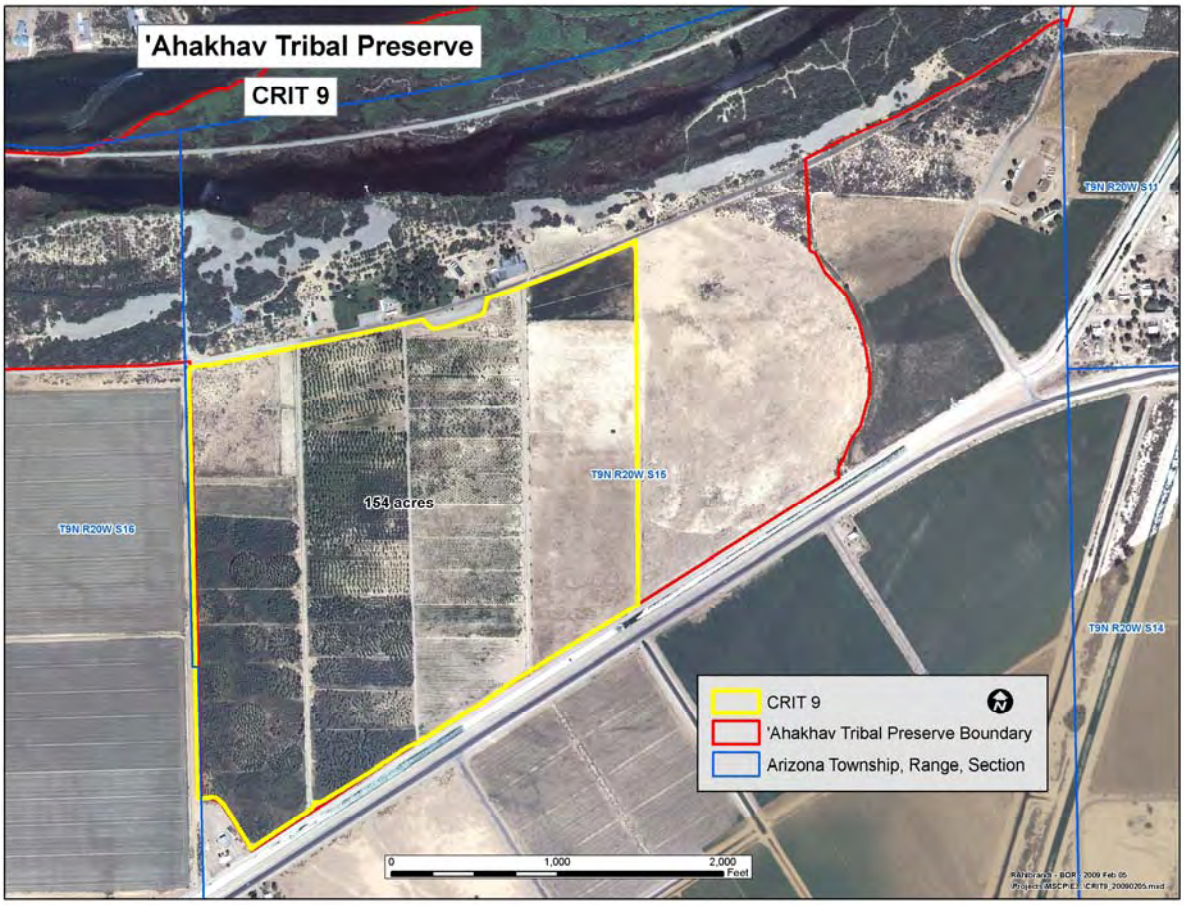
Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

’Ahakhav Tribal Preserve: Annual Report 2007



U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

March 2010

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Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
Lower Colorado Region
Boulder City, Nevada
http://www.lcrmscp.gov

March 2010

Executive Summary

The purpose of this annual report is to summarize activities that occurred on the ‘Ahakhav Tribal Preserve from October 1, 2006 through September 30, 2007. Contained within this document are sections describing land and water ownership, status of the land use agreement, monitoring data, and the habitat maintenance activities that occurred on the 154 acres of habitat. For reference purposes, the 154 acres of habitat was initiated in spring of 2005.

Since 2001, the Preserve and Reclamation have been working together to develop LCR MSCP covered species habitat and to examine alternative planting and irrigation techniques. The Preserve administration and LCR MSCP management are currently drafting a 48-year land use agreement for the sole purpose of creating LCR MSCP covered species habitat on the Preserve. Once approved, a development schedule as well as roles and responsibilities by each party will be agreed upon. The land use agreement would be in effect through April 2055.

CRIT 9 (154 acres) is currently being managed for LCR MSCP covered species. LCR MSCP covered species already present on the Preserve include: vermilion flycatcher (*Pyrocephalus rubinus*), Gila woodpecker (*Melanerpes uropygialis),* western yellow bat *(Lasiurus xanthinus),* and the California leaf-nosed bat *(Macrotus californicus).*

Monitoring for CRIT 9 was separated into four separate surveys: vegetation, southwestern willow flycatcher, yellow-billed cuckoo, and covered bat species. Vegetation surveys indicated the lack of understory throughout CRIT 9. Southwestern willow flycatcher surveys indicate no nesting individuals during the breeding season. Yellow-billed cuckoo surveys indicated the presence of one individual. Bat surveys indicated the presence of a single yellow bat and single California leaf-nosed bat.

Background

Since 2001, Bureau of Reclamation's Lower Colorado Region has been assisting the Colorado River Indian Tribes (CRIT) at the 'Ahakhav Tribal Preserve in their efforts to restore native habitat on their lands.

