveys: accounting for individuals present but not detected. *Auk* 119:18-25.
- (GBBO) Great Basin Bird Observatory. 2008. Annual report on the Lower Colorado River riparian bird surveys. Unpublished Report Submitted to the Bureau of Reclamation, Lower Colorado Region, October 2008.

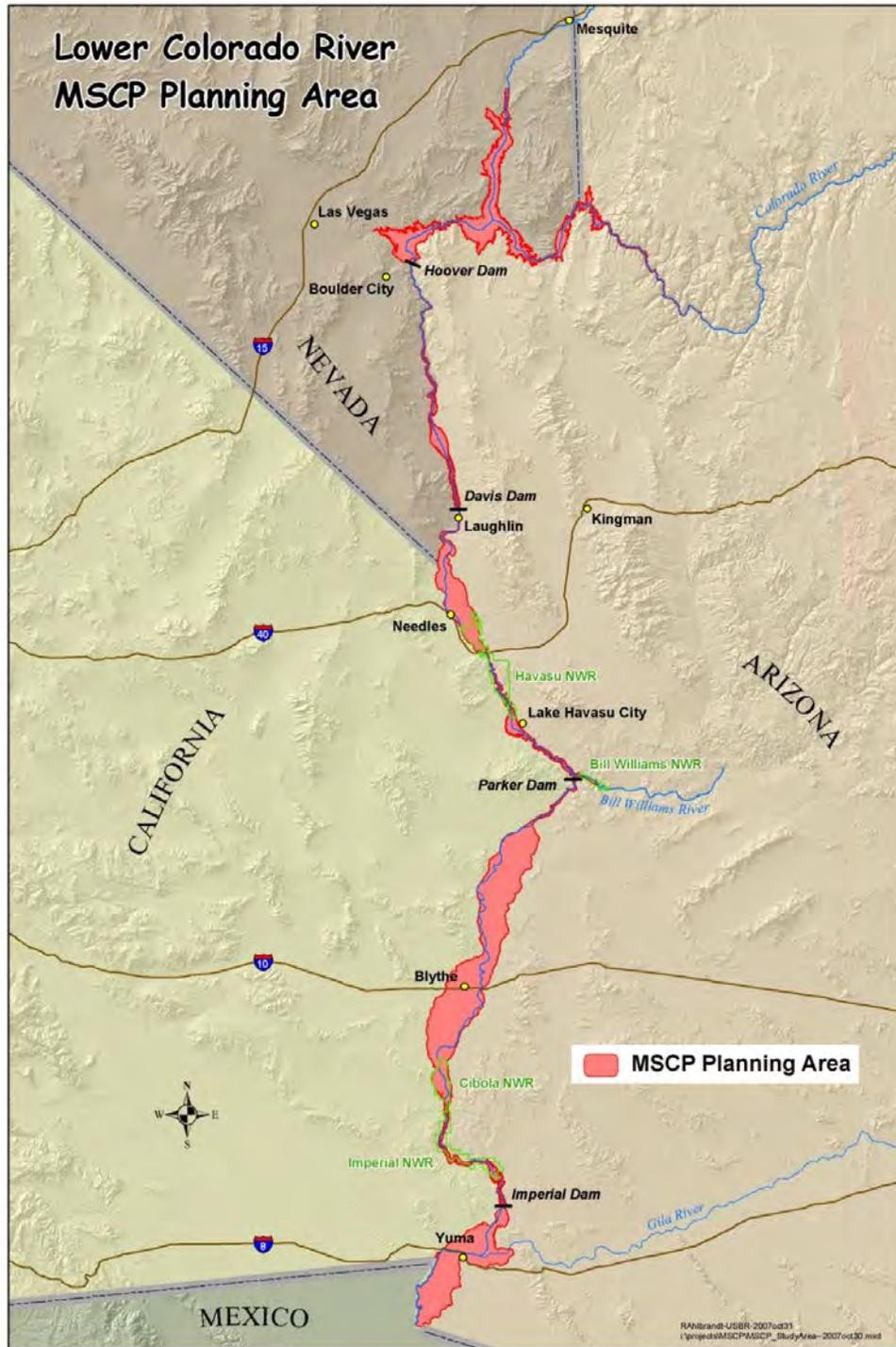
(GBBO) Great Basin Bird Observatory. 2009. Annual report on the lower Colorado River riparian bird surveys. Unpublished Report Submitted to the Bureau of Reclamation, Lower Colorado Region, October 2009.

(GBBO) Great Basin Bird Observatory. 2010. Summary report on the Lower Colorado River Riparian Bird Surveys, 2008-2010. Unpublished Report Submitted to the Bureau of Reclamation, Lower Colorado Region, December 2010.

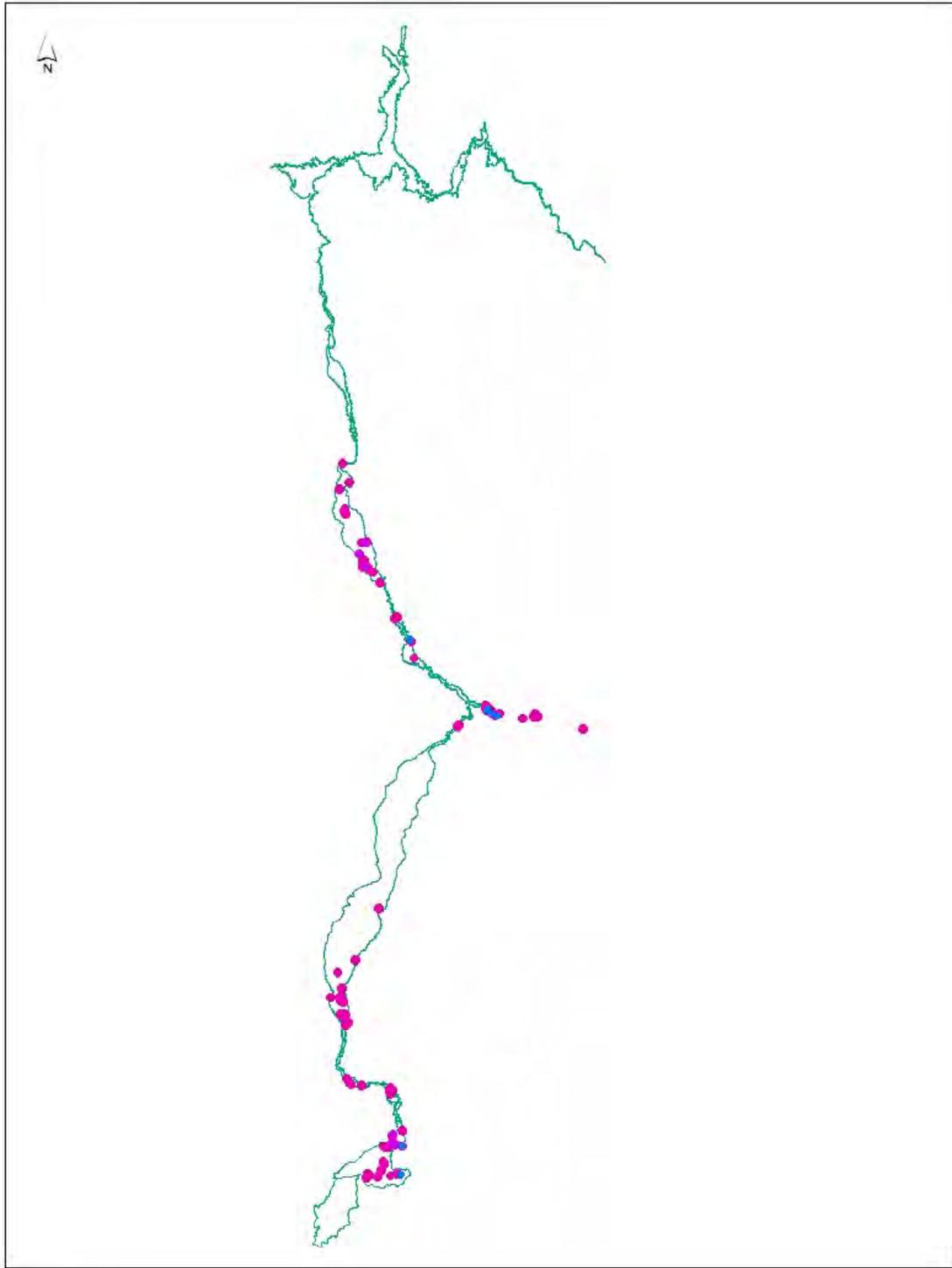
(USBR) U.S. Bureau of Reclamation. 2006. Lower Colorado River Multi-Species Conservation Program. <http://www.lcrmscp.gov>

(USBR) U.S. Bureau of Reclamation. 2008. Species Accounts for the lower Colorado River Multi-Species Conservation Program. <http://www.lcrmscp.gov/technicalrepts.html>

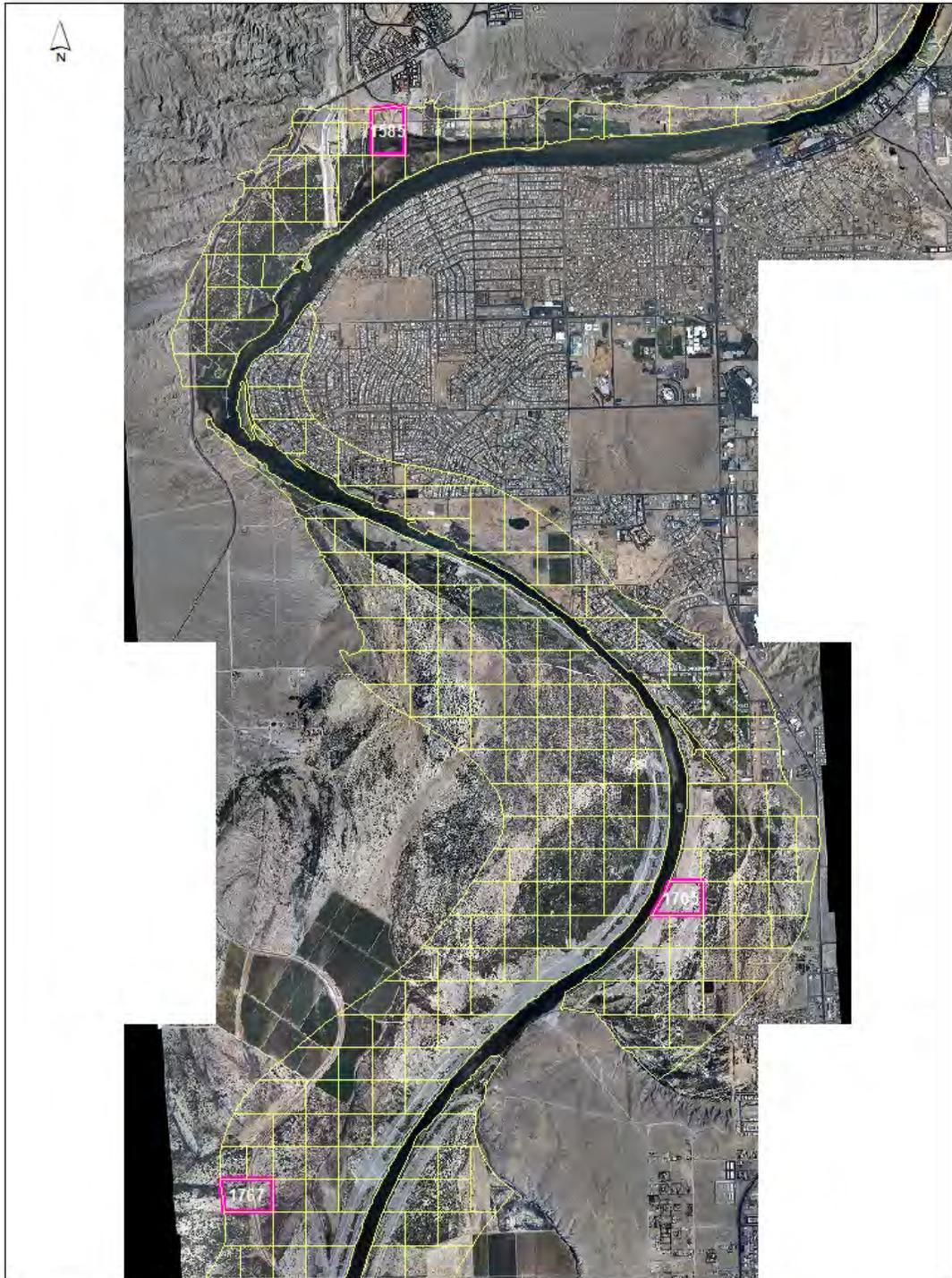
Appendix 1a. Map of the LCR-MSCP study area for system-wide bird surveys (in pink). Map provided by the U.S. Bureau of Reclamation, Lower Colorado River Region.



