Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Avian Use of Habitat Creation Projects 2006 Annual Report

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

November 2007

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Lower Colorado River
Multi-Species Conservation Program

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2006 Annual Report

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Acronyms and Abbreviations

AGFD	Arizona Game and Fish Department
ANOVA	Analysis of Variance (statistical)
AOU	American Ornithological Union
CDFG	California Department of Fish and Game
CNWR	Cibola National Wildlife Refuge
CRIT	Colorado River Indian Tribes
CVCA	Cibola Valley Conservation Area
CW	Cottonwood-Willow land cover type, as defined in the LCR MSCP HCP
E	Evenness
H'	Ecological Species Diversity in terms of bits
ha	Hectare
HCP	Habitat Conservation Plan
HNWR	Havasu National Wildlife Refuge
LCR	Lower Colorado River
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
MAPS	Monitoring Avian Productivity and Survivorship
MCWA	Mohave County Water Authority
n	Sample size
N_1	Ecological Species Diversity in terms of species
P	Probability (statistical)
PVER	Palo Verde Ecological Reserve
Reclamation	Bureau of Reclamation
S	Species Richness
SE	Standard Error
SWFL	Southwestern Willow Flycatcher
WIFL	Willow Flycatcher
YBCU	Yellow-billed Cuckoo
%	Percent

Introduction

Avian pre- and post-development monitoring have been conducted at habitat creation projects during the breeding season of 2006 to fulfill requirements of the lower Colorado River Multi-Species Conservation Program (LCR MSCP). Avian pre- and post-development monitoring have the following objectives: 1) to estimate presence and absence of avian species, 2) to estimate density of LCR MSCP covered species, 3) to create habitat models for all habitats where pre-development monitoring is conducted, and 4) to estimate indices such as avian relative abundance, species richness, species composition, and evenness. Avian species are good indicators of ecosystem health due to their sensitivity to environmental change regarding a variety of physical and biological factors (Elliot et al. 2004).

Avian pre-development monitoring acts as a baseline to compare with avian post-development monitoring. This monitoring provides Reclamation with quantitative data on how restoring native habitat changes avian abundance, composition, diversity, and richness in an area, especially in regards to LCR MSCP covered species. Avian pre-development monitoring also detects any LCR MSCP covered avian species that are utilizing the current habitat and could possibly be affected by habitat manipulation that may occur at the sites of habitat creation projects. Avian post-development monitoring allows Reclamation to analyze the effectiveness of created habitats in terms of providing habitat to LCR MSCP covered avian species and other riparian-obligate sensitive avian species

Avian post-development monitoring during the breeding season has been conducted at habitat creation projects along the LCR since 2002. This report compares avian abundance, composition, diversity, and richness between one demonstration project (Cibola Nature Trail) and three LCR MSCP projects (Cibola Valley Conservation Area Phase 1, CRIT 9, Beal Lake) after habitat has been developed. This report also compares avian abundance, composition, diversity, and richness between three LCR MSCP future projects (Cibola Valley Conservation Area Phase 2, Palo Verde, Hart Mine Marsh) before habitat has been developed.

Study Areas

Beal Lake Riparian Habitat Creation Project

Beal Riparian is a two-phase project that was initiated in the spring of 2003. The 100-acre (40 ha) project is a joint effort between Reclamation and the Havasu National Wildlife Refuge (HNWR) to evaluate riparian habitat creation techniques for the improvement of habitat for the southwestern willow flycatcher (*Empidonax traillii extimus*) (SWFL) and other terrestrial and marsh species of concern (LCR MSCP 2006a). When complete, the project will contain approximately 100 acres (40 ha) of Fremont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii*), and coyote willow (*Salix exigua*) habitat. For further description of the project, refer to *Beal Lake Riparian Development: Overview* (LCR MSCP 2006a).

Cibola Nature Trail Habitat Creation Project

The Cibola Nature Trail was established in 1999 as a joint effort between Reclamation and the Cibola National Wildlife Refuge (CNWR) to create specific habitat for the SWFL (BR 2003).

The Cibola Nature Trail is a 22.5 acre (9.1 ha) project located at the CNWR that contains three distinct areas: 1) a 13.6-acre (5.5 ha) mixture of honey (*Prosopis glandulosa*) and screwbean mesquite (*Prosopis pubescens*), 2) a 6.4-acre (2.6 ha) area of Goodding's willow, and 3) a 2.5-acre (1.0 ha) area of Fremont cottonwood. For further description of the project refer to *Riparian Habitat Vegetation Monitoring at the Cibola NWR Nature Trail: 2006* (LCR MSCP 2007a).

Cibola Valley Conservation Area Habitat Creation Project

The Cibola Valley Conservation Area (CVCA) is located in Arizona between river miles 98.8 and 104.9, and is a 1,019-acre (412 ha) multiphase project to convert agricultural fields into riparian habitat. The initial partnership for CVCA includes Reclamation, Mohave County Water Authority (MCWA), and the Arizona Game and Fish Department (AGFD). Phase 1 was implemented in Fiscal Year 2006 and converted approximately 64 acres (26 ha) of active agricultural fields to cottonwood-willow (CW) habitat. Additionally, 22 acres (9 ha) were established as an on-site native plant nursery for future plant stock collection and will be managed for habitat after other nurseries have been developed for the LCR MSCP. Phase 2 is scheduled to begin in Fiscal Year 2007 and will restore 80 acres (32 ha) of habitat. Phase 3 is scheduled to begin in Fiscal Year 2008 and will restore 100 acres (40 ha) of habitat. This habitat will be managed for the SWFL, western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) (YBCU), and other covered species listed in the LCR MSCP Habitat Conservation Plan (HCP). For further description of this project refer to *Cibola Valley Conservation Area Development Plan* (LCR MSCP 2005a).

CRIT 9 'Ahakhav Preserve Habitat Creation Project

The 'Ahakhav Tribal Preserve is located in Reach 4, between river miles 173 and 174, on lands owned and managed by the Colorado River Indian Tribes (CRIT). The CRIT 9 project is located across from the preserve's park and nursery, on out-of-production agricultural land. This land originally consisted of volunteer alfalfa (*Medicago sativa*), saltcedar (*Tamarix ramosissima*), and Russian thistle (*Salsola iberica*). The CRIT 9 project was planted with 135 acres (55 ha) of Fremont cottonwood, Goodding's willow, coyote willow, honey mesquite, and screwbean mesquite. Habitat creation occurred in four sections from November 2001 to March 2005. For further description of the project refer to *'Ahakhav Tribal Preserve Revegetation Research and Development Project* (CRIT 2006).

Hart Mine Marsh Habitat Creation Project

Hart Mine Marsh is a decadent marsh located on CNWR. Currently, drainage water from the refuge's agricultural fields enters Hart Mine Marsh through gated structures in the Arnett Ditch. Previous management practices have not allowed any outflow from the marsh; therefore, the drain water terminates in the marsh to evaporate and stagnate. The result is poor water quality, limited marsh habitat, and saline upland areas, some completely devoid of vegetation or dominated by saltcedar. Suitable marsh habitat will be created by deepening 20 acres (8 ha) of the marsh. Forty acres (16 hectares) adjacent to the deepened areas will be re-graded to provide a more suitable marsh area, adjacent permanent open water, and controllable water levels. Water, diverted by gravity from the Arnett Ditch, would be used to flood leveled fields and create marsh habitat conditions. Water levels would be managed by a series of small water control structures such as culverts or stop logs.