Since the inception of the Lower Colorado River Multi-Species Conservation Program, the program has budgeted and described activities conducted on the Preserve within the annual work plan process. This report is being prepared to document the development and management of native land cover types and record monitoring data for calendar year 2007.

1.0 General Site Information

The sites reserved for LCR MSCP habitat development are known as CRIT 9 (154 acres), CRIT 10 (54 acres), and CRIT 11 (60 acres). At the time of this writing CRIT 9 is the only established habitat being maintained and monitored for the program's covered species.

Large conservation areas such as the Preserve are developed over a number of years and can ultimately be managed to benefit multiple covered species. Currently, CRIT 9 has been established and is continually maintained.

The intended outcome of this project is the establishment of riparian habitat although soils are sandy and do not allow for holding of irrigated water for extended periods of time. At the present time, the area is being considered for management of yellow-billed cuckoo and, potentially, southwestern willow flycatcher.

LCR MSCP covered species identified through monitoring indicate the presence of vermilion flycatcher (*Pyrocephalus rubinus*), Gila woodpecker (*Melanerpes uropygialis)*, western yellow bat *(Lasiurus xanthinus)*, and the California leaf-nosed bat *(Macrotus californicus)*.

1.1 Location

The project site is located on the Colorado River Indian Tribes Reservation south of Parker, Arizona. The Colorado River Tribal Council approved the 'Ahakhav Tribal Preserve in special session through Tribal Resolution #168-95 in August 1995. The Resolution was created to protect fish and wildlife resources and provide educational and outreach opportunities for the local community.

The 'Ahakhav Tribal Preserve is located within Reach 4 of the LCR MSCP Planning Area between river miles 173 and 174 (Figure 1).

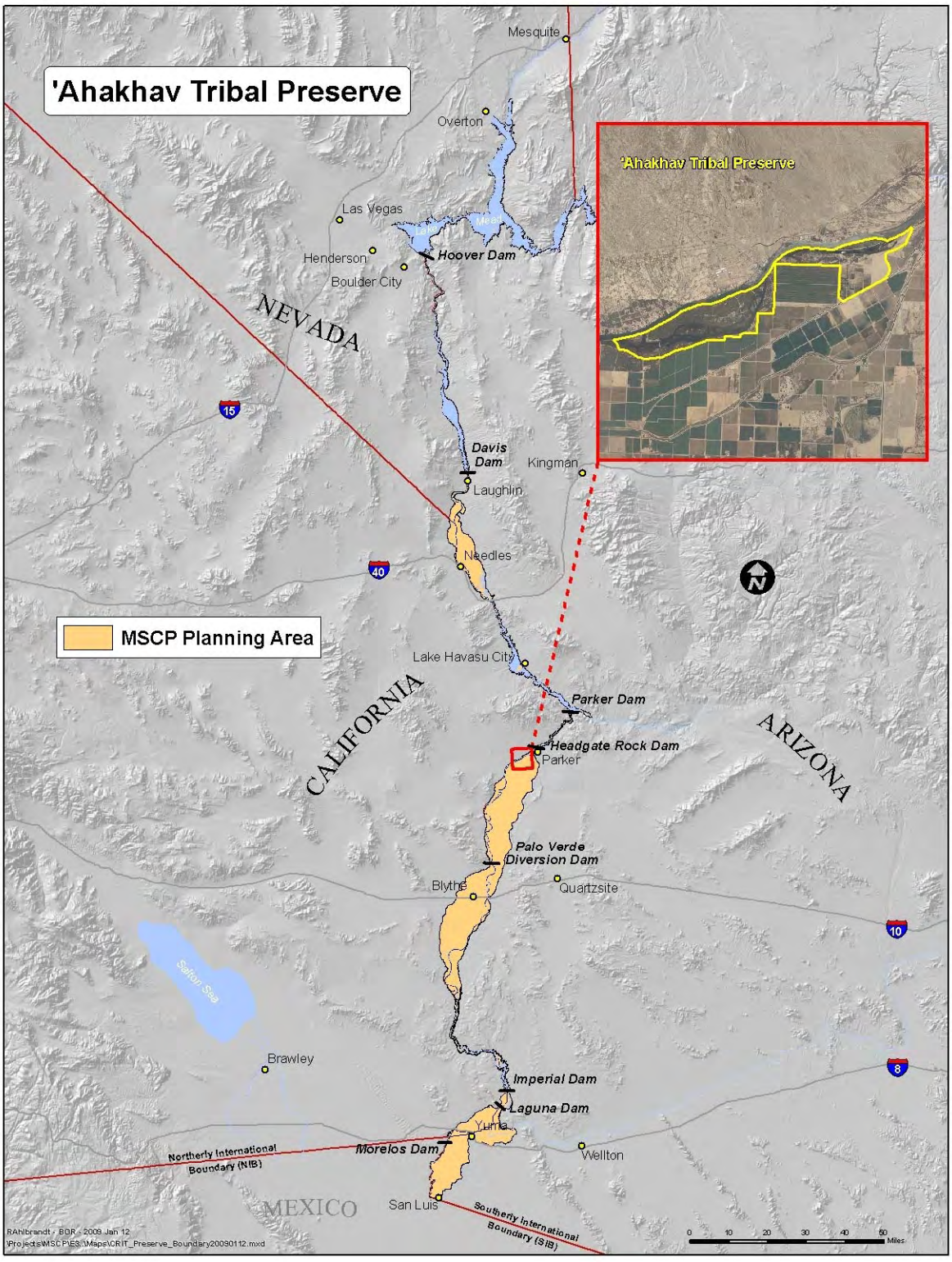

Figure 1. Location of the ‘Ahakhav Tribal Preserve

1.2 Land Ownership

The ‘Ahakhav Tribal Preserve is an in-holding encompassed by the Colorado River Indian Tribes Reservation.