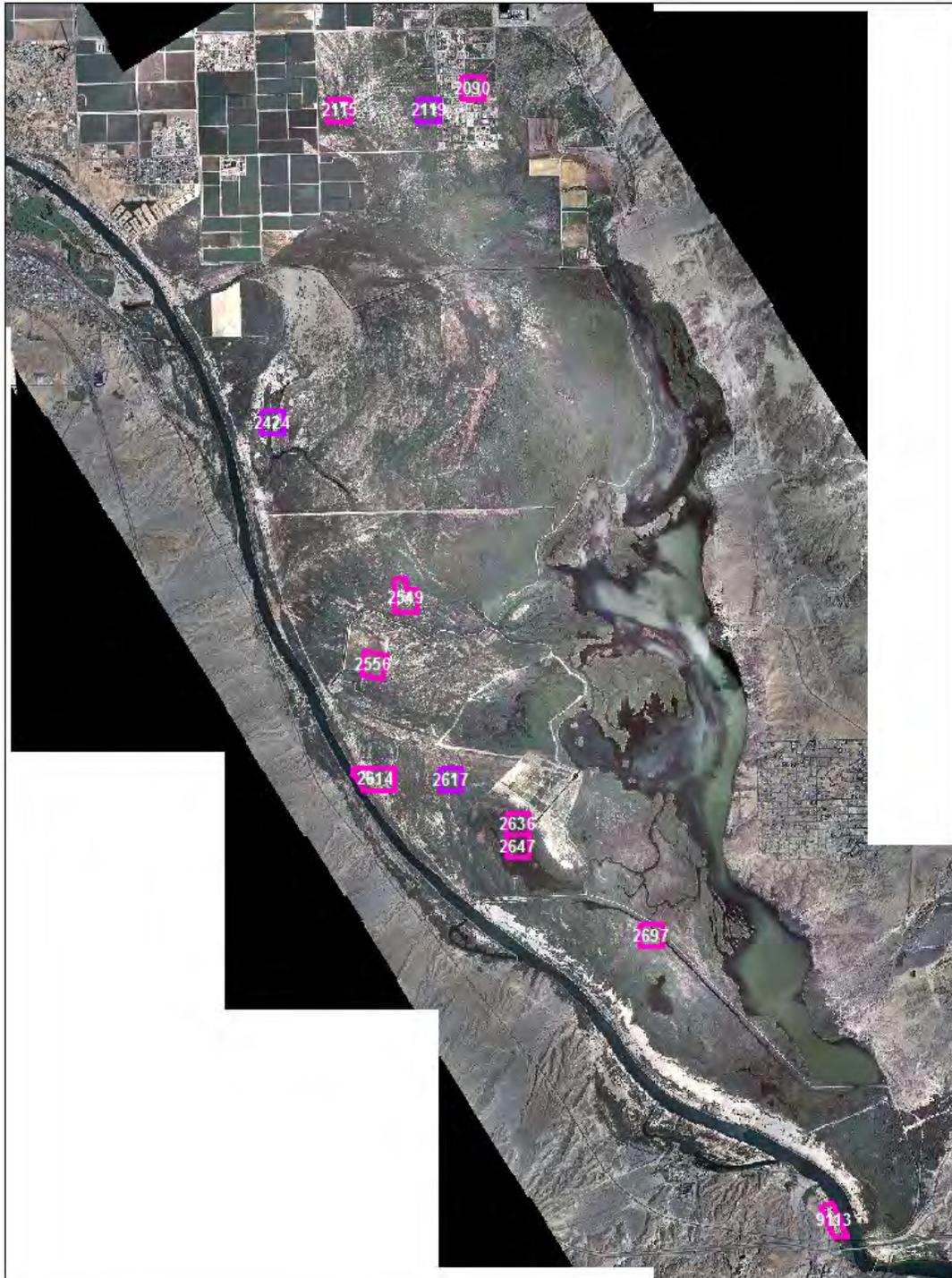
Appendix 1b. Overview of system-wide plots surveyed in 2011 (rapid plots in pink, intensive plots in purple, and EI plots in blue) with the LCR MSCP reach boundary layer (reach boundary provided by the U.S. Bureau of Reclamation, Lower Colorado River Region. 2002).



Appendix 1c. Regional map of system-wide plots surveyed in 2011: Region 5 North (Davis Dam to Bill Williams River (excluding Havasu NWR)). Rapid plots are outlined in pink, intensive plots in purple, and EI plots in blue.



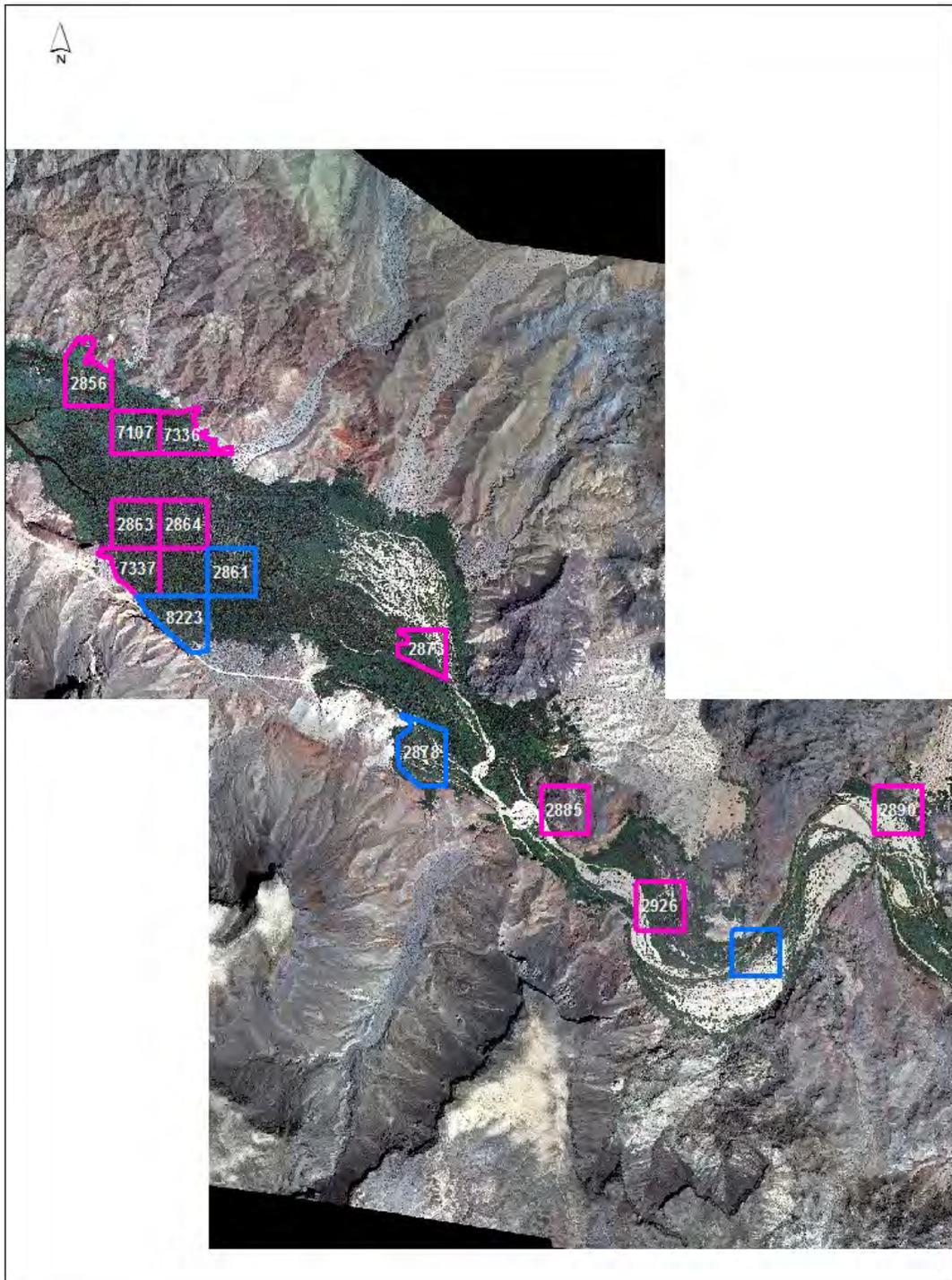
Appendix 1d. Regional map of system-wide plots surveyed in 2011: Region 5 (Davis Dam to Bill Williams River (excluding Havasu NWR) and Region 6 North (Havasu NWR (excluding Bill Williams unit))). Rapid plots are outlined in pink, intensive plots in purple, and EI plots in blue.



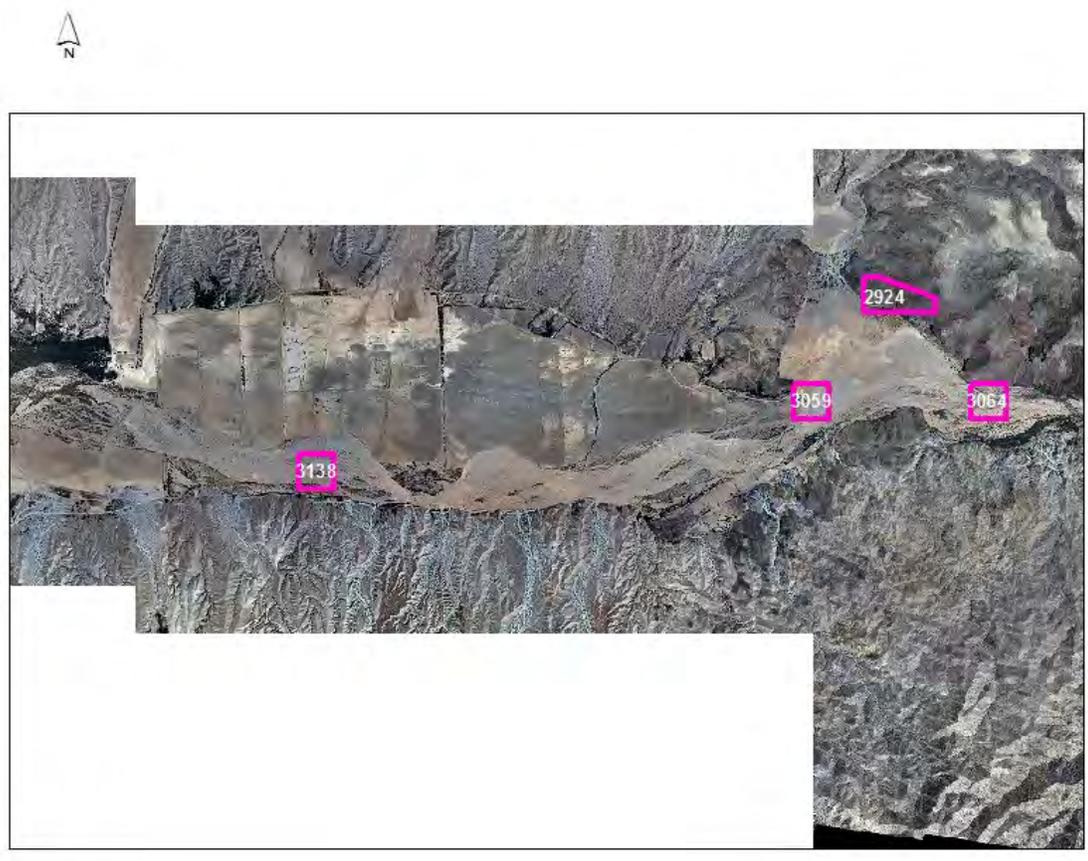
Appendix 1e. Regional map of system-wide plots surveyed in 2011: Region 6 South (Havasu NWR (excluding Bill Williams unit)). Rapid plots are outlined in pink, intensive plots in purple, and EI plots in blue.



Appendix 1f. Regional map of system-wide plots surveyed in 2011: Region 7 West (Bill Williams unit of the Havasu NWR). Rapid plots are outlined in pink, intensive plots in purple, and EI plots in blue.



Appendix 1g. Regional map of system-wide plots surveyed in 2011: Region 7 Planet Ranch (Bill Williams unit of the Havasu NWR). Rapid plots are outlined in pink, intensive plots in purple, and EI plots in blue.



Appendix 1h. Regional map of system-wide plots surveyed in 2011: Region 7 Lincoln Ranch (Bill Williams unit of the Havasu NWR). Rapid plots are outlined in pink, intensive plots in purple, and EI plots in blue.



Appendix 1i. Regional map of system-wide plots surveyed in 2011: Region 8 North, Parker Strip (Bill Williams unit to Cibola excluding the Colorado Reservation). Rapid plots are outlined in pink, intensive plots in purple, and EI plots in blue.



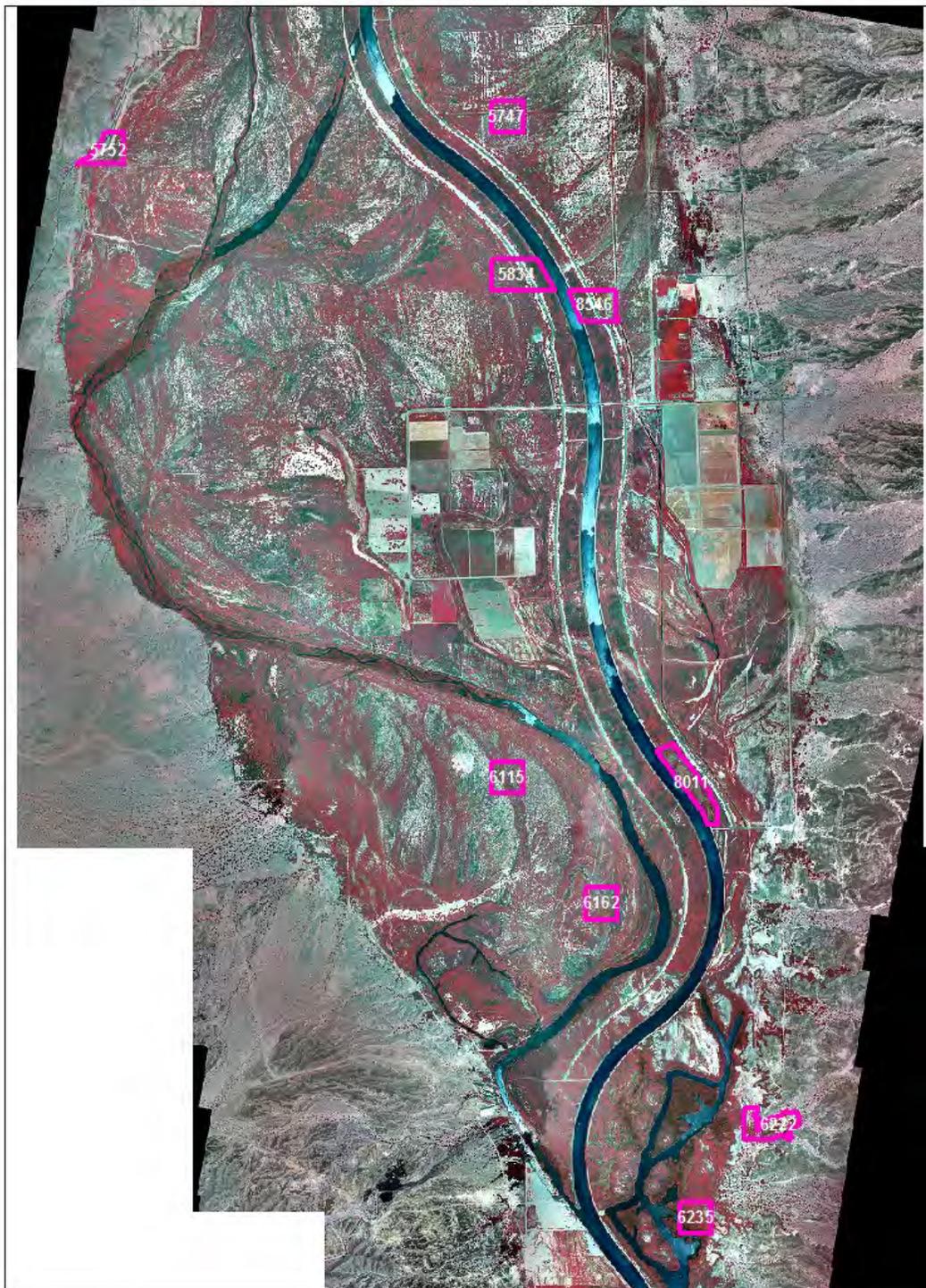
Appendix 1j. Regional map of system-wide plots surveyed in 2011: Region 8 Central (Bill Williams unit to Cibola excluding the Colorado Reservation). Rapid plots are outlined in pink, intensive plots in purple, and EI plots in blue.