Palo Verde Ecological Reserve Habitat Creation Project

Palo Verde Ecological Reserve (PVER) lies within the historic floodplain of the Colorado River in southeastern Riverside County, at the intersection of ranges 23 and 24 East and townships 5 and 6 South. The PVER 1,352-acre (547 ha) multiphase project is a joint effort between the California Department of Fish and Game (CDFG) and the LCR MSCP to convert agricultural land into riparian habitat. Phase 1 was implemented in Fiscal Year 2006 and consisted of a 30-acre (12 ha) nursery. Phase 2 will be implemented in Fiscal Year 2007 and consists of 80 acres (32 ha) of CW habitat. For further description of this project refer to *Palo Verde Ecological Reserve Development Plan* (LCR MSCP 2005b).

Methods

The following avian surveys were conducted during the 2006 breeding season: 1) tape playback surveys for SWFL (Sogge et al. 1997) at the Cibola Nature Trail, CRIT 9, and Beal Riparian; 2) tape playback surveys for YBCU at CRIT 9; 3) post-development avian area searches (Ralph et al. 1993) at Cibola Nature Trail; 4) post-development avian fixed-radius point counts (Great Basin Bird Observatory 2003) at Beal Riparian, CRIT 9, and CVCA Phase 1; 5) pre-development avian fixed-radius point counts (Great Basin Bird Observatory 2003) at CVCA Phase 2 and PVER; and 5) a constant-effort mist-netting station according to Monitoring Avian Productivity and Survivorship (MAPS) protocol (Desante et al. 2003) at Cibola Nature Trail. For more detailed methodology on the avian surveys, refer to the annual report of the appropriate habitat creation project and LCR MSCP protocols (LCR MSCP 2006b).

A standardized protocol for each avian survey was used so that comparison between projects could be made. Avian area searches or fixed-radius point counts were conducted on each project using standardized avian census techniques, so that relative abundance, species richness, diversity, and evenness could be compared between surveys (Ralph et al. 2003). Method was based solely on patch size of habitat; in large patch sizes (>80 acres (32 ha)), fixed-radius point counts were conducted, and in small patch sizes (<80 acres (8 ha)), avian area searches were conducted. Constant-effort mist-netting is a more intensive survey conducted in select areas, that gives indexes of survivorship, productivity, bird condition, and sex ratios. Tape playback surveys for SWFL and YBCU were conducted on projects where habitat is mature enough to support the species. Areas searches and constant-effort mist-netting were conducted at the Cibola Nature Trail during 2006. For this report, area search data were analyzed at the Cibola Nature Trail because the survey method allows for a complete avian census of the project. For more information about constant-effort mist-netting at the Cibola Nature Trail in 2006, refer to *Monitoring Avian Productivity and Survivorship at Cibola Nature Trail and HNWR* (LCR MSCP 2007b).

Mean and standard error per period per point for point counts, and per period for area searches were calculated for the following parameters at all habitat creation projects: 1) total relative abundance, 2) relative abundance per species, 3) species richness, 4) species diversity, and 5) evenness. Resident species were used in comparisons and analysis; migrant birds were excluded from the analysis. Birds observed as flyovers were excluded from analysis. Birds observed at distances greater than 328 ft (100 m) in point-count surveys were excluded from

analysis. The data for total relative abundance, relative abundance per species, species richness, species diversity, and evenness were graphed using histograms to check for normal distribution. Data for total relative abundance, relative abundance per species, and species richness were transformed using ($\sqrt{y}$ + .5) so that the data would follow a normal distribution, allowing parametric statistical tests (one-way analysis of variance) to be used. Data for species diversity and evenness were not transformed because they were derived indexes. Projects were split into two categories (pre-development and post-development monitoring) for comparisons. A one-way analysis of variance test (ANOVA) was conducted to determine differences in total relative abundance, relative abundance between species, species richness, species diversity, and evenness between projects for each category. A Tukey multicomparison test was used to determine for which projects the means differed. Data from projects where area searches were conducted versus projects where point counts were conducted could not be compared due to different survey methods.

Species richness was calculated as total number of species present. A species diversity index provides more information about community composition than species richness; it takes the relative abundance of different species into account. Evenness is a measurement of species similarity; it is the equitability with which individuals are distributed among the different species. Species diversity and evenness were determined using a natural logarithm version (Nur et al. 1999) of Shannon's Index (Krebs 1989). The equation using natural logarithms is:

$$H' = \sum_{i=1}^{i=S} (p_i)(\mathrm{In}p),\ i = 1, 2, \ldots S$$

where S is the number of species in the sample, and p_i is the proportion of all individuals belonging to the *i*th species. The transformation of H′ is given by $e^{H'}$ labeled as N_1 (MacArthur 1965). N_1 is used because it expresses diversity in terms of species, whereas H′ is expressed in bits. Species distribution is maximally even when $S = N_1$. Evenness expressed as $H'/H_{max} = H'/\mathrm{In}\ S$ is a measurement of how similar the abundance of different species are. Evenness is equal to 1.0 when there are similar proportions of all species.

Community similarity between projects for post-development monitoring was measured with the Renkonen index, and community similarity between projects for pre-development was measured with the Renkonen index (Community Similarity index):

$$P = \sum \text{minimum } (p^A_i, P^B_i)$$

where p^A_i is the percentage of species *i* in sample A, p^B_i is the percentage of species *i* in sample B, and S is the number of species found in either sample (Nur et al. 1999). The Renkonen index is a quantitative index that compares similarity in community composition between sites (Nur et al. 1999). The Renkonen index measures community similarity on a scale of 0 to 1, with 0 meaning there is no overlap of species between sites and 1 meaning there is complete species similarity between projects (Nur et al. 1999).

Results

Post-development Monitoring

The data did not follow a normal distribution for the majority of parameters. The true mean and standard error were reported. Data were transformed before one-way analysis of variance statistical tests were conducted.

Point Count Surveys

Mean relative abundance ranged from 6.34 to 20.27 individual birds per period per point at established habitat creation projects during the avian breeding season in 2006 (Table 1). Mean species richness ranged from 4.40 to 10.44 individual birds per period per point (Table 1). The mean species diversity index ranged from 1.93 to 7.39 birds of equal abundance per period per point (Table 1). The mean evenness index ranged from 0.46 to 0.85 per period per point (Table 1). Beal Riparian and CRIT 9 recorded a higher species diversity, evenness, and richness than CVCA Phase 1 ($P = 0.000$, $P = 0.000$, $P = 0.001$, respectively). CVCA Phase 1 recorded a higher total abundance than Beal Lake Riparian and CRIT 9 ($P=0.000$).

Area Search Surveys

Mean relative abundance was 102.70 individual birds per period at the Cibola Nature Trail during the breeding season of 2006. Mean species richness was 14.40 species per period. The mean species diversity index was 8.47 birds of equal abundance per period. The evenness index was 0.79 birds per period.