“The CRIT Reservation was created in 1865 by the Federal Government for “Indians of the Colorado and its tributaries,” originally for the Mohave and Chemehuevi, who had inhabited the area for centuries. People of the Hopi and Navajo Tribes were relocated to the reservation in later years, *(http://critonline.com, 2008)*”.

1.3 Water Availability

The CRIT maintain a present perfected water right #2 in the state of Arizona of 662,402 acre feet. Irrigation water to be used for habitat development or maintenance will be reported annually. The Preserve and LCR MSCP staff will jointly determine the duration and irrigation frequency to be applied on existing habitat.

1.4 Land Use Agreement

Reclamation and CRIT are working together under a 5-year Cooperative Agreement signed in September 2004. This agreement, which expires in December 2009, specifies areas to be restored and outlines the roles and responsibilities of each partner.

Quarterly coordination meetings between the Preserve and LCR MSCP staff ensure that all activities and reimbursable costs to be incurred are identified in advance.

2.0 Current Year Habitat Development and Management

2.1 CRIT 9 Habitat Management

Re-planting in some areas occurred in April 2007 in order to fill open areas within the habitat and create a denser mid-story. Approximately 4,245 coyote willow and 2,000 Goodding’s willow poles were planted close to the irrigation ditch in CRIT 9 sections 1, 2, and 3.

In July 2007, the cottonwood trees in CRIT 9 began to yellow and many of them showed signs of disease (discolored oozing wounds on the bark) (Figures 2 and 3). CRIT contacted the local University of Arizona Agricultural Extension office and the disease was identified as bacterial wetwood. This disease is normally not fatal. The yellowing of the leaves was not related to disease, but was probably caused by heat stress. Several new buds could be seen on the tips of the branches and by August 2007 the trees had recovered.

Figure 2. Yellowed cottonwood trees, July 2007.

Figure 3. Bacterial wetwood on cottonwood tree.

It was also suggested by Agricultural Extension personnel that weekly irrigation of such highly sandy soils may be flushing nutrients from the root zone and could be counterproductive to development of dense vegetation. A less frequent irrigation schedule was implemented after meeting with the Agricultural Extension personnel.

In an attempt to retain moist soils within highly sandy environments, Reclamation has been exploring alternative irrigation methods. If successful, an alternative irrigation method may provide suitable habitat for southwestern willow flycatcher.

During fall 2007, plastic pools were installed within CRIT 9 to retain water between irrigation cycles and provide a wet soil environment. In August 2007, after seven days post-irrigation, standing water and wet soil remained long enough to have cattails growing in them (Figure 4). Due to the time of year and quantity of irrigation water applied on-site, it is unclear if this irrigation alternative will be successful in the long term.

Figure 4. The blue rim of the plastic pool can be seen, with standing water and cattails inside the pool.

In order to achieve the habitat density requirements outlined in the program's Habitat Conservation Plan, a native plant nursery that allows for collection of plant stock was incorporated into the southwest corner of CRIT 9. The development of a native plant nursery reduces transportation and acquisition costs of new plant material. Also by utilizing local plant materials, genetic integrity of the existing stand is maintained. The establishment of the nursery will provide a consistent and readily accessible source of plant materials (i.e., cuttings, poles, seeds).

"Reclamation defines the term "poles" as plant material 1 to 4 inches in diameter that are taken from large branches, an entire tree, or from a tree with multiple trunks, and are planted directly into the ground, *(Cibola Valley Conservation Area Restoration Development Plan: Phase 1)."*

Species planted in the nursery included Goodding's willow and Fremont cottonwood. In order to accommodate motorized vehicle access for future harvesting of plant material, trees were planted 10-15 feet on center.

2.2 CRIT 10 Development

Site preparation activities, initiated at CRIT 10 in 2006, continued in 2007 (Figure 5). In February and March 2007, the entire 58 acres was laser leveled. A ditch pad was built and construction of a 42-inch irrigation ditch was initiated in April 2007. The ditch was completed in fall of 2007. In September 2007, gates were installed in the ditch and a pump was placed at the east end to pump water from the CRIT main canal. Alfalfa will be planted on CRIT 10 as a cover crop for at least one growing season.

Figure 5. CRIT 10 cleared, and leveled with irrigation ditch midway across the site.

2.3 CRIT 11 Development

Since CRIT 11 had never been developed for agriculture, a topographical survey was conducted in April 2007. Elevations within CRIT 11 range from 358 feet along Rodeo Road to 342 feet at the marsh. CRIT and Reclamation are in the process of determining the restoration potential of this area. In September 2007, a gate on CRIT's main canal failed, causing a washout across CRIT 11. The affected area covers approximately 1 acre and, in places, is over 7 feet deep and over 35 feet wide (Figure 6).

Figure 6. Red arrows show the beginning of the washout and its end at the backwater below the proposed CRIT 11 habitat creation site.

2.4 Irrigation: CRIT 9

CRIT 9 is serviced by concrete-lined irrigation canals that are connected to the main canals servicing the reservation. The CRIT 9 canals are gravity diverted and are operated by Preserve staff. Between January 2007 and October 2007, CRIT 9 was irrigated with 9.6 af/ac of water. No irrigation was conducted between October 2006 and January 2007.