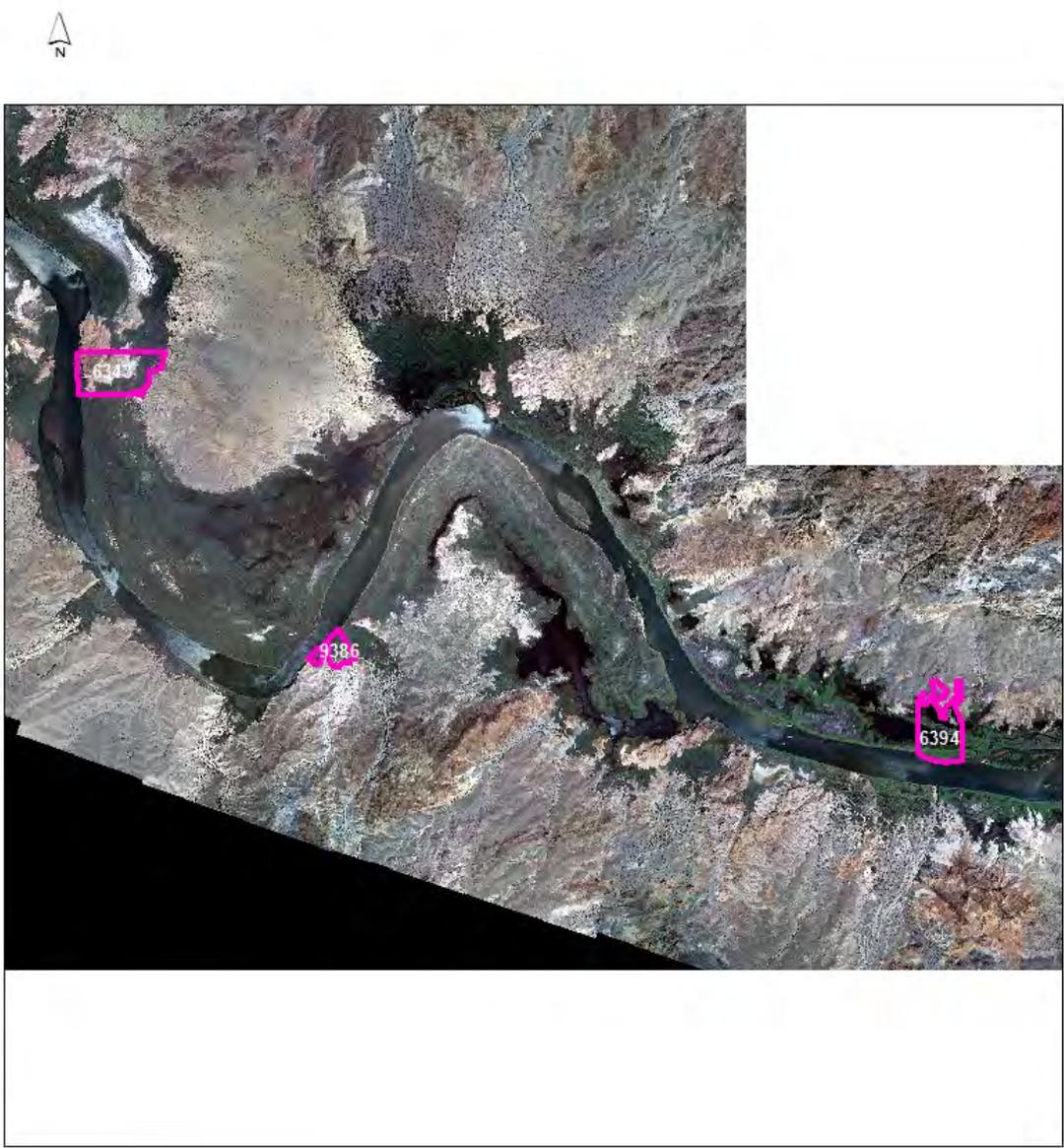
Appendix 1k. Regional map of system-wide plots surveyed in 2011: Region 8 South (Bill Williams unit to Cibola excluding the Colorado Reservation). Rapid plots are outlined in pink, intensive plots in purple, and EI plots in blue.



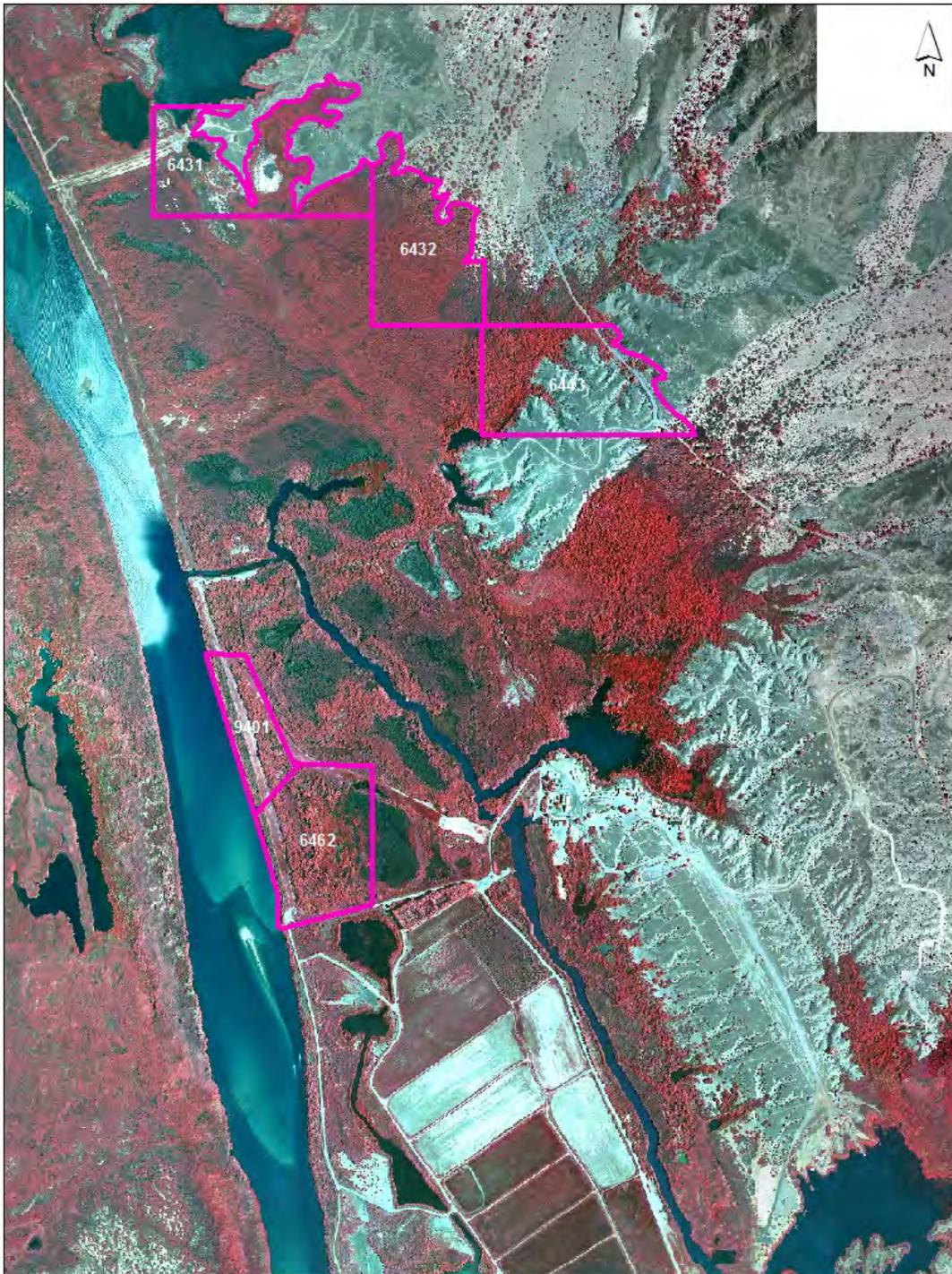
Appendix 11. Regional map of system-wide plots surveyed in 2011: Region 10 (Cibola NWR). Rapid plots are outlined in pink, intensive plots in purple, and EI plots in blue.



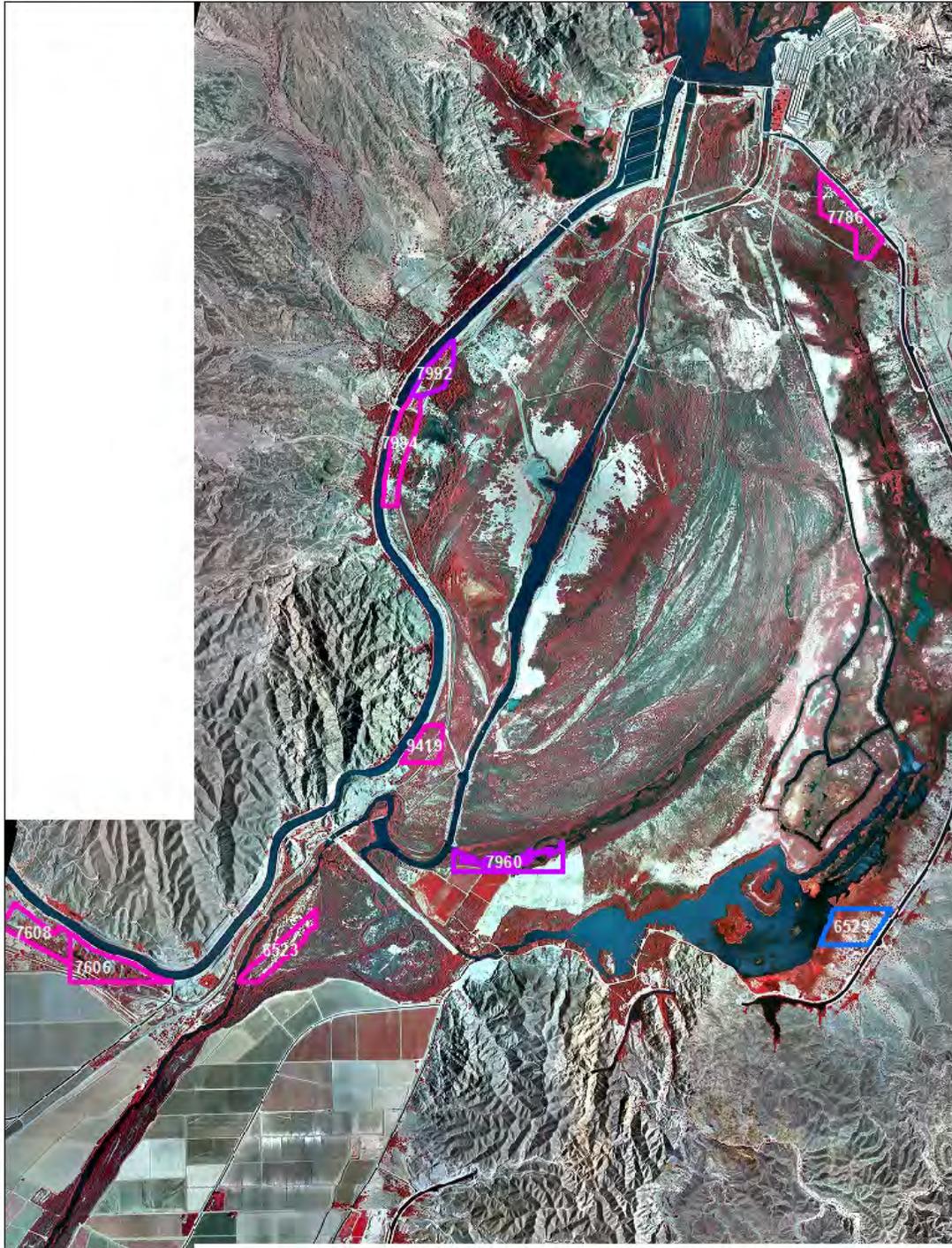
Appendix 1m. Regional map of system-wide plots surveyed in 2011: Region 11 North (Imperial NWR). Rapid plots are outlined in pink, intensive plots in purple, and EI plots in blue.