The following species were recorded at a higher relative abundance at Beal Riparian than at CRIT 9 and CVCA Phase 1: Bewick's wren ($P = 0.010$), great-tailed grackle ($P = 0.038$), common yellowthroat ($P = 0.000$), and Abert's towhee ($P = 0.000$) (Figure 1). The verdin and yellow-breasted chat were recorded at a higher relative abundance at Beal Riparian than at CRIT 9 ($P = 0.013$, $P = 0.018$, respectively) (Figure 1). The following species were recorded at a higher relative abundance at CVCA Phase 1 than at Beal Riparian and CRIT 9: red-winged blackbird ($P = 0.000$), cliff swallow ($P = 0.000$), and horned lark ($P = 0.010$) (Figure 1). The white-winged dove and mourning dove were recorded at a higher relative abundance at CRIT 9 than at Beal Riparian and CVCA Phase 1 ($P = 0.001$, $P = 0.000$, respectively) (Figure 1). The following species were recorded at a higher relative abundance at CRIT 9 than at Beal Riparian: Bullock's oriole ($P = 0.009$), northern mockingbird ($P = 0.032$), and Say's phoebe ($P = 0.032$) (Figure 1).

Species Composition per Habitat Creation Project

Red-winged blackbird dominated CVCA, comprising 80% of the population (Figure 2). Western kingbird, red-winged blackbird, brown-headed cowbird, and house finch comprised 64% of the population at the Cibola Nature Trail (Figure 3). Western kingbird, mourning dove, brown-headed cowbird, and Bullock's oriole comprised 49% of the population at CRIT 9 (Figure 4). House finch, great-tailed grackle, and Abert's towhee comprised 50% of the population at Beal Riparian (Figure 5).

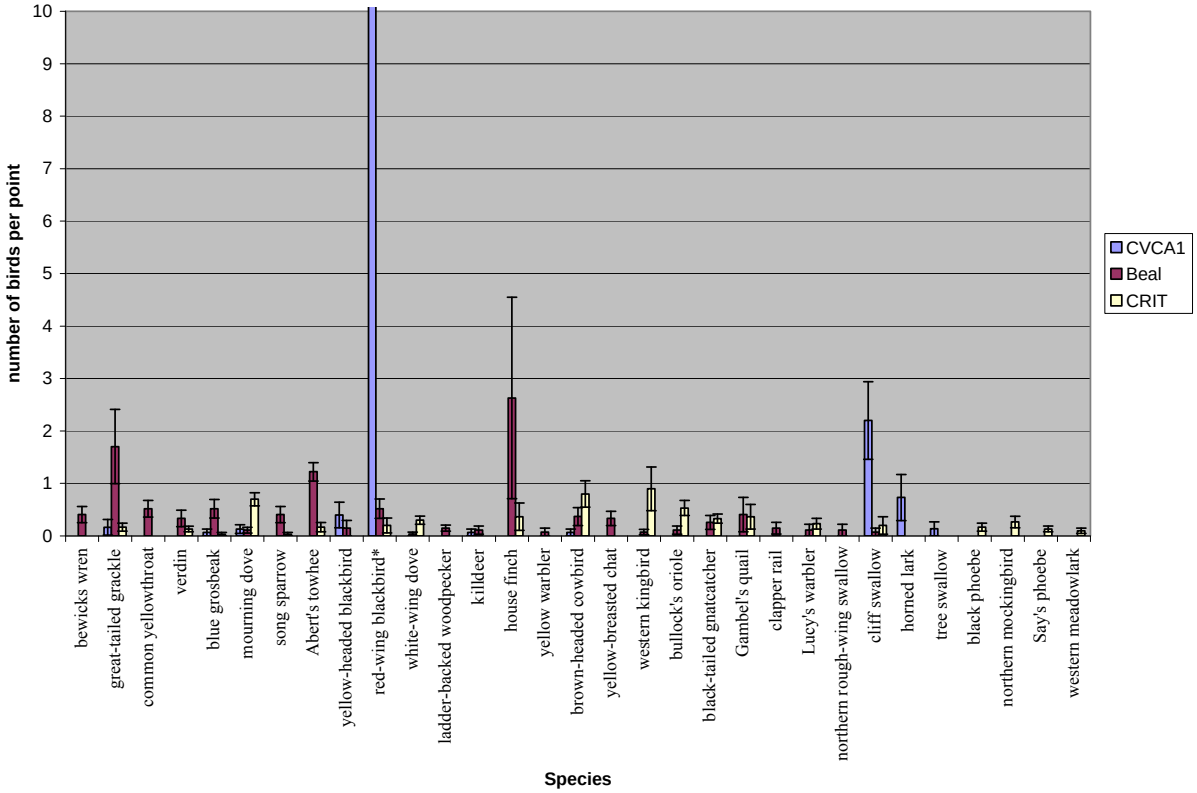
Table 1. Mean relative abundance of total individual birds, species richness, species diversity, and evenness per period per point for point-count surveys at Beal Lake Riparian, CRIT 9, and CVCA Phase 1, 2004-2006.

Project-Year	Sample Size (Number of points) n	Number of Surveys per Year	Mean Relative Abundance and Standard Error	Mean Species Richness and Standard Error	Mean Species and Standard Error	Mean Evenness and Standard Error
Beal Riparian 2006	n = 9	3	10.85 (2.44)	10.44 (0.83)	7.39 (0.72)	.85 (0.04)
Beal Riparian 2005	n = 14	3	6.19 (0.69)	7.42 (0.47)	5.83 (0.34)	.88 (0.01)
Beal Riparian 2004	n = 14	3	4.83 (0.83)	5.57 (0.78)	4.68 (0.63)	.86 (0.04)
CRIT 9 2006	n = 10	3	6.34 (1.25)	9.00 (1.04)	7.43 (0.84)	.91 (0.02)
CVCA Phase 1 2006	n = 5	3	20.27 (1.62)	4.4 (0.48)	1.93 (0.08)	.46 (0.03)

Table 2. Mean relative abundance of total individual birds, species richness, species diversity, and evenness per period for area search surveys, Cibola Nature Trail, 2002-2006.