2.5 Irrigation: CRIT 10

In April 2007, a 42-inch irrigation ditch was constructed to deliverer water to CRIT 10. Due to the higher elevation on CRIT 10, irrigation water must be pumped from the adjacent main canal. Due to fuel, maintenance, and labor costs associated with pumping, native dry land cover types are being considered for planting to reduce overall operating costs.

2.6 Irrigation: CRIT 11

CRIT 11 is still in development and planning stages, and no irrigation infrastructure currently services the site. The site is planned for development in Fiscal Year 2012. Engineering analysis utilizing adjacent canals will guide irrigation ditch construction.

2.7 Site Maintenance

In April 2007, several access roads throughout the habitat area were re-contoured and covered with a layer of rock base. Post and cable was installed at each entry point in CRIT 9 to prevent unauthorized road use. “No Hunting” signs were posted around the perimeter of the area. Weeds along the canal in CRIT 10 were treated with herbicides, ports were cleared of debris, broken ports were repaired, and cracks within the ditches were patched as needed.

2.8 Management of Existing Land Cover

CRIT 9 (154 acres) is currently the only portion of the Preserve designated as LCR MSCP covered species land cover type. Management of the 154 acres is limited to routine maintenance. Maintenance activities conducted during 2007 included: clearing and repairing of irrigation ditches, installation of habitat boundary signage, installation of post and cable at the entrance of habitat areas and the planting of poles throughout bare spots to promote the growth of a dense mid-story.

2.9 Wildland Fire Management

Wildland fire management activities are coordinated through the Colorado River Indian Tribes’ Wildland Fire Office. The Preserve is incorporated into the entire reservation’s Fire Management Plan. CRIT Wildland maintains “mutual aide agreements” with multiple wildland fire agencies along the river. These agreements allow the use of other agencies’ personnel and resources in the event of a large-scale wildland fire.

2.10 Law Enforcement

Law enforcement regulations are handled through the Colorado River Indian Tribes’ Fish and Game Department. Examples of regulations the wardens enforce are use periods during authorized times, no hunting (except in designated areas), valid fishing and hunting licenses, no alcohol allowed within the Preserve, and vehicle access restrictions within the habitat areas.

2.11 Public Use

Public use on the Preserve is limited to low-impact recreational activities. Although hunting is not allowed within habitat areas, hunting is allowed on portions of the Preserve not scheduled for habitat development. Examples of low-impact recreation include wildlife watching, sport fishing, walking trail use, collection of native plant material for cultural uses, and education and outreach opportunities for the local community.

3.0 Monitoring

3.1 Vegetation Monitoring

In 2007, vegetation was monitored in CRIT 9 using protocols adapted from established methods. Different techniques were used to describe vegetation components of each phase. Vegetation monitoring objectives include:

1) Characterize current plant community composition and structure.
2) Monitor changes in plant community composition and structure over time.
3) Determine when vegetation components meet defined habitat criteria needed for accomplishment of HCP conservation measures.

Sampling Design

Random sampling may not be the best sample design choice for measuring vegetation communities. This type of sampling design relies on very large sample sizes to adequately represent all of the variability within communities. Inherent in the nature of random sampling is the likelihood of missing or under representing components and features that are rare (Barour et al. 1987), as well as the likelihood of sampling locations that do not accurately reflect the average plant community. These design shortcomings are overcome by using rather large sample sizes, which can be costly, as well as labor and time intensive.

A hybrid approach that combines subjective and quantitative sampling was tested in 2007 (Mueller-Dombois and Ellenberg 1974, Kent and Coker 1992). This approach has been commonly used to obtain landscape level ecological measurements, especially where the goal is to describe and classify vegetation into community groups. Examples of this approach include the National Vegetation Classification (Grossman et al. 1998), Ecological Types of the Upper Gunnison Basin (Johnson 2001), and Mapping Standards and Methods used by the North American Weed Management Association (Stohlgren et al. 2003).

Selection of Plot Locations

Sampling sites were selected within homogeneous vegetation that was stratified by Anderson and Ohmart vegetation classification types (Anderson and Ohmart 1984; Younker and Andersen 1986). A stratified sampling design was chosen to reduce within sample variability. Subjective and random sampling components were combined after stratification. Previous year's sampling points and stratification of restoration areas were examined; restoration project planting plan maps were consulted, as were biologists that were very familiar with the established stands. A walk-through examination of each identified vegetation type was completed by the ecologist. A sample site was subjectively chosen that best represented average site conditions with respect to species composition, structure, spacing, openness, and homogeneity (Mueller-Dumbois and Ellenberg 1974). The following guidelines were used to choose the sample site: 1) avoid edges of stands whenever possible, 2) examine the entire polygon or unit before choosing the sample site, 3) sample one transect that best represents the site, and 4) use the smallest diameter circular plot that allows for measuring approximately 10 sample trees per plot. Since the objective of sampling was the characterization of vegetation

associations, placement of plots such that they included discordant floristic composition or environmental conditions was avoided. Within homogeneous vegetation, random and restricted random schemes were used to locate the plots within a site. This stratified sampling of representative types is an efficient approach to identifying and characterizing vegetation types through quantitative analysis (Kent and Coker 1992).

Sampling Methods

Data from vegetation plots was collected in September 2007. Vertical cover and percent frequency were measured using the Daubenmire cover method. This method is relatively simple and rapid to use. The most important factor in obtaining meaningful data is selecting representative areas in which to establish the sample transect. Study sites should be located within a single plant community within a single ecological site. Transects and sampling points can be randomly or subjectively located within representative areas.