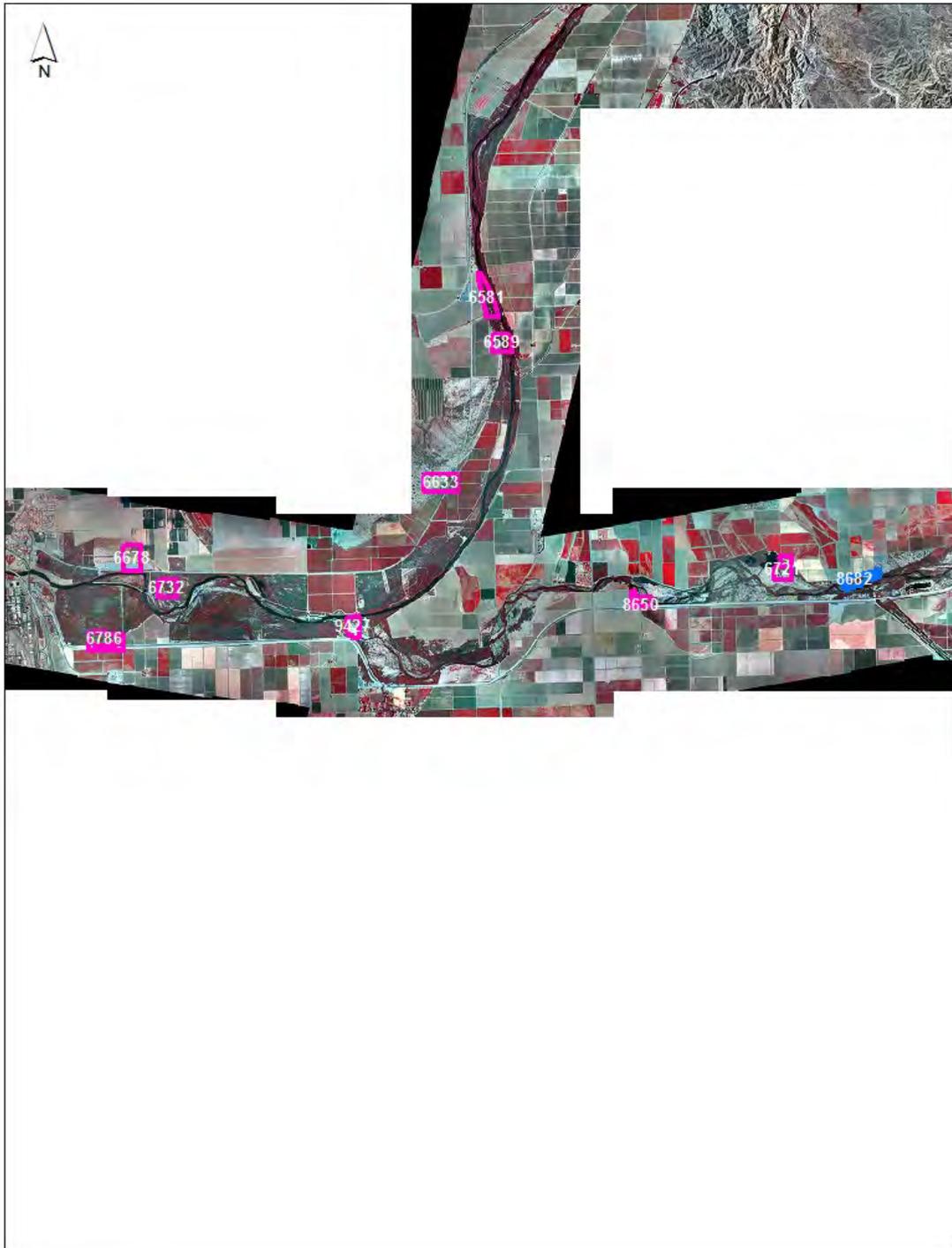
Appendix 1n. Regional map of system-wide plots surveyed in 2011: Region 11 South (Imperial NWR). Rapid plots are outlined in pink, intensive plots in purple, and EI plots in blue.



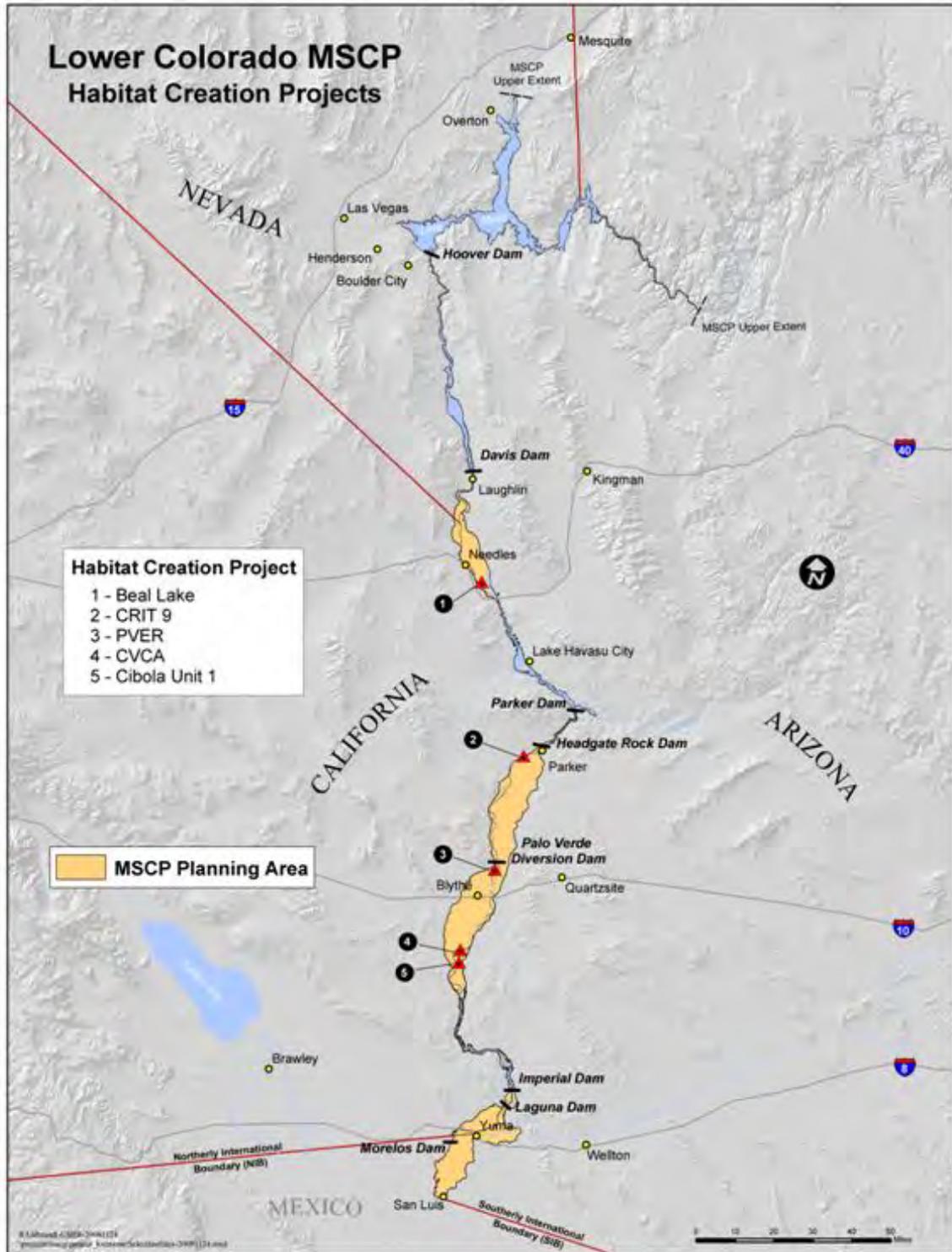
Appendix 1o. Regional map of system-wide plots surveyed in 2011: Region 12 North (Colorado River from the Imperial NWR to Yuma). Rapid plots are outlined in pink, intensive plots in purple, and EI plots in blue.



Appendix 1p. Regional map of system-wide plots surveyed in 2011: Region 12 South (Colorado River from the Imperial NWR to Yuma). Rapid plots are outlined in pink, intensive plots in purple, and EI plots in blue.



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



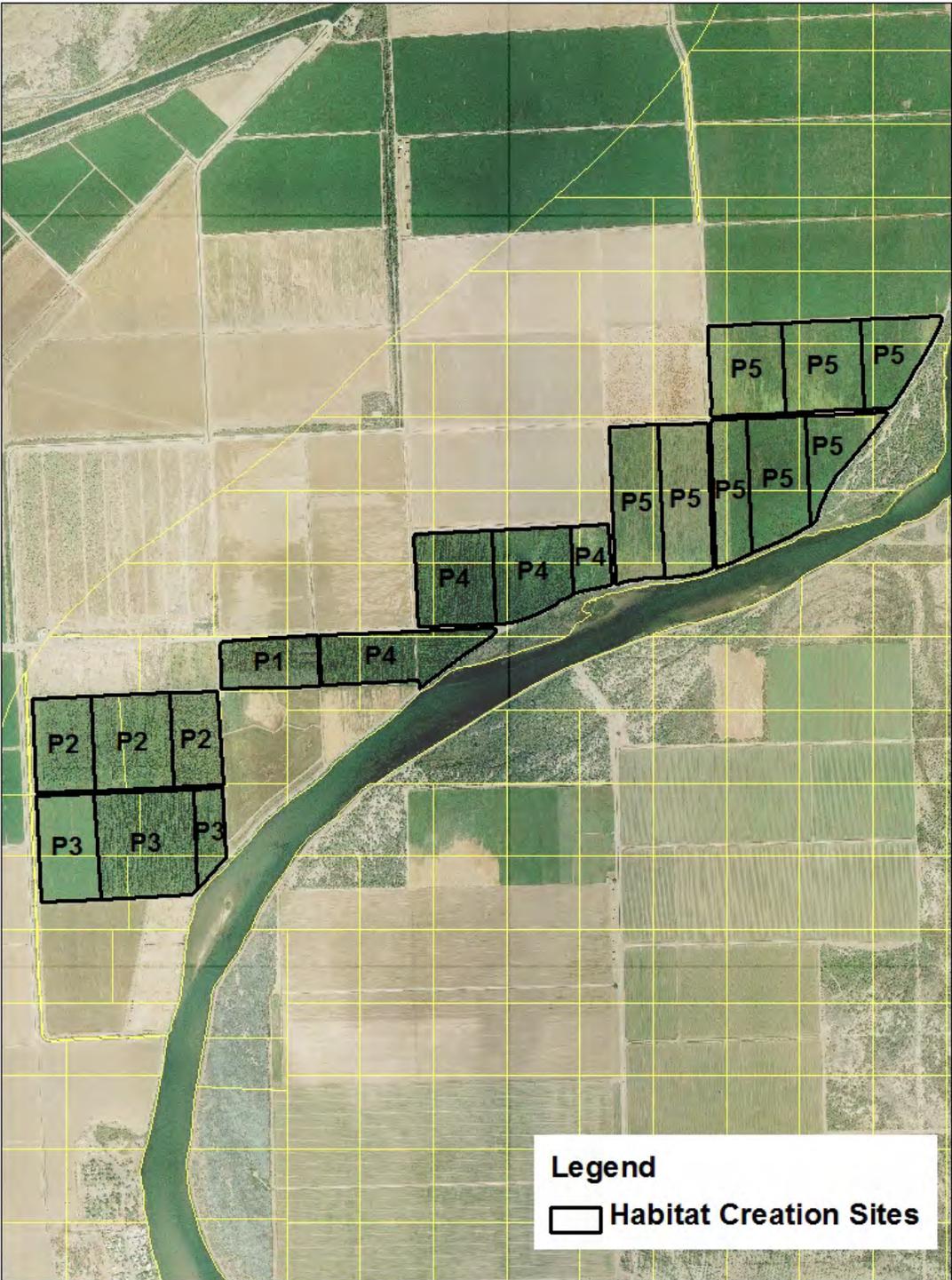
Appendix 1r. Overview of Beal Lake habitat creation site and four riparian bird survey plots, 2011.



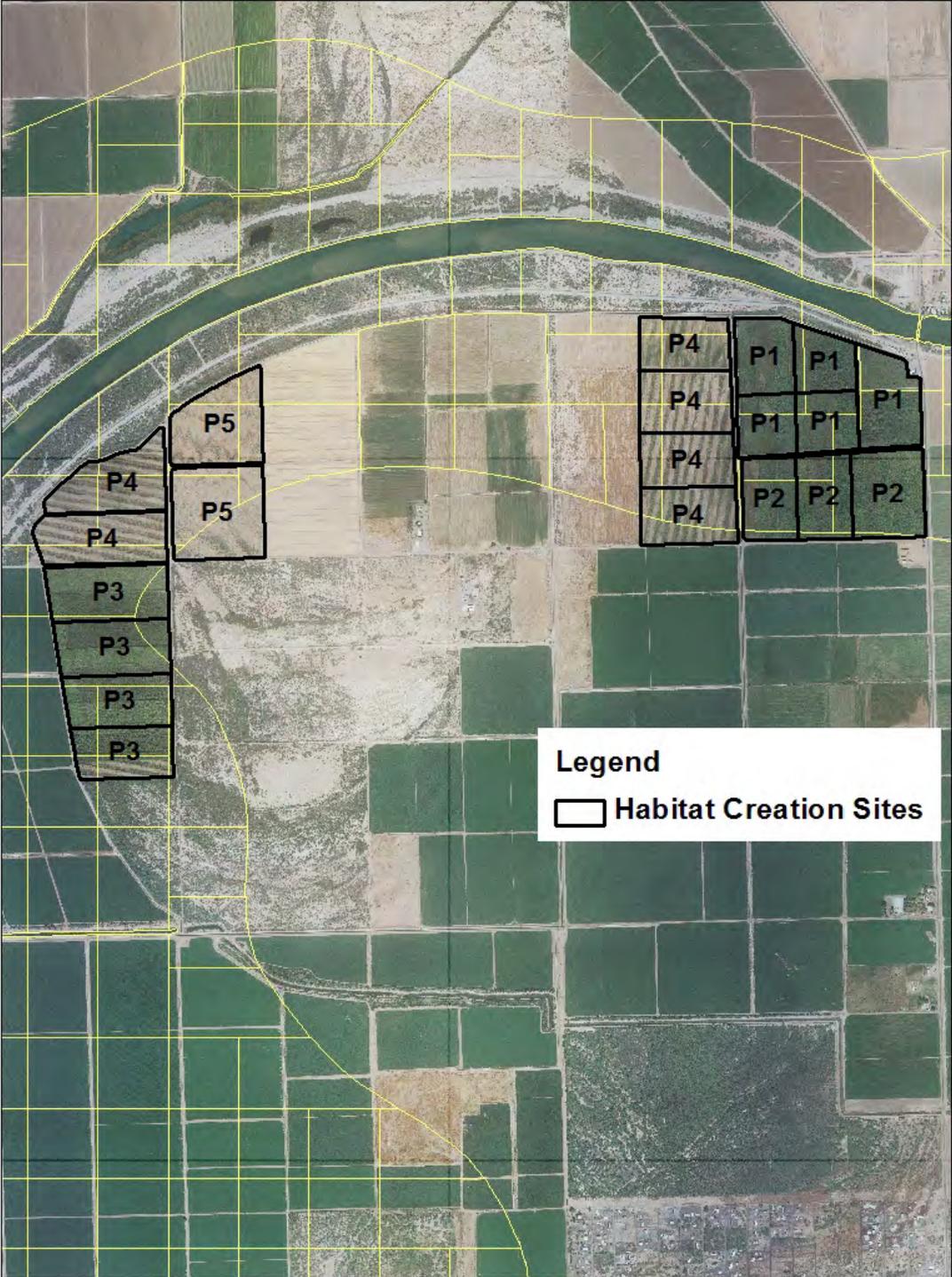
Appendix 1s. Overview of Colorado River Indian Tribes habitat creation site and five riparian bird survey plots, 2011.