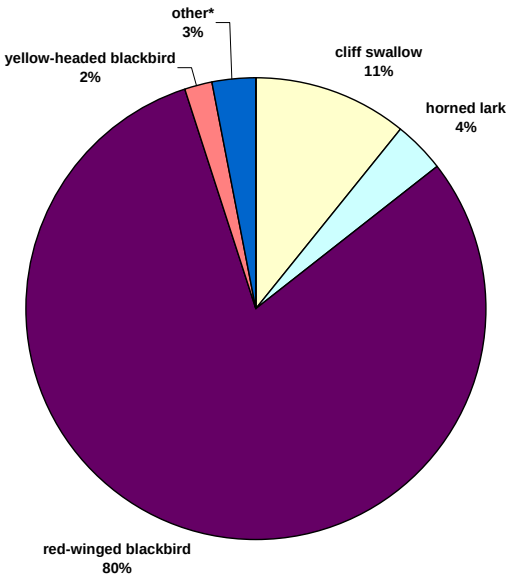
Project-Year	Sample Size (Number of periods per year) n	Mean Relative Abundance per Period and Standard Error	Species Richness per Period and Standard Error	Species Diversity per Period and Standard Error	Evenness per Period and Standard Error
Cibola Nature Trail 2006	n = 10	102.70 (11.15)	14.4 (0.77)	8.47 (0.73)	0.79 (0.03)
Cibola Nature Trail 2005	n = 10	141.56 (16.44)	9.41 (0.29)	8.89 (0.63)	0.78 (0.02)
Cibola Nature Trail 2004	n = 10	103.50 (6.96)	14.6 (0.98)	8.34 (0.69)	0.79 (0.02)
Cibola Nature Trail 2003	n = 4	121.25 (14.70)	12 (1.47)	6.79 (0.96)	0.76 (0.03)
Cibola Nature Trail 2002	n = 3	120.33 (22.70)	11.67 (0.33)	6.87 (0.61)	0.78 (0.03)

Figure 1. Mean relative abundance per species at CVCA Phase 1, Beal Riparian, and CRIT 9, breeding season 2006. Error bars are Standard Error. For CVCA Phase 1, n = 5; for Beal Lake Riparian, n = 9; and for CRIT 9, n = 10.



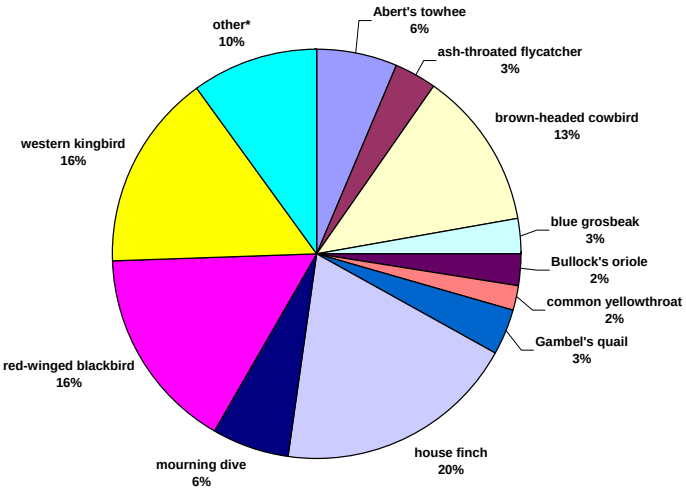
* Red-winged blackbird for CVCA is off the scale of the graph. Red-winged blackbird for CVCA had a mean of 16.53 and standard error of 1.84.

Figure 2. Avian Species Composition at CVCA Phase 1, breeding season 2006.



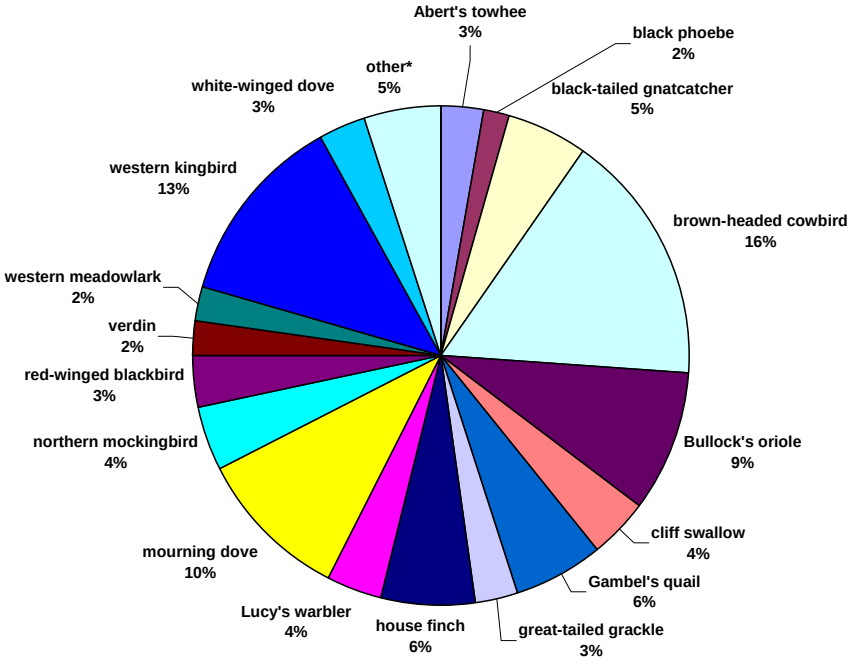
*Other category includes brown-headed cowbird, killdeer, tree swallow, great-tailed grackle, blue grosbeak, and mourning dove.

Figure 3. Avian Species Composition at Cibola Nature Trail, breeding season 2006.



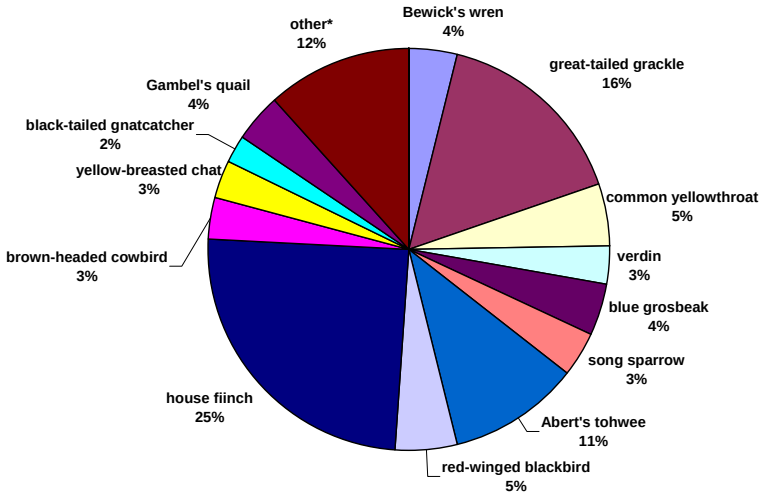
*Other category includes American kestrel, Anna's hummingbird, black-chinned hummingbird, black-tailed gnatcatcher, cliff swallow, common ground dove, Costa's hummingbird, great blue heron, great horned owl, great-tailed grackle, killdeer, lesser nighthawk, ladder-backed woodpecker, loggerhead shrike, Lucy's warbler, northern mockingbird, northern rough-winged swallow, verdin, white-winged dove, yellow-breasted chat, yellow-headed blackbird, and yellow warbler.

Figure 4. Avian Species Composition at CRIT 9, breeding season 2006.



*Other category includes blue grosbeak, song sparrow, common raven, house sparrow, northern flicker, and vermilion flycatcher.

Figure 5. Avian Species Composition at Beal Riparian, breeding season 2006.



*Other category includes western wood pewee, ash-throated flycatcher, mourning dove, crissal thrasher, least bittern, yellow-headed blackbird, white-winged dove, ladder-backed woodpecker, killdeer, loggerhead shrike, yellow warbler, western kingbird, Bullock's oriole, clapper rail, Lucy's warbler, northern rough-winged swallow, and cliff swallow.