The Daubenmire method consists of systematically placing a 20- by 50-cm quadrat frame along a tape on a permanently located 30-m long linear transect. Vegetation attributes were measured within each frame; results were recorded by frame and averaged by transect. Percent cover, percent frequency, and species composition by cover were recorded. Canopies extending over the quadrat were estimated even if the plants were not rooted in the quadrat. Overlapping canopy cover was included in the cover estimates by species; therefore, total cover may exceed 100%. Total cover may not reflect actual ground cover using this method (USDI BLM 1996). Rebar posts were pounded in the ground at 1.5-m intervals along each transect to allow for easy and accurate placement of microplots in the same position in future years.

A 10-cover class system was used to record cover in quadrat frames (Daubenmire 1959, USDI 1996) (Table 1). An exact estimate of cover is thought to give a false sense of precision, and cover estimates from multiple observers may not agree (Barour et al. 1987).

Table 1. Daubenmire cover classes

Cover Class	Range	Midpoint
T	0-1%	0.5%
0	1-9%	5.5%
1	10-19%	15%
2	20-29%	25%
3	30-39%	35%
4	40-49%	45%
5	50-59%	55%
6	60-69%	65%
7	70-79%	75%
8	80-89%	85%
9	90-99%	94.5%
X	100%	99.5%

Data Analysis

Percent cover was calculated by species as follows: 1) the numbers of quadrats in which a given species occurred in a given cover class were tallied, 2) this sum was multiplied by the midpoint value for that particular cover class, 3) the products for all cover classes by species were totaled, and 4) this total was divided by the number of quadrats sampled on the transect.

The percent frequency for each plant species was calculated by dividing the number of occurrences of a plant species (the number of quadrats in which a plant species was observed) by the total number of quadrats sampled along each transect. The resulting value was multiplied by 100. Species composition is based on canopy cover of the various species. It is determined by dividing the percent canopy cover of each plant species by the total canopy cover of all plant species.

Canopy Cover and Species Composition

The line intercept method was used to estimate horizontal, linear canopy cover and species composition by measuring plant intercepts along the course of a transect line (the same 30-m tape transect as used for the Daubenmire Cover Frequency measurements). Transects were permanently marked to facilitate more accurate repeated measures to detect change. Foliar cover and percent composition by cover are the vegetation attributes monitored with this method. The line intercept method is best suited where the boundaries of plant growth are relatively easy to determine (USDI 1996). The line intercept method, with a theoretical zero width, is therefore expected to provide the least-biased, most accurate estimates of canopy cover, as well as additional information on stand layering and species composition (Fiala et al. 2006).

The observer moved along the transect line following the tape and measured the horizontal linear length of each plant crown that intercepted the taped line. The start and end point of each of these intercepts was recorded. Small gaps in the canopy were included within the entire edges of the canopy and no attempt was made to read intercept intervals around these gaps. Observers were careful not to inadvertently move the tape to include or exclude certain plants and not to trample vegetation.

Percent overstory density measured on a spherical densiometer was recorded in previous years. Because these measurements are relatively quick and easy to take, and because we might be able to correlate relationships between canopy cover values measured on the line intercept transect with canopy cover values measured on the spherical densiometer, this measurement was continued in 2007.

Canopy cover was calculated by counting the proportion of the 96 points that are intersected by the canopy. Overstory density measured in this way does not incorporate gaps or openings in the canopy, but subtracts them out. Spherical densiometer readings were taken in each of the four cardinal directions on the circular tree plot. The instrument was held level, at elbow height (Lemmon 1956).

Data Analysis

Canopy cover of each plant species was calculated by totaling the intercept measurements for all individuals of that species along the transect line and converting this total to a percent. The total cover measured on each transect was calculated by adding the cover percentages for all the species together. This total could exceed 100% if the intercepts of overlapping canopies were recorded. Percent species composition is based on the percent cover of each species. Percent species composition was calculated by dividing the percent cover for each plant species by the total cover for all plant species.

Each 30-m transect was a single sampling unit. For trend analysis, either a paired t-test or the nonparametric Wilcoxon signed rank test will be used when testing for change between years. When comparing more than two sampling periods, repeated measures ANOVA will be used.

When using the densiometer, four readings were recorded and averaged together at each site. If the number of dots covered by blue sky (canopy openings) were recorded, then:

$$\text{Total dots of open canopy} \times 1.04 = \text{Total closed canopy}, \quad \text{and}$$

$$100 - \text{Total closed canopy} = \text{Percent overstory density (Lemmon 1956).}$$

If the total number of dots covered by canopy were recorded, this value was subtracted directly from 100 to get percent overstory density.

Photo Monitoring

Standardized photos were taken at the start (0 m), end (30 m), and halfway (15 m) points of the linear transect. Photographs were also taken from the center of the tree/shrub plot looking in each of the cardinal directions from the center of the plot. An 8-foot tall (2.4-m) range pole was placed in the photos 5 m from the camera on the linear plot and at the edge of the tree plots, which varied in size. The pole serves for scale as well as calculating obstruction by cover.

Tree and Shrub Density and Growth Plots

Previous year's data were collected on 0-5 m and 5-11.3 m radius circular plots. These data included species, stem density, total height, and diameter breast height (DBH). At times, the 0-5 m radius circle had hundreds of shrubs on it, and the 5-11.3 m radius plot had an inadequate or excessive sample size on it. There were also issues associated with accuracy and efficiency when tallying hundreds of shrubs on a plot. We applied a fixed plot method; however, a polyreal plot sampling design was used (Husch et al. 1982). Several different fixed plot sizes were used, with the plot radius varying depending on the characteristics of the sampled stand. The polyreal plot design was intended to optimize the number of sample trees on a plot (approximately 10 trees). This approach was tried to reduce time spent collecting tree measurements and processing data.