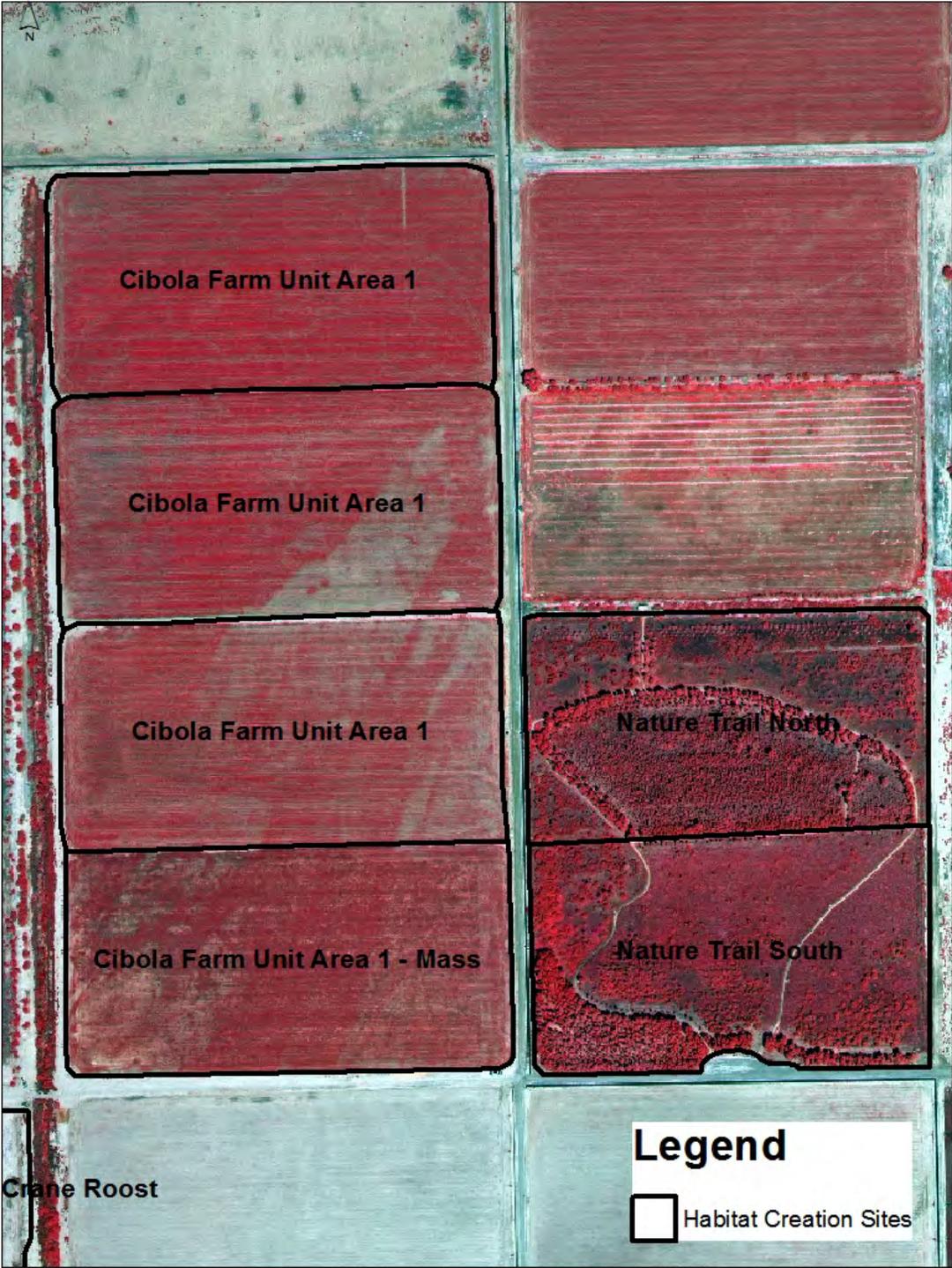
Appendix 1t. Overview of Palo Verde Ecological Reserve (PVER) habitat creation site and 5 phases and 19 riparian bird survey plots, 2011.



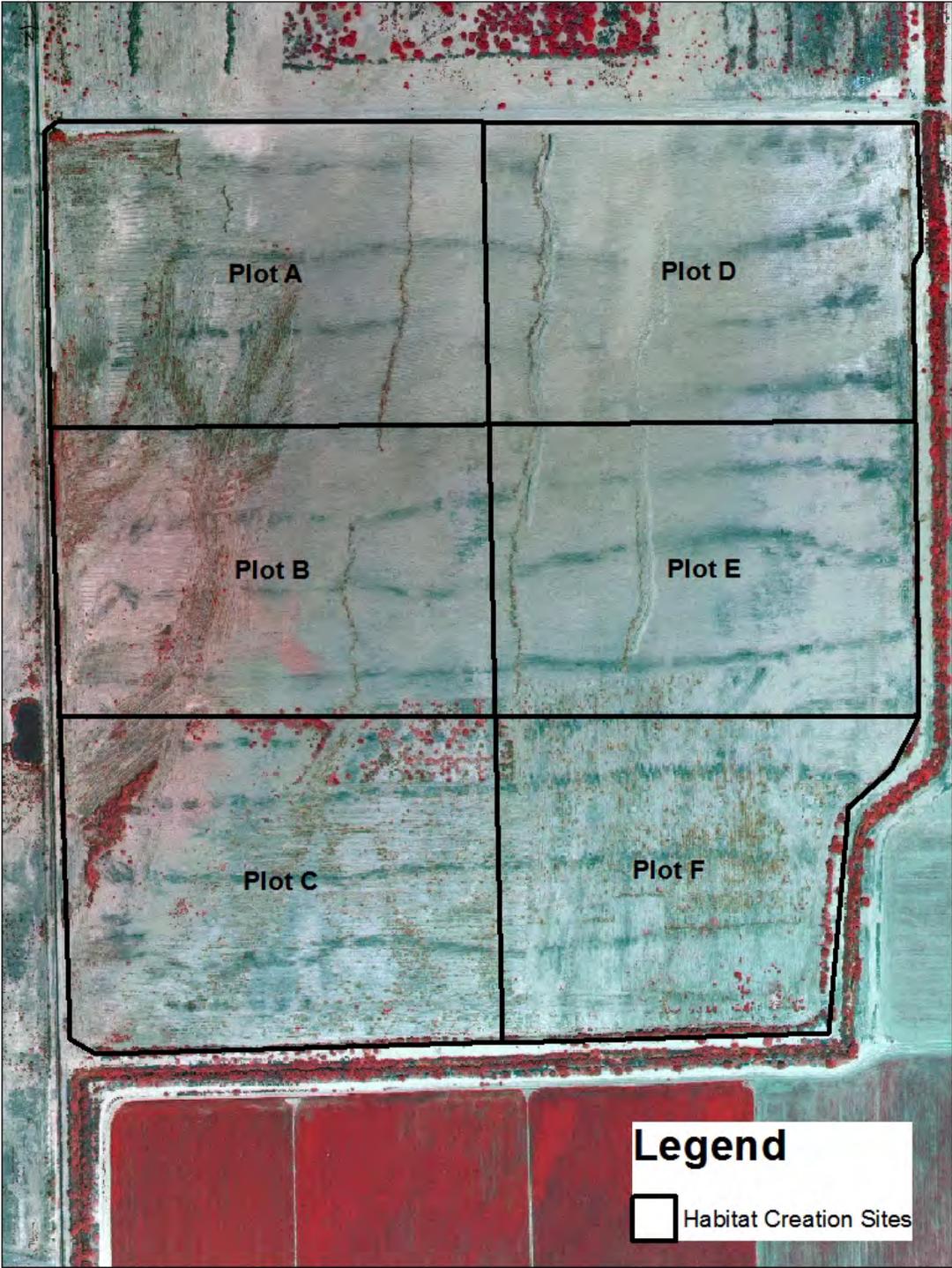
Appendix 1u. Overview of Cibola Valley Conservation Area (CVCA) habitat creation site with 5 phases and 20 riparian bird survey plots, 2011.



Appendix 1v. Overview of Cibola Farm Unit 1 habitat creation sites with six riparian bird survey plots, 2011.



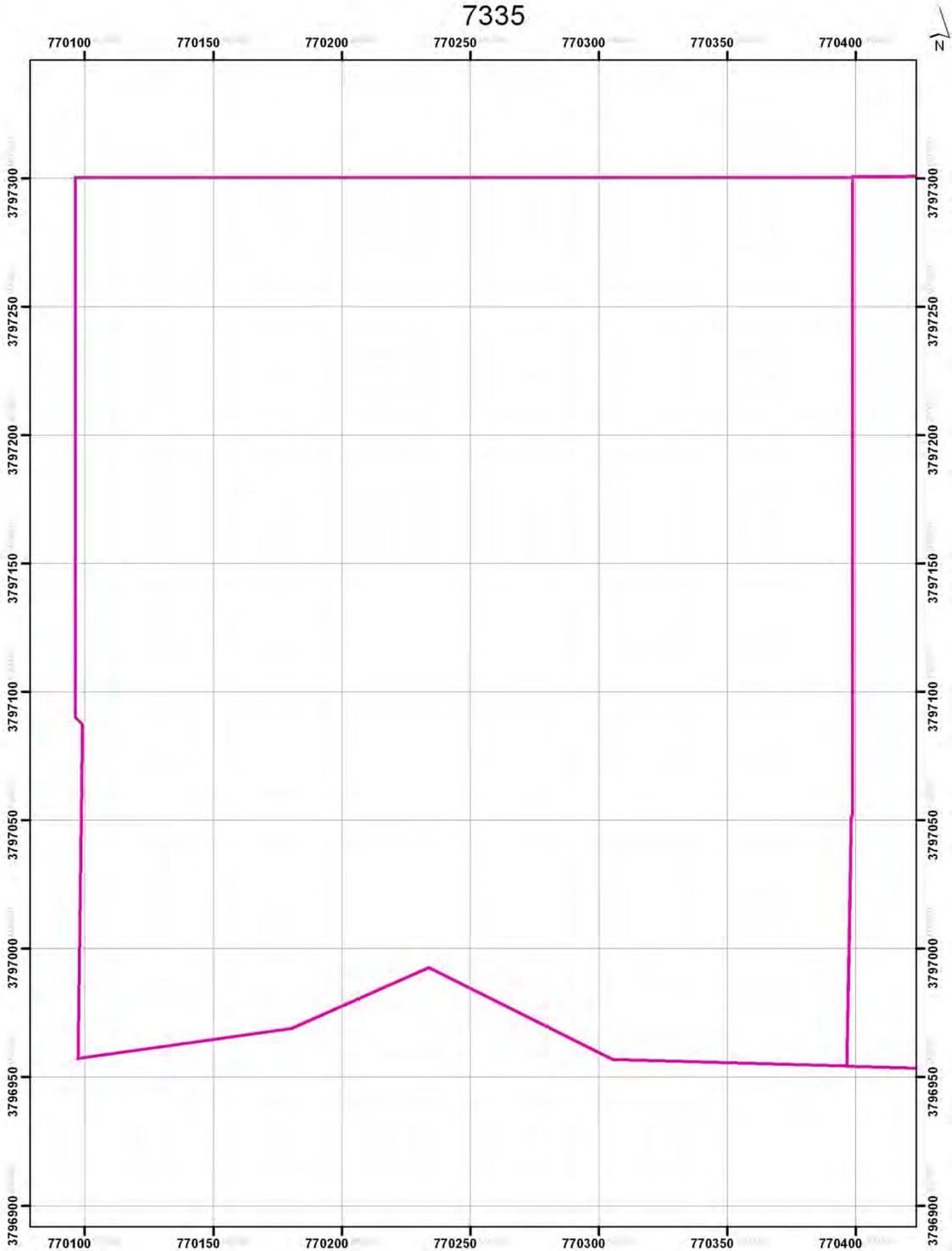
Appendix 1w. Overview of Cibola Farm Unit 5: Crane Roost habitat creation site with six riparian bird survey plots, 2011.