Pre-development Monitoring

Point Counts

Mean relative abundance ranged from 7.08 to 22.66 individual birds per period per point in current habitat at future habitat creation projects during the breeding season of 2006 (Table 3). Mean species richness ranged from 4.25 to 11.14 species per period per point (Table 3). The mean species diversity index ranged from 2.65 to 6.87 of birds of equal abundance per period per point (Table 3). The evenness ranged from 0.60 to 0.84 per period per point (Table 3). Hart Mine Marsh recorded a higher species diversity and richness than CVCA Phase 2, CVCA Control, and PVER ($P = 0.000$ and $P = 0.000$, respectively). Hart Mine Marsh recorded a higher species evenness than PVER ($P = 0.001$). PVER recorded higher species abundance than CVCA Phase 2, CVCA Control, and Hart Mine Marsh ($P = 0.000$).

The following species were recorded at a higher relative abundance at Hart Mine Marsh than at CVCA Phase 2, CVCA Control, and PVER: black-tailed gnatcatcher ($P = 0.000$), brown-headed cowbird ($P = 0.000$), lesser nighthawk ($P = 0.000$), and common yellowthroat ($P = 0.000$) (Figure 6). The horned lark was recorded at a higher relative abundance at CVCA Control than at Hart Mine Marsh and PVER ($P = 0.000$) (Figure 6). The mourning dove was recorded at a higher relative abundance at PVER than at Hart Mine Marsh and CVCA Control ($P = 0.001$) (Figure 6). The red-winged blackbird was recorded at a higher relative abundance at PVER than at Hart Mine Marsh ($P = 0.004$) (Figure 6). The ash-throated flycatcher was recorded at a higher relative abundance at Hart Mine Marsh than at PVER ($P = 0.003$) (Figure 6).

Species Composition per Future Habitat Creation Project

Red-winged blackbird dominated the population at CVCA Phase 2 and CVCA Control, comprising 72% and 60% of the population, respectively (Figures 7 and 8). Red-winged blackbird, white-winged dove, and brown-headed cowbird comprised 49% of the population at Hart Mine Marsh (Figure 9). Red-winged blackbird and mourning dove comprised 73% of the population at PVER (Figure 10).

Renkonen Index

The Renkonen Index for post-development monitoring between all established habitat creation projects was low at 6.42% (Table 4). The Renkonen Index for pre-development monitoring in current habitat at all future habitat creation projects was 32.79% (Table 4).

Yellow-billed Cuckoo and Southwestern Willow Flycatcher Surveys

There were no YBCU individuals detected at the established habitat creation projects. There was one willow flycatcher (WIFL) detected at CRIT 9 prior to 15 June, one WIFL detected at Beal Riparian, and five WIFL detected at the Cibola Nature Trail prior to 15 June.

Table 3. Mean relative abundance of total individual birds, species richness, species diversity, and evenness per period per point for point count surveys, PVER, Hart Mine Marsh, and CVCA Phase 2, 2006.

Project-Year	Sample Size (Number of points) n	Mean Relative Abundance and Standard Error	Mean Species Richness and Standard Error	Mean Species Diversity and Standard Error	Mean Evenness and Standard Error
CVCA Control 2006	n = 12	7.08 (2.69)	4.25 (0.75)	2.65 (0.39)	0.69 (0.08)
CVCA Phase 2 2006	n = 4	10.80 (2.43)	6.17 (0.86)	4.11 (0.54)	0.73 (0.06)
PVER 2006	n = 30	22.66 (1.66)	7.63 (0.44)	3.67 (0.29)	0.60 (0.04)
Hart Mine Marsh 2006	n = 14	11.43 (1.34)	11.14 (0.82)	6.87 (0.67)	0.84 (0.03)

Table 4. Renkonen Index (Community Similarity Index) between habitat creation projects along the LCR in pre- and post-development avian monitoring, breeding season 2006.

Project Compared	Percent
Pre-development monitoring, all projects (CVCA Phase 2, CVCA Control, PVER, Hart Mine Marsh)	35.87%
Pre-development monitoring, agricultural fields (CVCA Phase 2, CVCA Control, PVER)	39.67%
Post-development monitoring, all projects (CRIT 9, Beal Riparian, and CVCA Phase 1)	6.42%
Post-development monitoring, CRIT 9 and Beal	32.79%
Post-development monitoring, CRIT 9 and CVCA Phase 1	9.01%
Post-development monitoring, Beal Riparian and CVCA Phase 1	8.78%

Figure 6. Mean relative abundance per species at CVCA Phase 2, CVCA Control, Hart Mine Marsh, and PVER, breeding season 2006. Error bars are Standard Error. For CVCA Phase 1, n = 4; CVCA control, n = 12; Hart Mine Marsh; n = 14; and PVER, n = 30.