Data Analysis

The number of trees and shrubs per acre was figured by determining the Tree Factor or Shrub Factor for each plot. The Tree Factor is a conversion factor that specifies the number of trees or shrubs represented by each tree or shrub that is measured on the plot.

$$TF = 1/\text{area of plot}$$

where the area of the plot is 10,000 m^2 for figuring per hectare values. The Tree Factor is then multiplied by the number of trees counted on the plot to get stand density in trees per hectare.

Results

A total of four plots were established in 2007 across Phase 1 and Phase 2.

Phase 1, Section 1, Cottonwood

The understory sampled within the cottonwood-dominated plot was sparse grasses and sandbur. Grasses occurred in 60% of the microplots sampled; however, cover was measure at 12%. Litter covered 90% and occurred in every microplot. Average litter depth was 1.3 in (3.2 cm), and was mostly composed of fallen leaves. The shrub/sapling canopy layer was composed of coyote willow less than 2 m (6.6 ft) tall. Density was estimated at 79 shrubs/ha (32 shrubs/ac) in the sample plot.

Thirteen trees occurred on a 29.5-ft (9-m) radius plot. Overall tree density was estimated at 217 trees/ac (520 trees/ha), with 54% Goodding's willow and 46% Fremont cottonwood. Cottonwoods averaged 51.8 ft (15.8 m) tall and 8.8 in (22.3 cm) DBH, while Goodding's willow averaged 26.2 ft tall (8.0 m) and 2.4 in (6.0 cm) DBH. Average live crown height for Goodding's willows was measured at 4.9 ft (1.5 m), while cottonwood live crown height averaged 6.6 ft (2.0 m). Total canopy cover along the linear intercept was 57% (53% cottonwood and 4% Goodding's willow). Average overstory density, an indication of canopy closure, was estimated by spherical densiometer at 71%.

Phase1 Section 1, Mesquite

The understory sampled within the mesquite-dominated plot was predominantly Bermudagrass, sandbur, and aster. Bermudagrass occurred in 80% of the microplots sampled, with an average 55% canopy cover. Sandbur occurred on 50% of the sampled microplots, with an average 28% cover. Litter occurred in all microplots sampled and had 95% cover. Bare ground averaged 3% cover. Litter average 2.6 in (6.7 cm) deep. One screwbean mesquite was observed within the shrub/sapling layer in this sample plot. Shrub density was estimated at 20 stems/ac (50 shrubs/ha).

Thirteen trees occurred on a 29.5-ft (9-m) radius plot. Overall tree density was estimated at 217 trees/ac (520 trees/ha), with 54% Goodding's willow and 46% Fremont cottonwood. Cottonwoods averaged 51.8 ft (15.8 m) tall and 8.8 in (22.3 cm) DBH, while Goodding's willow averaged 26.2 ft tall (8.0 m) and 2.4 in (6.0 cm) DBH. Average live crown height for Goodding's willows was measured at 4.9 ft (1.5m), while cottonwood live crown height averaged 6.6 ft (2.0 m).Total canopy cover along the linear intercept was 57% (53%

cottonwood and 4% Goodding's willow). Average overstory density, an indication of canopy closure, was estimated by spherical densiometer at 71%.

Eight screwbean mesquite trees, with 22 total stems, were measured on a 26-ft (8-m) radius plot. Overall density was estimated at 161 trees/ac (398 trees/ha) and 3,543 stems/ac (8,754 stems/ha). Average total height was 20.4 ft (6.2 m), average DRC was 6.3 in (16.1 cm), and the average low crown height was 4.9 ft (1.5 m). Canopy cover measured along the linear intercept was 90% (55% screwbean mesquite and 35% honey mesquite). Average overstory density was estimated by spherical densiometer at 68%.

Phase 1, Section 2, Cottonwood-Willow

Bermudagrass occurred in all sample microplots, with an average canopy cover measured at 56%. Average litter depth was 2.7 in (6.8 cm).

Nine trees occurred on a 33-ft (10-m) plot. Overall tree density was estimated at 116 trees/ac (286 trees/ha), with 89% Fremont cottonwood and 11% Goodding's willow. The average overall height of sample cottonwood trees was 34.1 ft (10.4 m), the average DBH was 4.6 in (11.6 cm), and the average low crown height was 4.9 ft (1.5 m). No shrubs occurred on a 33-ft (10-m) radius plot. Total canopy cover measured along the linear intercept was 67% (57% cottonwood, 10% Goodding's willow, and less than 1% coyote willow). Average overstory density was estimated by spherical densiometer at 49%.

Phase 2, Section 3, Willow

Bermudagrass, an unidentified grass, and an aster occurred in sample microplots. Bermudagrass occurred in 40% of the plots and averaged 30% canopy cover. Grass appeared in 30% of microplots and averaged 13% canopy cover. Litter occurred in 100% of microplots and averaged 65% canopy cover. Bare soil occurred in 80% of microplots and averaged 33% cover. Litter depth averaged 0.6 in (1.6 cm). The shrub/sapling canopy layer with a 33-ft (10-m) sample plot was composed of honey mesquite and *Baccharis*. Shrub density was estimated at 39 shrubs/ac (95 shrubs/ha).