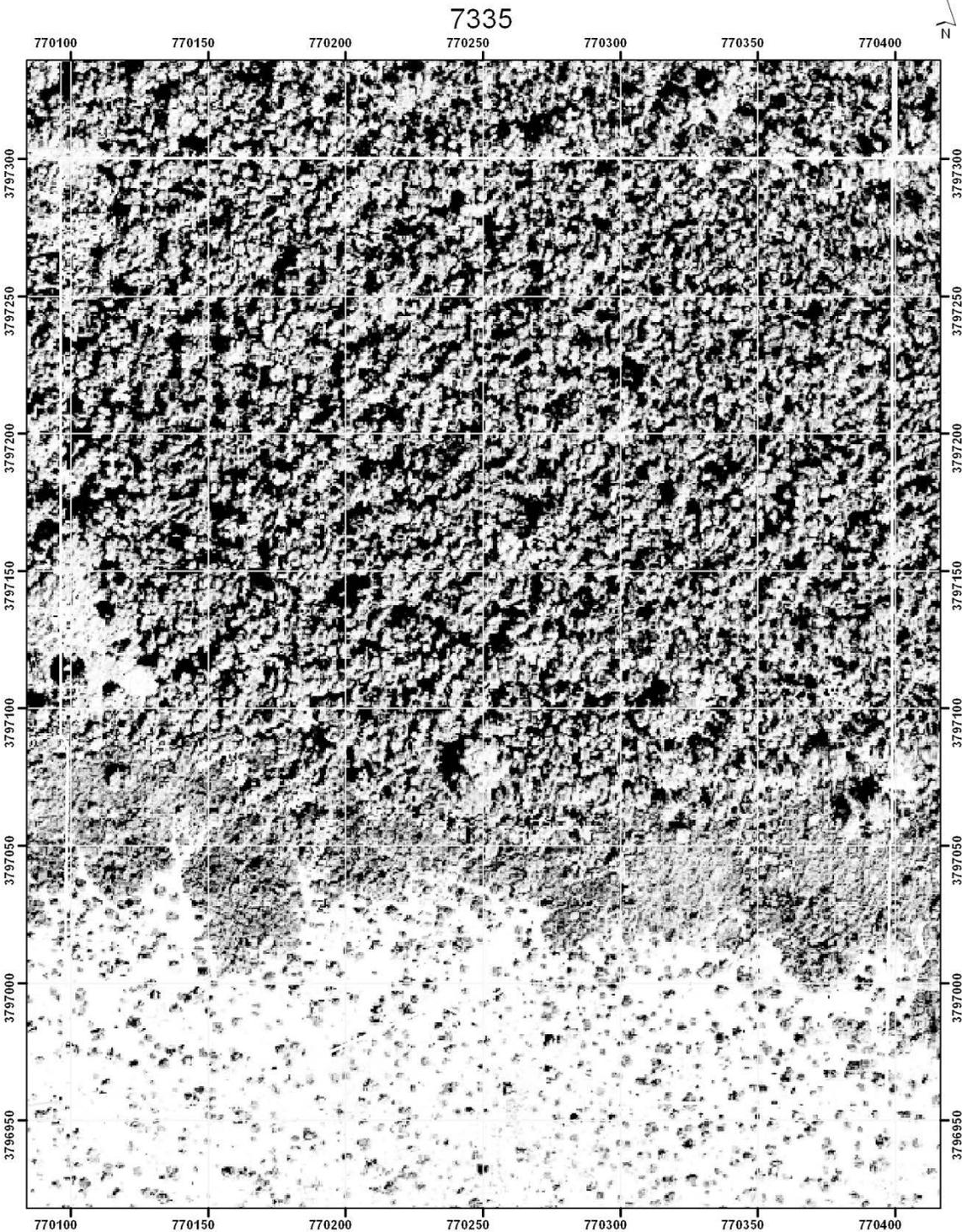
Appendix 2a. Example of a system-wide bird monitoring plot.



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

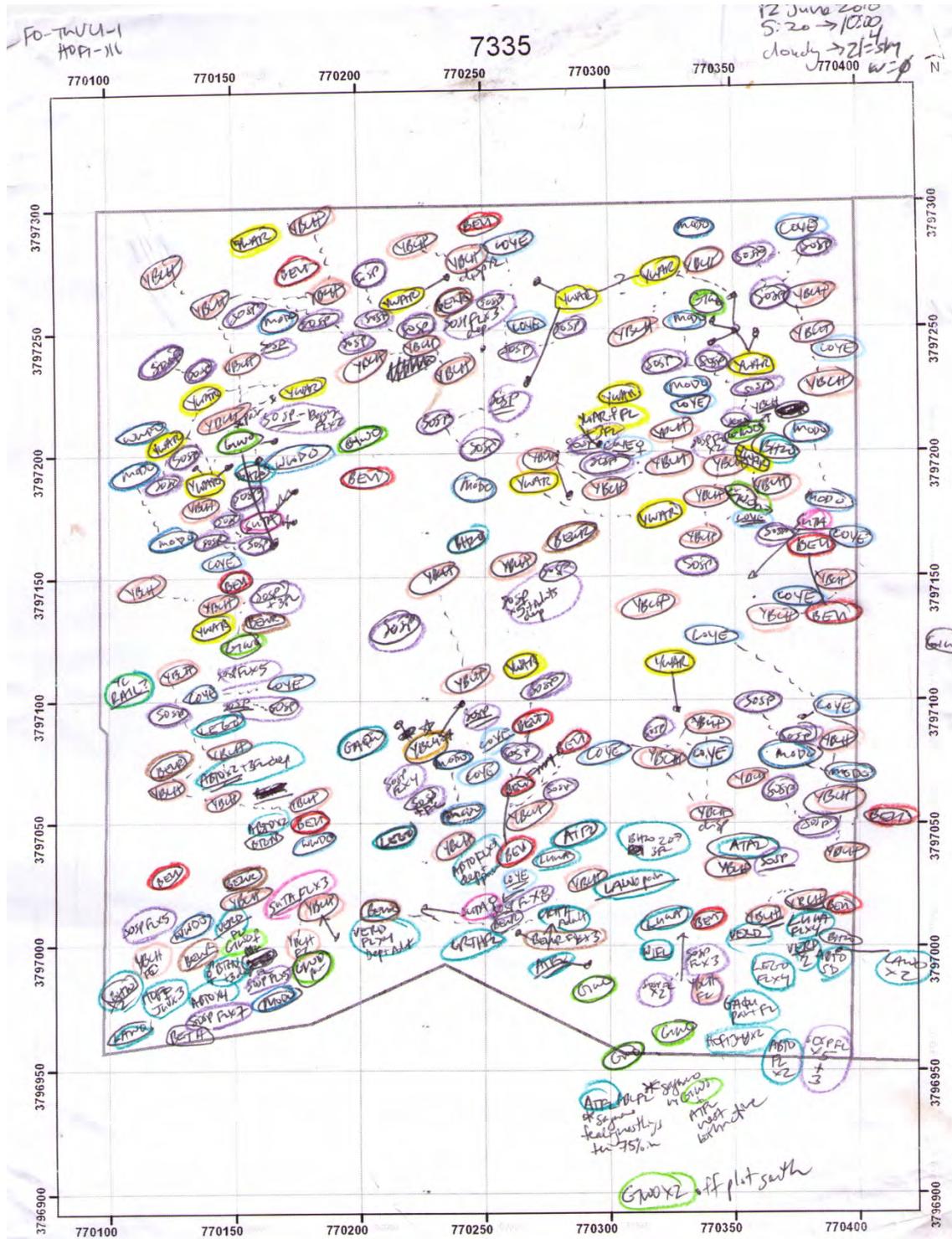


Appendix 2c. Example of a bird survey plot map with grid, including grayscale imagery for reference.



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Appendix 2d. Example of a filled-out bird survey plot map from a rapid area search.



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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: 10:00 Sky Code: 3

Wind Code: 0

Map Reference Code	Species	# Male	# Female	# Unknown	# Juv	seen/heard only	Obs. Possible			Probable			Confirmed			Incidental	Comments		
							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
BEW1	Brewer's Wren	1		1	3	X	X												
2																			
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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 - Tapack Year: 2010
 UTM's of Plot Corner: 1 785450 1 3831950
 Surveyor Name(s): John Diemel

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		
Verdian	2.5		
Gambel'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		
W.K. 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 (refer 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	—	—	—	—	—	—	—	—	—	—	100	IN
	SOSP2	—	—	—	—	—	—	—	—	—	—	0	OUT
	SOSP3	—	—	—	—	—	—	—	—	—	—	0	OUT
	SOSP4	—	—	—	—	—	—	—	—	—	—	0	OUT

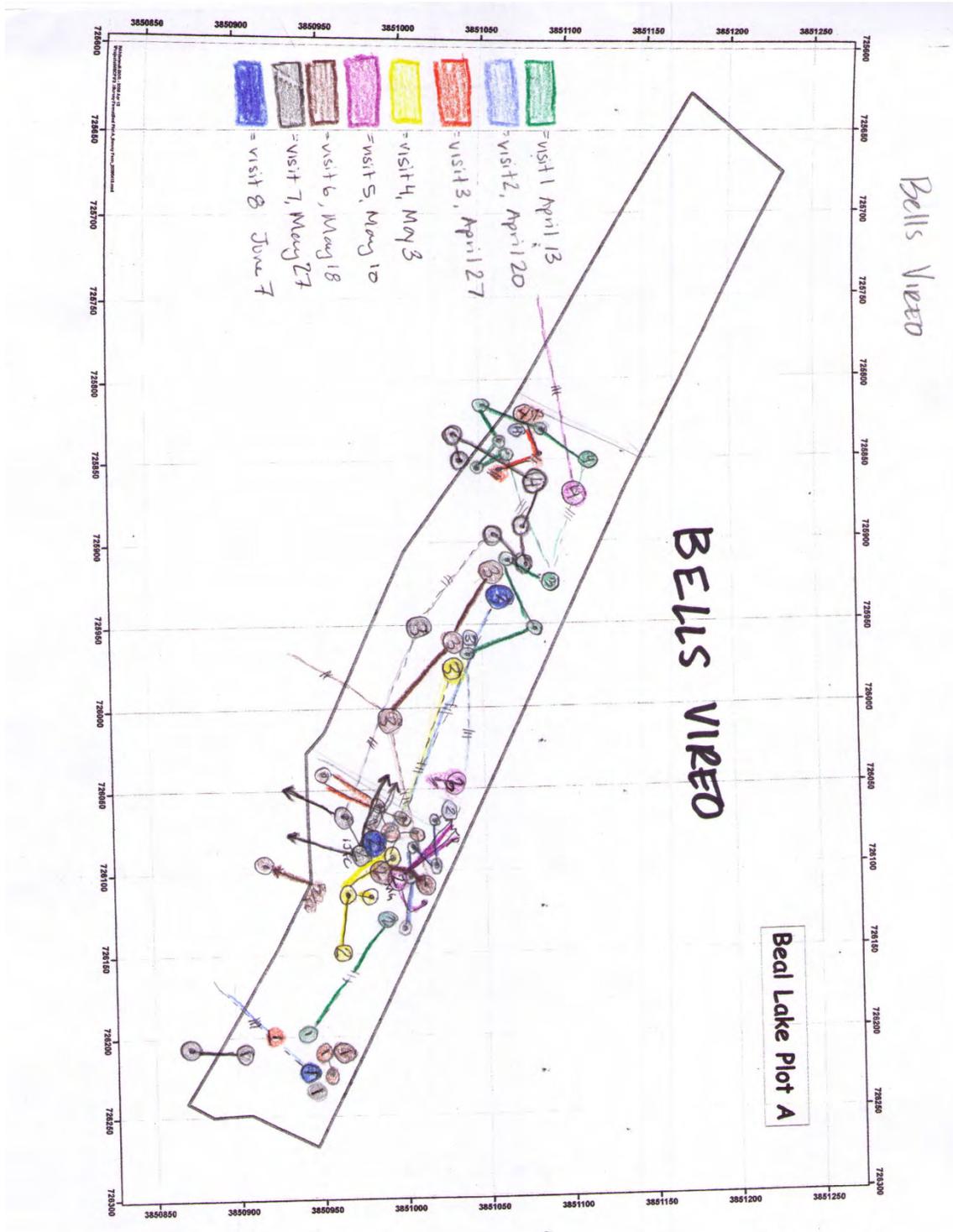
construction: nest being constructed (evidence: nest material carried or construction observed)
 eggs: nest being incubated (evidence: adult observed incubating eggs, or nest with eggs found)
 nestlings: young present in nest (evidence: food carried to nest, fecal sacs carried away from nest, begging 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 (Arizona Bell's vireo) compiled at the end of an intensive survey effort for each species on the plot.



Appendix 3. Rapid Area Search Protocol.

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

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

There are 2 main differences between intensive rapid surveys:

1. Rapid surveys happen 2 times in the season- once in the 1st half of the season and once in the 2nd half- Intensive surveys happen once a week for 8 weeks throughout the season.

2. In rapid surveys, we will not be making territory maps for all the species in the plot- We will just need to determine the number of breeding pairs of all species in the plot. We will still mark down individuals' locations on the grid or photomap, and we will use this information to determine if territories should be counted in or out. The final call will be made by the surveyor immediately after the 2nd 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 1st half of the season- Know which birds are known breeders and which are known migrants- don't spend time with known migrants- record their presence and move on to the next bird. Similarly, record fly-overs and move on.

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

If LCR MSCP 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.

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Appendix 4a. Presence of migrants and other non-breeders, by species, detected during rapid area searches at Beal Lake habitat creation plots in 2011. Fly-overs are included in this list, but incidental birds that were not in or above the plot during the survey are not included. 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 *. Listed in alphabetical order.

Species	BEAL A	BEAL B	BEAL C	BEAL D
Audubon's Warbler		X*		
Dusky Flycatcher			X*	
Gray Vireo			X*	
Hammond's Flycatcher			X*	
Lazuli Bunting				X*
Orange-crowned Warbler		X*	X*	
Pacific-slope Flycatcher	X*	X*		
Townsend's Warbler			X*	
Violet-green Swallow				X*
Western Tanager		X*		
Western Wood-Pewee	X*	X*	X*	X*
Wilson's Warbler	X*	X*	X*	
Yellow-rumped Warbler	X*		X*	

* LCR MSCP covered species

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Appendix* 4b. Presence of migrants and other non-breeders, by species, detected during rapid area searches at CRIT 9 habitat creation plots in 2011. Fly-overs are included in this list, but incidental birds that were not in or above the plot during the survey are not included. 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 *. Listed in alphabetical order.

Species	CRIT Plot A	CRIT Plot B	CRIT Plot C	CRIT Plot D	CRIT Plot E
Audubon's Warbler			X*		X*
Cassin's Vireo			X*	X*	
Dusky Flycatcher				X*	
Hammond's Flycatcher			X*		X*
Northern Mockingbird					X
Orange-crowned Warbler			X*		
Pacific-slope Flycatcher	X*	X*	X*	X*	X*
Swainson's Thrush	X*				
Warbling Vireo	X*		X*	X*	
Western Tanager		X*		X*	X*
Western Wood-Pewee	X*	X*	X*	X*	X*
Wilson's Warbler			X*	X*	X*
Yellow-rumped Warbler			X*		

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Appendix 4c. Presence of migrants and other non-breeders, by species, detected during rapid area searches at CVCA habitat creation plots in 2011. Fly-overs are included in this list, but incidental birds that were not in or above the plot during the survey are not included. 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 *. Listed in alphabetical order.