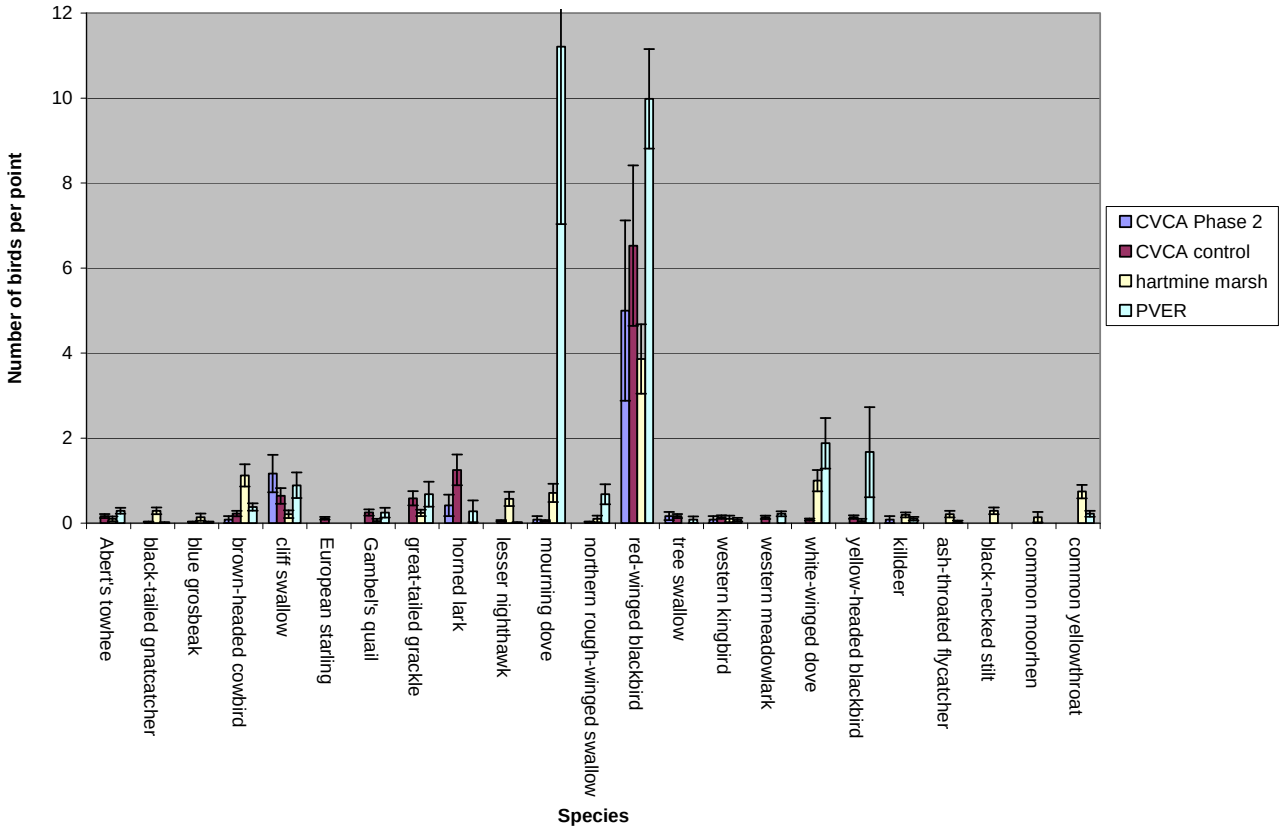
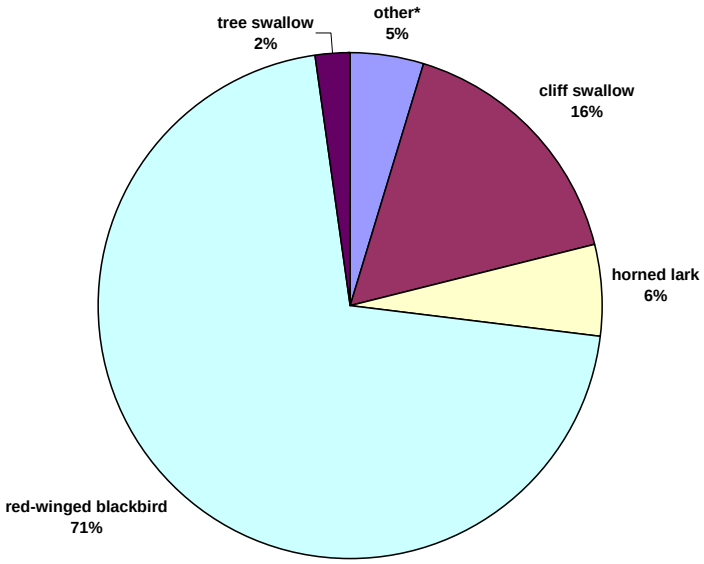
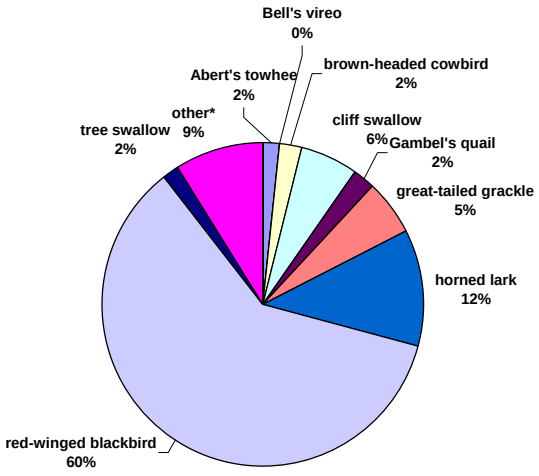


Figure 7. Avian Species Composition at CVCA Phase 2, breeding season 2006.



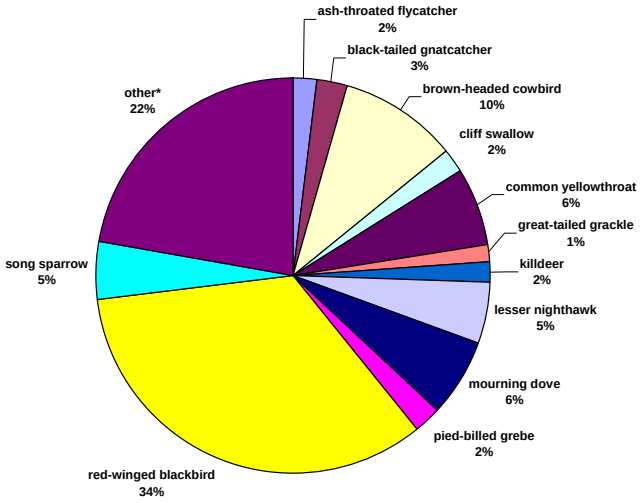
*Other category includes western kingbird, killdeer, brown-headed cowbird, and mourning dove.

Figure 8. Avian Species Composition at CVCA Control, breeding season 2006.



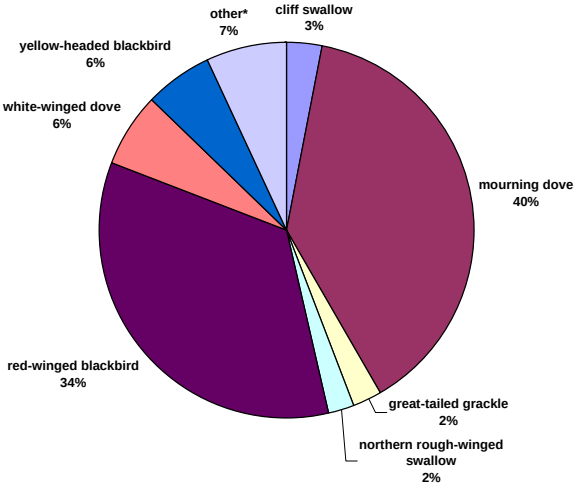
*Other category includes lesser nighthawk, mourning dive, northern mockingbird, northern rough-winged swallow, European starling, Eurasian collared-dove, common ground-dove, Bullock's oriole, blue grosbeak, black-throated gnatcatcher, barn swallow, yellow-headed blackbird, white-winged dove, western meadowlark, and western kingbird.

Figure 9. Avian Species Composition at Hart Mine Marsh, breeding season 2006.



*Other category includes Abert's towhee, blue grosbeak, Bullock's oriole, Gambel's quail, northern rough-winged swallow, western kingbird, yellow-headed blackbird, black phoebe, canyon wren, common moorhen, crissal thrasher, great blue heron, great egret, house finch, ladder-backed woodpecker, green heron, least bittern, loggerhead shrike, marsh wren, turkey vulture, and western tanager.

Figure 10. Avian Species Composition at PVER, breeding season 2006.



*Other category includes common raven, northern mockingbird, lesser nighthawk, Say's phoebe, Gambel's quail, ladder-backed woodpecker, Abert's towhee, verdin, peregrine falcon, song sparrow, Lucy's warbler, redhead, green heron, great blue heron, loggerhead shrike, house finch, common yellowthroat, ash-throated flycatcher, killdeer, greater roadrunner, western meadowlark, tree swallow, western kingbird, Anna's hummingbird, American coot, turkey vulture, brown-headed cowbird, blue grosbeak, and black-tailed gnatcatcher.

Table 5. American Ornithological Union Codes (AOU), common names, and scientific names of species detected at established and future habitat creation projects during avian pre- and post-development monitoring.