Nine trees occurred on a 33-ft (10-m) radius plot. Overall tree density was estimated at 116 trees/ac (287 trees/ha), with 89% Goodding's willow and 11% screwbean mesquite. The average overall height of Goodding's willow was 20.0 ft (6.1 m), average DBH was 2.5 in (6.4 cm), and the average low crown height was 1.3 ft (0.4 m). The height of the sample screwbean mesquite was 23.3 ft (7.1m), the DRC was 8.9 in (22.7 cm), and the low crown height was 4.9 ft (1.5m). Total canopy cover measured along a linear intercept was 40% (100% Goodding's willow). Average overstory density measured with a spherical densiometer was 33%.

Discussion

The mean canopy height and DBH of the cottonwoods and willows in areas classified as cottonwood-willow II were similar to yellow-billed cuckoo habitat characteristics observed on other river systems (Halterman 2001; Laymon 2000; LCR MSCP 2006a). The density of trees and saplings at CRIT 9 exceeded the density of trees and sapling at known cuckoo nesting sites (Halterman 2001; Laymon 2000; LCR MSCP 2006a). The CRIT 9 site, comprises 104 ac (42 ha) of cottonwood-willow land cover types, and is a large enough patch size for suitable nesting habitat (Halterman 1991; Laymon and Halterman 1989; LCR MSCP 2006a). However, a mid-

and understory component was lacking within this site in 2006. Goodding's willows and coyote willows were planted 5 ft apart (1.5 m) in January 2007 to provide a mid-story component and provide greater canopy cover. Canopy cover was lower at the CRIT 9 than it was at yellow-billed cuckoo habitat on other river systems (Halterman 1991, 2001; Laymon and Halterman 1989; Laymon 2000; LCR MSCP 2006a).

3.2 Avian Monitoring

Methods

Post-development avian monitoring was conducted at CRIT 9 utilizing the double-sampling intensive and rapid area search method. CRIT 9 was divided into seven plots approximately 22 ac (9 ha) in size. One rapid area search survey was conducted in each plot during the breeding season on 16, 30, and 31 May 2007. A second rapid area search survey was conducted in two plots randomly chosen as intensive plots. Seven intensive area search surveys were conducted in one plot on 7, 12, 14, 20, 22, 26, and 29 June 2007. Six intensive area search surveys were conducted in the second plot on 8, 13, 15, 19, 21, and 26 June 2007. Rapid and intensive area search surveys were conducted according to LCR MSCP protocol (LCR MSCP in press).

Habitat monitoring associated with the double sampling area search method was conducted at CRIT 9. Habitat monitoring was conducted in all seven plots on 26 July 2007. A 164 by 164 ft (50 by 50 m) grid was overlayed on each plot using a Geographic Information System, and Universal Transverse Mercator points were selected every 164 ft (50 m) throughout the plot. The data for each point was recorded on a habitat profile form. The vertical profile for a circle with a diameter of 3.3 ft (1.0 m), centered on the selected point was described. The vertical zones and the substrate for each point were described in the form height, density, species, species-1, species-2, and species-3. Height means the top of the zone. The density categories were dense (>75% cover), medium (25-75% cover), or sparse (25% cover). Cover means the total canopy coverage as viewed from above or below. Up to four species with at least 25% cover (within the zone) were recorded (Bart in press).

Avian point-count surveys were conducted one time during the breeding season on 15 May 2007 at each of the 10 point-count stations that were established in previous years. Points were established 820 ft (250 m) apart utilizing a systematic random sampling method. An 820 by 820 ft (250 by 250 m) grid was overlayed on each plot using a Geographic Information System, and Universal Transverse Mercator points were selected every 820 ft (250 m) throughout the plot. The purpose of conducting the point-count surveys along with the double-sampling area search method was to compare previously collected data with data from 2007. Point-count surveys were conducted according to LCR MSCP protocol (LCR MSCP in press).

Density, in birds per acre (hectare) for breeding and migratory species, was calculated from the rapid area search data. The number of males observed was multiplied by two to account for their mates (Bart in press). Species composition of breeding birds (migrants excluded) was calculated for breeding season avian surveys conducted in 2006-2007. Species richness, ecological diversity, and evenness were calculated for breeding season avian surveys conducted in 2006-2007 for breeding birds.

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:

$$H' = \sum_{i=1}^{i=S} (p_i)(\mathrm{In}p),\ i = 1, 2, \ldots S \qquad N_1 = e^{H'}$$

where S = number of species in the sample, and p_i is the proportion of all individuals belonging to the *i*th species. H'= diversity in terms of bits and N_1= diversity in terms of species. The transformation of H´ is given by $e^{H'}$, labeled as N_1 (MacArthur 1965). The original Shannon's Index is calculated in a logarithm base 2 (Nur et al. 1999). H' is expressed in terms of bits, which is the logarithmic unit of data storage capacity. The equation above is calculated using natural logarithms (Nur et al. 1999). The maximum N value is equal to the species richness value.

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 to each other. Evenness is equal to 1.0 when there are similar proportions of all species, and approaches zero as proportions of species become more dissimilar.

Results

Two LCR MSCP covered species, the summer tanager (*Piranga rubra*) and the vermilion flycatcher (*Pyrocephalus rubinus*), were detected at CRIT 9 in 2007 in low densities (0.7 birds per ac (0.1 birds per ha) for summer tanager and 0.2 birds per ac (0.5 birds per ha) for vermillion flycatcher) during rapid surveys (Table 2) (Bart in press).