Species	CVCA Phase 1	CVCA Phase 2	CVCA Phase 3	CVCA Phase 4	CVCA Phase 5
American Pipit					X*
Audubon's Warbler	X*	X*	X*		
Black-headed Grosbeak		X*		X*	X*
Black-throated Gray Warbler		X*	X*		
Brewer's Blackbird			X*		
Brewer's Sparrow				X*	X*
Chipping Sparrow				X*	
Clay-colored Sparrow				X*	
Cliff Swallow	X		X	X	
Dusky Flycatcher	X*				
Flycatcher spp.		X*			
Hermit Thrush			X*		
Hummingbird spp.		X*			
Lincoln's Sparrow				X*	
MacGillivray's Warbler		X*		X*	
Mountain White-crowned Sparrow				X*	
Nashville Warbler	X*				
Northern Rough-winged Swallow			X		
Orange-crowned Warbler	X*	X*	X*		X*
Pacific-slope Flycatcher	X*		X*		
Phainopepla		X			
Rufous Hummingbird				X*	
Savannah Sparrow					X*
Say's Phoebe				X	X
Solitary Vireo			X*		
Swainson's Hawk			X*^		
Swainson's Thrush	X*				X*
Townsend's Warbler	X*				
Tree Swallow			X*		
Turkey Vulture	X^		X^		

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Species	CVCA Phase 1	CVCA Phase 2	CVCA Phase 3	CVCA Phase 4	CVCA Phase 5
Warbling Vireo	X*	X*	X*		X*
“Western” Flycatcher	X*	X*	X*		
Western Tanager	X*	X*	X*	X*	
Western Wood-Pewee	X*	X*	X*		X*
White-crowned Sparrow	X*		X*	X*	X*
White-tailed Kite		X			X
Willow Flycatcher*	X	X			X
Wilson's Warbler	X*	X*	X*	X*	X*
Yellow-rumped Warbler			X*		

*LCR-MSCP covered species

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Appendix 4d. Presence of migrants and other non-breeders, by species, detected during rapid area searches at PVER habitat creation plots in 2011. Fly-overs are included in this list, but incidental birds that were not in or above the plot during the survey are not included. 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 *. Listed in alphabetical order.

Species	PVER Phase 1 Plot A	PVER Phase 2 Plot A	PVER Phase 3 Plot A	PVER Phase 4 Plot A	PVER Phase 5 Plot A
American Pipit			X*		
Audubon's Warbler			X*		
Barn Swallow					X*^
Black and White Warbler	X*				
Black-crowned Night-Heron			X		
Black-headed Grosbeak		X*		X*	
Black-tailed Gnatcatcher			X		
Brewer's Sparrow					X*
Cliff Swallow					X
Common Raven			X		X
Costa's Hummingbird			X*		
Empidonax spp.		X*			
European Starling				X	
Great Blue Heron					X^
Great Egret			X		
Hammond's Flycatcher		X*	X*		
House Wren			X		
Indigo Bunting				X	
Killdeer					X
Long-billed Curlew					X*
Marsh Wren			X		
Northern Rough-winged Swallow					X
Olive-sided Flycatcher	X*		X*		
Orange-crowned Warbler	X*				
Pacific-slope Flycatcher		X*			
Peregrine Falcon			X		
Ring-billed Gull			X*		
Savannah Sparrow					X*
Say's Phoebe					X

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Species	PVER Phase 1 Plot A	PVER Phase 2 Plot A	PVER Phase 3 Plot A	PVER Phase 4 Plot A	PVER Phase 5 Plot A
Sharp-shinned Hawk			X^		
Short-eared Owl					X*
Swainson's Thrush	X*				
Townsend's Warbler		X*	X*		
Tree Swallow					X*^
Turkey Vulture			X^		X^
Vaux's Swift				X^	
Warbling Vireo		X*	X*		
“Western” Flycatcher			X*		
Western Tanager	X*	X*	X*		
Western Wood-Pewee		X*	X*		
White-faced Ibis			X^		X^
White-winged Dove					X
Willow Flycatcher*		X			
Wilson's Warbler	X*	X*	X*	X*	X*
Winter Wren			X*		
Yellow-rumped Warbler	X*		X*		

* LCR MSCP covered species

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Appendix 4e. Presence of migrants and presumed non-breeders, by species, detected during rapid area searches at the Cibola Farm Unit 1 sites in 2011. Fly-overs are included in this list, but incidental birds that were not in or above the plot during the survey are not included. 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 *. Listed in alphabetical order.

Species	Nature Trail North Plot A	Nature Trail South Plot B	Cibola Farm Unit Area 1 Plot A	Cibola Farm Unit Area 1 Plot B	Cibola Farm Unit Area 1 Plot C	Cibola Farm Unit Area 1 - Plot D
American Kestrel			X	X		
Audubon's Warbler		X*				
Barn Swallow				X*^		
Blackburnian Warbler			X*			
Black-crowned Night-Heron			X	X		
Black-headed Grosbeak	X*	X*		X*		
Black-throated Gray Warbler	X*	X*				
Brewer's Blackbird			X*	X*		
Broad-winged Hawk	X*^					
Chipping Sparrow					X*	
Common Ground-Dove		X				
Cooper's Hawk		X				X
Dusky Flycatcher		X*	X*			
Gray Flycatcher		X*				
Great-tailed Grackle		X				
Hermit Thrush			X*			
Indigo Bunting			X			
Killdeer		X				
Ladder-backed Woodpecker			X	X		
Lawrence's Goldfinch	X					
Lazuli Bunting		X*		X*		
MacGillivray's Warbler	X*	X*				
Marsh Wren			X			
Nashville Warbler		X*				
Olive-sided Flycatcher				X*		
Orange-crowned Warbler	X*	X*			X*	
Red-winged Blackbird	X	X				
Rose-breasted Grosbeak				X*		
Say's Phoebe					X	

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Sharp-shinned Hawk			X	X		
Song Sparrow			X			
Swainson's Thrush		X*				
Townsend's Warbler	X*	X*	X*	X*		
Tree Swallow			X*^	X*^		
Turkey Vulture			X^	X^		
Warbling Vireo		X*	X*	X*		X*
“Western” Flycatcher	X*	X*	X*	X*		
Western Meadowlark		X		X		
Western Tanager	X*	X*	X*			X*
Western Wood-Pewee	X*	X*	X*	X*	X*	X*
White-faced Ibis				X^		
White-tailed Kite	X*		X*	X*		
White-throated Swift				X^		
Willow Flycatcher*		X	X	X		
Wilson's Warbler	X*	X*	X*	X*		X*
Yellow Warbler					X	
Yellow-headed Blackbird		X	X	X		

* LCR MSCP covered species

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Appendix 4f. Presence of migrants and presumed non-breeders, by species, detected during rapid area searches at the Cibola Farm Unit 5: Crane Roost sites in 2011. Fly-overs are included in this list, but incidental birds that were not in or above the plot during the survey are not included. 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 *. Listed in alphabetical order.

Species	Plot A	Plot B	Plot C	Plot D	Plot E	Plot F
Barn Swallow			X*^			
Black-headed Grosbeak	X*			X*		
Great Blue Heron						X
House Finch				X		
Lawrence's Goldfinch				X		
Lazuli Bunting	X*			X*		
MacGillivray's Warbler				X*		
Northern Rough-winged Swallow			X			X
Orange-crowned Warbler						X*
Pacific-slope Flycatcher				X*		
Phainopepla						X
Townsend's Warbler				X*		
Warbling Vireo	X*	X*		X*		X*
Western Tanager				X*		
Western Wood-Pewee				X*		X*
White-faced Ibis	X^					
Willow Flycatcher*				X		
Wilson's Warbler				X*	X*	X*
Yellow Warbler*				X		

*LCR-MSCP covered species

Appendix 5. Comprehensive species list from avian surveys conducted along the lower Colorado River in 2011. * 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	Rapid			Intensive		
		System-wide	Habitat Creation	Laguna Division Conservation Area	System-wide	Habitat Creation	Laguna Division Conservation Area
Abert's Towhee	<i>Melospiza aberti</i>	X	X	X	X	X	X
American Avocet*	<i>Recurvirostra americana</i>	X					
American Bittern*	<i>Botaurus lentiginosus</i>	X					
American Coot	<i>Fulica americana</i>	X		X	X		X
American Kestrel	<i>Falco sparverius</i>	X	X				
American Pipit*	<i>Anthus rubescens</i>		X				
American White Pelican*^	<i>Pelecanus erythrorhynchos</i>	X					
Anna's Hummingbird	<i>Calypte anna</i>	X	X	X	X	X	X
Ash-throated Flycatcher	<i>Myiarchus cinerascens</i>	X	X	X	X	X	X
Bank Swallow*	<i>Riparia riparia</i>	X		X			X
Barn Owl	<i>Tyto alba</i>		X				
Barn Swallow*	<i>Hirundo rustica</i>	X	X	X	X		X
Arizona Bell's vireo	<i>Vireo bellii</i>	X	X	X	X	X	
Belted Kingfisher	<i>Megasceryle alcyon</i>	X	X				
Bewick's Wren	<i>Thryomanes bewickii</i>	X	X	X	X		
Black Phoebe	<i>Sayornis nigricans</i>	X		X			X
Black Rail	<i>Laterallus jamaicensis</i>	X		X	X		
Black-bellied Plover*	<i>Pluvialis squatarola</i>	X					
Blackburnian Warbler*	<i>Dendroica fusca</i>		X				
Black-chinned Hummingbird	<i>Archilochus alexandri</i>	X	X	X	X	X	X
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>	X	X				
Black-headed Grosbeak*	<i>Pheucticus melanocephalus</i>	X	X	X	X	X	

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Species	Scientific Name	Rapid			Intensive		
		System-wide	Habitat Creation	Laguna Division Conservation Area	System-wide	Habitat Creation	Laguna Division Conservation Area
Black-necked Stilt*	<i>Himantopus mexicanus</i>	X		X			X
Black-tailed Gnatcatcher	<i>Polioptila melanura</i>	X	X	X	X	X	X
Black-throated Gray Warbler*	<i>Dendroica nigrescens</i>	X	X		X	X	
Black-throated Sparrow	<i>Amphispiza bilineata</i>	X			X		
Blue Grosbeak	<i>Passerina caerulea</i>	X	X	X	X	X	X
Blue-gray Gnatcatcher	<i>Polioptila caerulea</i>	X		X			
Brewer's Blackbird*	<i>Euphagus cyanocephalus</i>		X				
Brewer's Sparrow*	<i>Spizella breweri</i>	X	X	X			X
Broad-winged Hawk*^	<i>Buteo platypterus</i>		X				
Bronzed Cowbird*	<i>Molothrus aeneus</i>	X					
Brown-crested Flycatcher	<i>Myiarchus tyrannulus</i>	X					
Brown-headed Cowbird	<i>Molothrus ater</i>	X	X	X	X	X	X
Bullock's Oriole	<i>Icterus bullockii</i>	X	X	X	X	X	X
Burrowing Owl	<i>Athene cunicularia</i>	X					
Bushtit*	<i>Psaltriparus minimus</i>	X					
Cactus Wren	<i>Campylorhynchus brunneicapillus</i>	X					
Canyon Wren	<i>Catherpes mexicanus</i>	X					
Caspian Tern*^	<i>Hydroprogne caspia</i>	X					
Cassin's Vireo*	<i>Vireo cassinii</i>	X	X		X	X	
Cedar Waxwing*	<i>Bombycilla cedrorum</i>	X					
Chipping Sparrow*	<i>Spizella passerina</i>	X	X	X	X		
Cinnamon Teal*	<i>Anas cyanoptera</i>	X					
Yuma Clapper rail	<i>Rallus longirostris</i>	X		X			
Clay-colored Sparrow*	<i>Spizella pallida</i>		X				
Cliff Swallow	<i>Petrochelidon pyrrhonota</i>	X	X	X	X		X
Common Ground-Dove	<i>Columbina passerina</i>	X	X	X		X	

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Species	Scientific Name	Rapid			Intensive		
		System-wide	Habitat Creation	Laguna Division Conservation Area	System-wide	Habitat Creation	Laguna Division Conservation Area
Common Moorhen	<i>Gallinula chloropus</i>	X			X		
Common Raven	<i>Corvus corax</i>	X	X		X	X	
Common Snipe	<i>Gallinago gallinago</i>	X					
Common Yellowthroat	<i>Geothlypis trichas</i>	X	X	X	X	X	X
Cooper's Hawk	<i>Accipiter cooperii</i>	X	X			X	
Cordilleran Flycatcher*	<i>Empidonax occidentalis</i>	X					
Costa's Hummingbird	<i>Calypte costae</i>	X	X	X			
Crissal Thrasher	<i>Toxostoma crissale</i>	X	X	X	X		X
Double-crested Cormorant^	<i>Phalacrocorax auritus</i>	X		X			
Dusky Flycatcher*	<i>Empidonax oberholseri</i>		X			X	
Eared Grebe	<i>Podiceps nigricollis</i>	X					
Eurasian Collared-Dove	<i>Streptopelia decaocto</i>	X	X	X		X	
European Starling	<i>Sturnus vulgaris</i>	X	X	X		X	
Gadwall^	<i>Anas strepera</i>	X		X			
Gambel's Quail	<i>Callipepla gambelii</i>	X	X	X	X	X	X
Gila Woodpecker	<i>Melanerpes uropygialis</i>	X		X	X		
Gilded Flicker	<i>Colaptes chrysoides</i>	X					
Gray Flycatcher*	<i>Empidonax wrightii</i>	X	X	X		X	
Gray Vireo*	<i>Vireo vicinior</i>		X				
Great Blue Heron	<i>Ardea herodias</i>	X	X	X			
Great Egret	<i>Ardea alba</i>	X	X	X			X
Great Horned Owl	<i>Bubo virginianus</i>	X	X				
Greater Roadrunner	<i>Geococcyx californianus</i>	X	X	X	X	X	
Great-tailed Grackle	<i>Quiscalus mexicanus</i>	X	X	X	X	X	X
Green Heron	<i>Butorides virescens</i>	X		X			X
Green-tailed Towhee*	<i>Pipilo chlorurus</i>	X					