Code	Common Name	Scientific Name
BNST	black-necked stilt	*Himantopus mexicanus*
GAQU	Gambel's quail	*Callipepla gambelii*
PBGR	pied-billed grebe	*Podilymbus podiceps*
LEBI	least bittern	*Ixobrychus exilis*
GBHE	great blue heron	*Ardea herodias*
GREG	great egret	*Ardea alba*
GRHE	green heron	*Butorides virescens*
TUVU	turkey vulture	*Cathartes aura*
AMKE	American kestrel	*Falco sparverius*
CLRA	Yuma clapper rail	*Rallus longirostris yumanensis*
COMO	common moorhen	*Gallinula chloropus*
AMCO	American coot	*Fulica americana*
WESA	western sandpiper	*Calidris mauri*
KILL	killdeer	*Charadrius vociferus*
EUCD	Eurasion collared-dove	*Streptopelia decaocto*
WWDO	white-winged dove	*Zenaida asiatica*
MODO	mourning dove	*Zenaida macroura*
COGD	common ground-dove	*Columbina passerina*
BCHU	black-chinned hummingbird	*Archilocus alexandri*
ANHU	Anna's hummingbird	*Calypte anna*
COHU	Costa's hummingbird	*Calypte costae*
YBCU	yellow-billed cuckoo	*Coccyzus americanus occidentalis*
GHOW	Great horned owl	*Bubo virginianus*
LBBO	ladder-backed woodpecker	*Picoides scolaris*
LENI	lesser nighthawk	*Chordeiles acutipennis*
NOFL	northern flicker	*Colaptes auratus*
WWPE	western wood peewee	*Contopus sordidulus*
SWFL	southwestern willow flycatcher	*Empidonax trailii extimus*
BLPH	black phoebe	*Sayornis nigricans*
SAPH	Say's phoebe	*Sayornis saya*
VEFL	vermilion flycatcher	*Pyrocephalus rubinus*
ATFL	ash-throated flycatcher	*Myiarchus cinerascens*
WEKI	western kingbird	*Tyrannus verticalis*
LOSH	loggerhead shrike	*Lanius ludovicianus*
BEVI	Bell's vireo	*Vireo belli*
CORA	common raven	*Corvux corax*
HOLA	horned lark	*Eremophila alpestris*
TRES	tree swallow	*Tachycineta bicolor*
NRWS	northern rough-winged swallow	*Stelgidopteryx serripennis*
CLSW	cliff swallow	*Petrochelidon pyrrhonota*
BASW	barn swallow	*Hirundo rustica*

Code	Common Name	Scientific Name
VERD	verdin	*Auriparus flaviceps*
CAWR	canyon wren	*Catherpes mexicanus*
BEWR	Bewick's wren	*Thryomanes bewickii*
MAWR	marsh wren	*Cistothorus palustris*
BTGN	black-tailed gnatcatcher	*Polioptila melanura*
NOMO	northern mockingbird	*Mimus polyglottos*
CRTH	crissal thrasher	*Toxostoma crissale*
EUST	European starling	*Sturnus vulgaris*
LUWA	Lucy's warbler	*Vermivora luciae*
YWAR	yellow warbler	*Dendroica petechia*
COYE	common yellowthroat	*Geothlypis trichas*
YBCH	yellow-breasted chat	*Icteria virens*
ABTO	Abert's towhee	*Pipilo aberti*
SOSP	song sparrow	*Melospiza melodia*
BLGR	blue grosbeak	*Passerina caerulea*
RWBL	red-winged blackbird	*Agelaius phoeniceus*
WEME	western meadowlark	*Sturnella neglecta*
YHBL	yellow-headed blackbird	*Xanthocephalus xanthocephalus*
GTGR	great-tailed grackle	*Quiscalus mexicanus*
BHCO	brown-headed cowbird	*Molothrus ater*
BUOR	Bullock's oriole	*Icterus bullockii*
HOFI	house finch	*Carpodacus mexicanus*
HOSP	house sparrow	*Passer domesticus*

Discussion

Post-development Monitoring

The only LCR MSCP covered species detected at established habitat creation projects were small populations of yellow warblers at Beal Riparian and Cibola Nature Trail, and a small population of vermilion flycatchers at CRIT 9. Sensitive non-covered avian species as listed in the LCR MSCP HCP (2004) were detected at all projects.

CRIT 9 and Beal Riparian had higher avian indexes such as diversity, evenness, and richness than did CVCA Phase 1. This was expected because habitat at CRIT 9 and Beal Riparian has been established for a much longer period. The habitat at CVCA has not matured enough to support a high species diversity and richness of birds. Species composition was different across projects as expected due to each habitat creation project having different habitat characteristics.

Cibola Valley Conservation Area is a multi-phase habitat creation project on former agricultural land. Species utilizing CVCA Phase 1 (red-winged blackbird, cliff swallow, horned

lark) were species typically associated with agricultural fields. Phase 1 of this project was established during the spring before the surveys took place. Trees were at an early stage of growth and were surrounded by agricultural land, which is the probable reason this project attracted avian species associated with agricultural habitat.

Although community similarity was more similar between Beal Riparian and CRIT 9 than between CVCA 1 and the other projects, there were still differences in species composition between the two projects. Beal Riparian contains more of a mosaic of habitat in different stage classes and different densities than does CRIT 9. The cottonwood, willow, and mesquite trees have not reached the size class that similar trees have at CRIT 9 (LCR MSCP 2006c and 2006d). The habitat at CRIT 9 is more uniform than the habitat at Beal Riparian. There are two distinct sections in terms of species composition: mesquite and cottonwood-willow habitat. There are four distinct sections in terms of size class because each of these four sections was planted during a different year (CRIT 2006). Trees at CRIT 9 were not planted as densely as trees at Beal Riparian, allowing trees to reach greater size classes in a shorter amount of time and creating more of an open understory (CRIT 2006). Beal Riparian contained a portion of the project that was irrigated weekly during the breeding season (LCR MSCP 2006c). The entire CRIT 9 project was irrigated monthly (LCR MSCP 2006d). The habitat differences at these two projects produced differences in some components of avian species composition, although the two projects are in similar stages of development (Beal Lake 2003-2005 and CRIT 9 2001-2005). Bewick's wren, common yellowthroat, yellow-breasted chat, Abert's towhee, and verdin were probably more abundant at Beal Riparian than at CRIT 9 because of the denser understory and more frequent irrigation. Bullock's oriole and Say's phoebe were probably more abundant at CRIT 9 than at Beal Riparian due to the larger height and diameter-at-breast-height of trees, and the more open understory.

Post-development monitoring will continue on established projects in future years to detect density of LCR MSCP covered species and indexes of relative abundance, species composition, species richness, and evenness at all established habitat creation projects.

Pre-development Monitoring

Hart Mine Marsh recorded higher indexes of species richness, diversity, and evenness than did other future habitat creation projects. There was existing riparian vegetation at Hart Mine Marsh, while the other projects were agricultural habitat. It is expected that existing riparian vegetation, even if it is poor in quality, would provide habitat for a more diverse group of birds than would agricultural habitat, as agricultural habitat is always changing due to harvesting and lacks vertical height structure.

Species composition differed between the three projects. It was expected that species composition would differ between Hart Mine Marsh and the agricultural projects and that Hart Mine Marsh would have more species associated with riparian shrub areas (black-tailed gnatcatcher, brown-headed cowbird, common yellowthroat, ash-throated flycatcher) than agricultural habitat did. Community similarity between all projects was not much higher than community similarity between agricultural areas, possibly due to the much higher numbers of mourning doves and much lower number of horned larks present at PVER than at CVCA.

Some probable reasons why species composition differed between the two agricultural projects are location, types of crops planted in fields, surrounding habitat, and the timing of when fields were cut.

The only LCR MSCP covered species detected at future habitat creation projects was one Bell's vireo at CVCA control, one Bell's vireo at PVER, and a small population of least bitterns at Hart Mine Marsh. The control portion of CVCA will not be developed anytime soon. The control portion can be compared to the developed portion for difference in abundance of LCR MSCP covered species. Point counts at PVER were conducted across the entire multiphase project. Reclamation can observe how abundance of LCR MSCP covered species changes as the project develops. Reclamation can also observe how the population of least bitterns at Hart Mine Marsh changes in terms of abundance once the quality of marsh habitat is improved. Construction or improvements at Hart Mine Marsh should not take place in the spring when these birds breed, so that the current population of least bitterns is not effected.

Habitat models for agricultural areas and other pre-development situations will be created from pre-development monitoring. At least one more year of monitoring at these habitat creation projects should allow for creation of habitat models.

Changes to Surveys in the Future

All point counts conducted in 2006 and previous years were conducted using unadjusted point-count surveys. Data were analyzed for indexes such as relative abundance, species richness, species diversity, and evenness. Recent data indicates that unadjusted point counts cannot be reliably used to compare bird abundance and other parameters among species, different habitat types, or among observers due to bias in detectibility rates (Farnsworth et al. 2002, Forcey et al. 2006). Reclamation will use a double sampling method in the future as a means to reduce bias due to closure, surplus birds, and detection rates (Bart et al. 2004)

All point counts conducted in 2006 and previous years were established on a project-by-project basis. All points were 820 ft (250 m) apart on each transect. Transects, however, were not necessarily set up in a uniform manner across habitat creation projects. For the year 2007, Reclamation consulted with the USGS to set up a time-efficient avian use monitoring protocol; this protocol is uniform among habitat creation projects and uses methods that will account for detectability and reduce bias, so that study objectives are met. A double sampling method using rapid and intensive area searches will be used (Bart 2007).

Literature Cited

Bart, J., S. Droege, P. Geissler, B. Peterjohn, and C. J. Ralph. 2004. Density estimation in wildlife surveys. Wildlife Society Bulletin 32(4):1242-1247.

Bart J. 2007. Lower Colorado River Riparian Bird Surveys 2007. United States Geological Survey. Boise, ID. Submitted to Bureau of Reclamation IA#06AA300022.

Bureau of Reclamation. 2003. Habitat Restoration on the Lower Colorado River: Demonstration Projects 1995-2002. (Unpublished report). Boulder City, NV 89006.

Colorado Indian River Tribes. 2006. 'Ahakhav Tribal Preserve Revegetation Research and Development Project. Colorado River Indian Tribes "Ahakhav Tribal Preserve" Parker, AZ 85344. Submitted to Bureau of Reclamation.

DeSante D. F., K. M. Burton, P. Velez, and D. Froehlich. 2002. MAPS Manual, 2002 Protocol, Instructions for the Establishment and Operation of Constant-effort Bird-banding Stations as Part of the Monitoring Avian Productivity and Survivorship (MAPS) Program. The Institute for Bird Populations. Point Reyes Station, CA. 63 p.

Elliot, G., M. Chase, G. Geupel, and E. Cohen. 2004. Developing and Implementing an Adaptive Conservation Strategy: A Guide for Improving Adaptive Management and Sharing the Learning Among Conservation Practitioners. Point Reyes Bird Observatory Conservation Science, Stinson Beach, CA 94970.

Farnsworth, G. L., K. Pollock, J. Nichols, T. R. Simons, J. E. Hines, and J. R. Sauer. 2002. A removal model for estimating detection probabilities from point-count surveys. The Auk 119(2):414-425.

Forcey, G. M, J. T. Anderson, F. K. Ammer, and R. C. Whitmore. 2006. Comparison of two double-observer point-count approaches for estimating breeding bird abundance. Journal of Wildlife Management 70(6):1674-1682.

Great Basin Bird Observatory. 2003. Nevada Bird Count. A Habitat-based Monitoring Program for Breeding Birds of Nevada. Instruction Package and Protocol for Point Count Surveys. http://www.gbbo.org/pdf/Instructions.2003.doc. Accessed Dec. 2004.

Krebs, C. 1989. Ecological Methodology. Harper and Row, New York.

Lower Colorado River Multi-Species Conservation Program. 2004. Lower Colorado River Multi-Species Conservation Program, Volume II, Final Habitat Conservation Plan. December 17. (J&S 00450.00.) Sacramento, CA.

LCR MSCP. 2005a. The Cibola Valley Conservation Area Development Plan. Bureau of Reclamation, Lower Colorado Region, Boulder City, NV.

LCR MSCP. 2005b. The Palo Verde Ecological Reserve Development Plan. Bureau of Reclamation, Lower Colorado Region, Boulder City, NV.

LCR MSCP. 2006a. Beal Lake Riparian Development: Overview. Bureau of Reclamation, Lower Colorado Region, Boulder City, NV.

LCR MSCP. 2006b. LCR MSCP. Monitoring Protocols for Wildlife Group of the Lower Colorado River Multi-Species Conservation Program. Bureau of Reclamation, Lower Colorado Region, Boulder City, NV.

LCR MSCP. 2007a. Riparian Habitat Vegetation Monitoring at the Cibola NWR Nature Trail: 2006. Bureau of Reclamation, Lower Colorado Region, Boulder City, NV.

LCR MSCP. 2007b. Monitoring Avian Productivity and Survivorship at the Cibola Nature Trail and the Havasu NWR. Bureau of Reclamation, Lower Colorado Region, Boulder City, NV.

LCR MSCP. 2007c. LCR MSCP. Beal Lake Riparian Annual Report 2006. Bureau of Reclamation, Lower Colorado Region, Boulder City, NV.

LCR MSCP. 2007d. LCR MSCP. ‘Ahakhav Tribal Preserve Re-vegetation Research and Development Project: Annual Report 2006. Bureau of Reclamation, Lower Colorado Region, Boulder City, NV.

MacArthur, R. H. 1965. Patterns of species diversity. Biological Review 40:510-533.

Nur, N., S. L. Jones, and G. R. Geupel. 1999. A Statistical Guide to Data Analysis of Avian Monitoring Programs. U.S. Fish & Wildlife Service, BTP-R6001-1999. Washington D.C.

Ralph, J. C., G. Geupel, P. Pyle, T. E. Martin, and D. F. DeSante. 1993. Handbook of Field Methods for Monitoring Landbirds. General Technical Report PSW-GTR-144. Pacific Southwest Research Station, USDA Forest Service, Albany, CA. 41 p.

Sogge, M. K., R. M. Marshall, S. J. Sferra, and T. J. Tibbitts. 1997. A Southwestern Willow Flycatcher Natural History Summary and Survey Protocol. Technical Report NPS/NAUCPRS/NRTR-97/12. USGS Colorado Plateau Research Station, Northern Arizona University, Flagstaff, AZ.