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Species	Scientific Name	Rapid			Intensive		
		System-wide	Habitat Creation	Laguna Division Conservation Area	System-wide	Habitat Creation	Laguna Division Conservation Area
Hammond's Flycatcher*	<i>Empidonax hammondii</i>	X	X		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			X		
House Wren	<i>Troglodytes aedon</i>	X	X		X		
Indigo Bunting	<i>Passerina cyanea</i>		X	X			X
Killdeer	<i>Charadrius vociferus</i>	X	X	X		X	X
Ladder-backed Woodpecker	<i>Picoides scalaris</i>	X	X	X	X	X	X
Lark Sparrow*	<i>Chondestes grammacus</i>	X			X		
Lawrence's Goldfinch	<i>Spinus lawrencei</i>	X	X				
Lazuli Bunting	<i>Passerina amoena</i>	X	X	X		X	X
Least Bittern	<i>Ixobrychus exilis</i>	X			X		
Least Sandpiper*	<i>Calidris minutilla</i>	X					
Lesser Goldfinch	<i>Spinus psaltria</i>	X	X	X	X	X	X
Lesser Nighthawk	<i>Chordeiles acutipennis</i>	X		X	X		X
Lincoln's Sparrow*	<i>Melospiza lincolnii</i>	X	X				
Little Blue Heron	<i>Egretta caerulea</i>	X					
Loggerhead Shrike	<i>Lanius ludovicianus</i>	X	X	X	X		
Long-billed Curlew*	<i>Numenius americanus</i>	X	X				
Lucy's Warbler	<i>Oreothlypis luciae</i>	X	X	X	X		X
MacGillivray's Warbler*	<i>Oporornis tolmiei</i>	X	X	X	X	X	
Mallard	<i>Anas platyrhynchos</i>	X		X			X
Marsh Wren	<i>Cistothorus palustris</i>	X	X	X	X		X

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Species	Scientific Name	Rapid			Intensive		
		System-wide	Habitat Creation	Laguna Division Conservation Area	System-wide	Habitat Creation	Laguna Division Conservation Area
Mountain White-crowned Sparrow*	<i>Zonotrichia l. oriantha</i>		X				
Mourning Dove	<i>Zenaida macroura</i>	X	X	X	X	X	X
Nashville Warbler*	<i>Oreothlypis ruficapilla</i>	X	X	X	X	X	
Northern Harrier	<i>Circus cyaneus</i>		X				
Northern Mockingbird	<i>Mimus polyglottos</i>	X	X	X			X
Northern Pintail*	<i>Anas acuta</i>	X					
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>	X	X	X	X		X
Olive-sided Flycatcher*	<i>Contopus cooperi</i>	X	X	X			
Orange-crowned Warbler*	<i>Oreothlypis celata</i>	X	X	X	X	X	X
Osprey	<i>Pandion haliaetus</i>	X		X			X
Peregrine Falcon	<i>Falco peregrinus</i>	X	X				
Phainopepla	<i>Phainopepla nitens</i>	X	X	X			X
Pied-billed Grebe	<i>Podilymbus podiceps</i>	X		X	X		
Plumbeous Vireo*	<i>Vireo plumbeus</i>	X					
Prairie Falcon^	<i>Falco mexicanus</i>	X					
Red-breasted Nuthatch*	<i>Sitta canadensis</i>	X					
Redhead*	<i>Aythya americana</i>	X					
Red-tailed Hawk	<i>Buteo jamaicensis</i>	X	X			X	
Red-winged Blackbird	<i>Agelaius phoeniceus</i>	X	X	X	X	X	X
Ring-billed Gull*^	<i>Larus delawarensis</i>		X				
Ring-necked Duck*^	<i>Aythya collaris</i>	X					
Rock Pigeon	<i>Columba livia</i>	X					
Rock Wren	<i>Salpinctes obsoletus</i>	X					
Rose-breasted Grosbeak*	<i>Pheucticus ludovicianus</i>		X				
Ruby-crowned Kinglet*	<i>Regulus calendula</i>	X					
Ruddy Duck*	<i>Oxyura jamaicensis</i>	X					

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Species	Scientific Name	Rapid			Intensive		
		System-wide	Habitat Creation	Laguna Division Conservation Area	System-wide	Habitat Creation	Laguna Division Conservation Area
Rufous Hummingbird*	<i>Selasphorus rufus</i>		X				
Rufous-winged Sparrow*	<i>Peucaea carpalis</i>	X					
Savannah Sparrow*	<i>Passerculus sandwichensis</i>	X	X				
Say's Phoebe	<i>Sayornis saya</i>	X	X	X	X	X	
Scott's Oriole	<i>Icterus parisorum</i>			X			
Sharp-shinned Hawk	<i>Accipiter striatus</i>		X				
Short-billed Dowitcher*	<i>Limnodromus griseus</i>			X			X
Short-eared Owl*	<i>Asio flammeus</i>		X				
Snowy Egret	<i>Egretta thula</i>	X		X	X		
Solitary Sandpiper*	<i>Tringa solitaria</i>	X					
“Solitary” Vireo*	<i>Vireo (sp)</i>		X				
Song Sparrow	<i>Melospiza melodia</i>	X	X	X	X	X	X
Sora	<i>Porzana carolina</i>	X					
Spotted Sandpiper	<i>Actitis macularius</i>	X		X			
Summer Tanager	<i>Piranga rubra</i>	X	X		X	X	
Swainson's Hawk*	<i>Buteo swainsoni</i>	X	X				
Swainson's Thrush*	<i>Catharus ustulatus</i>	X	X		X	X	
Townsend's Warbler*	<i>Dendroica townsendi</i>	X	X	X	X	X	X
Tree Swallow	<i>Tachycineta bicolor</i>	X	X	X	X		X
Turkey Vulture^	<i>Cathartes aura</i>	X	X	X	X		X
Vaux's Swift^	<i>Chaetura vauxi</i>	X	X				
Verdin	<i>Auriparus flaviceps</i>	X	X	X	X	X	X
Vermilion Flycatcher	<i>Pyrocephalus rubinus</i>	X	X			X	
Violet-green Swallow	<i>Tachycineta thalassina</i>	X	X	X			
Virginia Rail	<i>Rallus limicola</i>	X		X			
Virginia's Warbler*	<i>Oreothlypis virginiae</i>			X			

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Species	Scientific Name	Rapid			Intensive		
		System-wide	Habitat Creation	Laguna Division Conservation Area	System-wide	Habitat Creation	Laguna Division Conservation Area
Warbling Vireo*	<i>Vireo gilvus</i>	X	X	X	X	X	X
“Western” Flycatcher*	<i>Empidonax difficilis/occid.</i>	X	X	X	X	X	X
Western Grebe	<i>Aechmophorus occidentalis</i>	X					
Western Kingbird	<i>Tyrannus verticalis</i>	X	X	X	X	X	
Western Meadowlark	<i>Sturnella neglecta</i>	X	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	X	X	X
Western Wood-Pewee*	<i>Contopus sordidulus</i>	X	X	X	X	X	X
Whimbrel*	<i>Numenius phaeopus</i>	X					
White-crowned Sparrow*	<i>Zonotrichia leucophrys</i>	X	X	X	X		
White-faced Ibis^	<i>Plegadis chihi</i>	X	X	X	X		X
White-tailed Kite	<i>Elanus leucurus</i>		X				
White-throated Swift	<i>Aeronautes saxatalis</i>	X	X				
White-winged Dove	<i>Zenaida asiatica</i>	X	X	X	X	X	X
Willet*	<i>Tringa semipalmata</i>	X					
Willow Flycatcher	<i>Empidonax traillii</i>	X	X	X	X	X	X
Wilson's Snipe	<i>Gallinago delicata</i>	X					
Wilson's Warbler*	<i>Wilsonia pusilla</i>	X	X	X	X	X	X
Winter Wren*	<i>Troglodytes hiemalis</i>		X				
Yellow Warbler	<i>Dendroica petechia</i>	X	X	X	X	X	X
Yellow-breasted Chat	<i>Icteria virens</i>	X	X	X	X	X	X
Yellow-headed Blackbird	<i>Xanthocephalus xanthocephalus</i>	X	X	X		X	
Yellow-rumped Warbler*	<i>Dendroica coronata</i>	X	X	X	X	X	X

Appendix 6. List of all rapid area search plots surveyed for Components 1, 2, and 3 in 2011.

Plot Number	System-wide plots (n=80)	Habitat Creation (n=60)	LDCA (n=35)	Intensive area search - type	EI area search
1585	X				
1705	X				
1767	X				
1877	X				
1890	X				
1908	X				
2090	X				
2115	X				
2119	X			yes-system-wide	
2424	X			yes-system-wide	
2549	X			yes-system-wide	
2556	X				
2614	X				
2617	X				
2636	X				
2647	X				
2697	X				
2833	X				
2856	X				
2861	X			yes-system-wide	
2863	X				
2864	X				
2873	X				
2878	X			yes-system-wide	yes
2885	X				
2890	X				
2924	X				
2926	X				
3059	X				
3064	X				
3138	X				
5135	X				
5383	X				
5612	X				
5747	X				
5752	X				
5834	X				
6115	X				
6162	X				
6222	X				
6235	X				

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Plot Number	System-wide plots (n=80)	Habitat Creation (n=60)	LDCA (n=35)	Intensive area search - type	EI area search
6343	X				
6394	X				
6431	X				
6432	X				
6443	X				
6462	X				
6523	X				
6529	X			yes-system-wide	yes
6581	X				
6589	X				
6633	X				
6678	X				
6721	X				
6732	X				
6786	X				
6985	X				
7107	X				
7186	X				
7226	X				
7336	X				
7337	X				
7531	X				
7592	X				
7606	X				
7608	X				
7784			X	yes- LDCA	
7786	X				
7789			X		
7791			X		
7796			X		
7797			X		
7798			X		
7803			X	yes- LDCA	
7804			X		
7805			X		
7810			X		
7813			X		
7814			X		
7815			X		
7820			X		
7821			X		
7822			X		
7823			X		
7832			X	yes- LDCA	

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Plot Number	System-wide plots (n=80)	Habitat Creation (n=60)	LDCA (n=35)	Intensive area search - type	EI area search
7833			X		
7834			X		
7846			X		
7864			X		
7865			X		
7876			X		
7877			X		
7887			X		
7898			X		
7909			X		
7910			X		
7927			X	yes- LDCA	
7928			X		
7940			X		
7942			X		
7950			X		
7951			X		
7960	X			yes-system-wide	
7984	X				
7992	X			yes-system-wide	
8011	X				
8253	X				
8546	X				
8650	X				
9113	X				
9386	X				
9401	X				
9419	X				
8223	X			yes- for Component 3 only	yes
9427	X				
8226				yes- for Component 3 only	yes
8252				yes- for Component 3 only	yes
8682				yes- for Component 3 only	yes
Beal Plot A		X			
Beal Plot B		X			
Beal Plot C		X			
Beal Plot D		X			
Cibola Farm Unit Area 1 - Mass Plot D		X			
Cibola Farm Unit Area 1 Plot A		X			
Cibola Farm Unit Area 1 Plot B		X			

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Plot Number	System-wide plots (n=80)	Habitat Creation (n=60)	LDCA (n=35)	Intensive area search - type	EI area search
Cibola Farm Unit Area 1 Plot C		X			
Crane Roost Plot A		X			
Crane Roost Plot B		X			
Crane Roost Plot C		X			
Crane Roost Plot D		X			
Crane Roost Plot E		X			
Crane Roost Plot F		X			
CRIT 9 AHAKHAV PRESERVE Plot A		X			
CRIT 9 AHAKHAV PRESERVE Plot B		X			
CRIT 9 AHAKHAV PRESERVE Plot C		X		yes- for Component 3 only	yes
CRIT 9 AHAKHAV PRESERVE Plot D		X		yes- HC	
CRIT 9 AHAKHAV PRESERVE Plot E		X			
CVCA Phase 1 Plot A		X			
CVCA Phase 1 Plot B		X			
CVCA Phase 1 Plot C		X		yes- HC	
CVCA Phase 1 Plot D		X		yes- HC	
CVCA Phase 1 Plot E		X			
CVCA Phase 2 Plot A		X			
CVCA Phase 2 Plot B		X			
CVCA Phase 2 Plot C		X			
CVCA Phase 3 Plot A		X			
CVCA Phase 3 Plot B		X			
CVCA Phase 3 Plot C		X			
CVCA Phase 3 Plot D		X			
CVCA Phase 4 Plot A		X			
CVCA Phase 4 Plot B		X			
CVCA Phase 4 Plot C		X			
CVCA Phase 4 Plot D		X			
CVCA Phase 4 Plot E		X			
CVCA Phase 4 Plot F		X			
CVCA Phase 5 Plot A		X			
CVCA Phase 5 Plot B		X			
Nature Trail North Plot A		X			
Nature Trail South Plot B		X		yes- HC	
PVER Phase 1 Plot A		X			
PVER Phase 2 Plot A		X			
PVER Phase 2 Plot B		X			
PVER Phase 2 Plot C		X			
PVER Phase 3 Plot A		X			
PVER Phase 3 Plot B		X			

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Plot Number	System-wide plots (n=80)	Habitat Creation (n=60)	LDCA (n=35)	Intensive area search - type	EI area search
PVER Phase 3 Plot C		X			
PVER Phase 4 Plot A		X			
PVER Phase 4 Plot B		X			
PVER Phase 4 Plot C		X			
PVER Phase 4 Plot D		X			
PVER Phase 5 Plot A		X			
PVER Phase 5 Plot B		X			
PVER Phase 5 Plot C		X			
PVER Phase 5 Plot D		X			
PVER Phase 5 Plot E		X			
PVER Phase 5 Plot F		X			
PVER Phase 5 Plot G		X			
PVER Phase 5 Plot H		X			

Appendix 7. Table of all the plots surveyed with the intensive survey method, 2011.

Plots surveyed with Intensive Method 2011	System-wide intensive (n=8)	Habitat Creation intensive (n=4)	Extra intensive (n=7)	LDCA intensive (n=4)
2119	yes			
2424	yes			
2549	yes			
2861	yes			
2878	yes		yes	
6529	yes		yes	
7784				yes
7803				yes
7832				yes
7927				yes
7960	yes			
7992	yes			
8223			yes	
8226			yes	
8252			yes	
8682			yes	
CRIT 9 AHAKHAV PRESERVE Plot C			yes	
CRIT 9 AHAKHAV PRESERVE Plot D		yes		
CVCA Phase 1 Plot C		yes		
CVCA Phase 1 Plot D		yes		
Nature Trail South Plot B		yes		