An overall density of 11.6 birds per ac (28.6 birds per ha), comprising 23 species, was detected at CRIT 9 (Table 2) (Bart in press). The most abundant species detected were the house finch (*Carpodacus mexicanus*), mourning dove (*Columbina passerina*), red-winged blackbird (*Agelaius phoeniceus*), Brewer's sparrow (*Spizella breweri),* brown-headed cowbird (*Molothrus ater*), Gambel's quail (*Callipepela gambelii*), verdin (*Auriparus flaviceps*), Abert's towhee (*Pipilo aberti*), western wood-pewee (*Contopus sordidulus*) and great-tailed grackle (*Quiscalus mexicanus*) (Figure 7). A species richness of 23, an ecological diversity index of 14.3, and an evenness of 0.85 was detected at CRIT 9 in 2007 (Table 3).

Table 2. The number of individual birds per hectare per species (breeding birds and migrants) detected at the 'Ahakhav Preserve CRIT 9 Habitat Creation Project in avian surveys during the 2007 breeding season (Bart in press).

Species	Number of birds per hectare	Species	Number of birds per hectare
vermilion flycatcher	0.5	northern mockingbird	0.5
summer tanager	0.3	Wilson's warbler	0.5
house finch	4.8	white-winged dove	0.5
mourning dove	4.7	ash-throated flycatcher	0.4
red-winged blackbird	3.4	western tanager	0.4
Brewer's sparrow	3.4	Anna's hummingbird	0.3
brown-headed cowbird	3.0	brown-crested flycatcher	0.3
Gambel's quail	2.1	black phoebe	0.3
verdin	1.4	Bullock's oriole	0.3
Abert's towhee	1.3	Cordilleran flycatcher	0.3
western wood-pewee	1.1	common raven	0.3
great-tailed grackle	1.0	common yellowthroat	0.3
Lucy's warbler	0.9	Pacific slope flycatcher	0.3
western kingbird	0.9	warbling vireo	0.3
black-chinned hummingbird	0.5	willow flycatcher	0.3
blue grosbeak	0.5	Say's phoebe	0.2

Figure 7. The percentage of the population that the most abundant species comprised (>3%) per species per year at the Ahakhav Preserve CRIT 9 Habitat Creation Project during breeding season avian surveys (Bart in press, Raulston and Sabin in press).

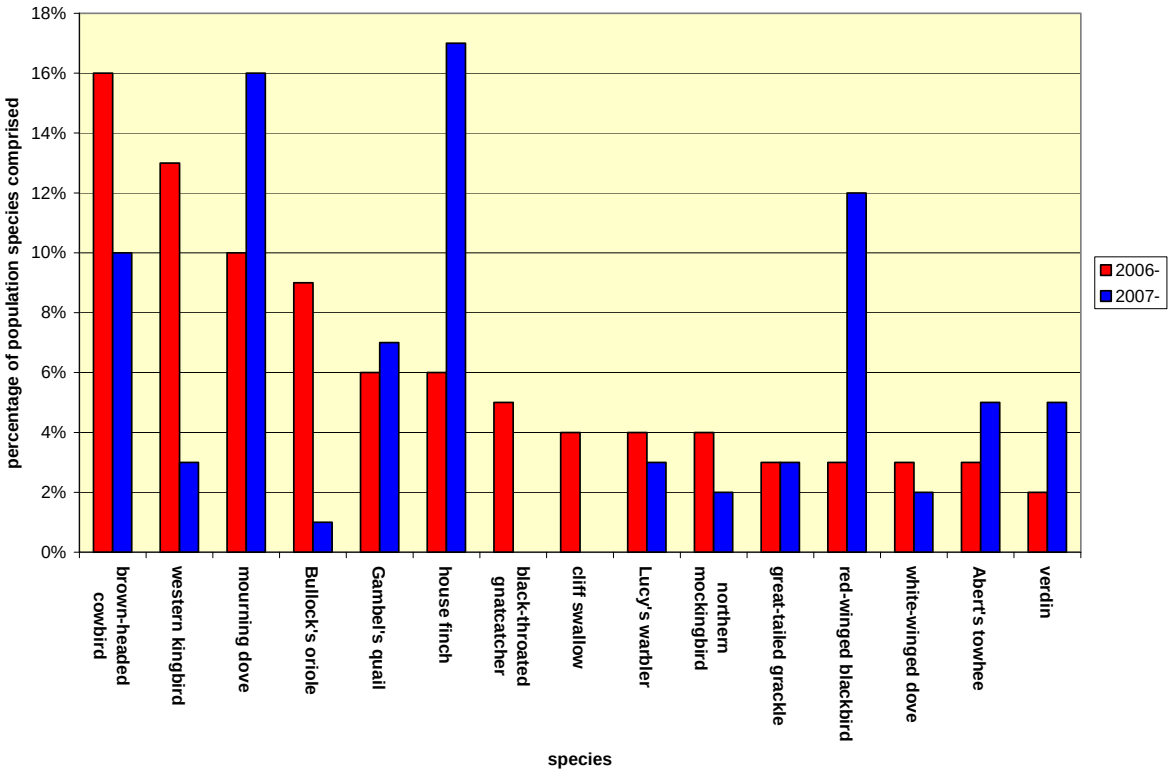

Table 3. Species Richness, Ecological Diversity, and Evenness for the Ahakhav Preserve CRIT 9 Habitat Creation Project during breeding season avian surveys (migrants excluded) (Bart in press, Raulston and Sabin 2008).

Year	Species Richness (S)	Ecological Diversity (N_1)	Evenness (E)
2006	25	16.2	0.87
2007	23	14.3	0.85

Discussion

The avian survey protocol was adjusted in 2007 from a point-count method to a double-sampling area search method to follow the protocol used for system-wide avian monitoring. A double-sampling approach was used to provide detection ratios for each species. An area search method was used to provide better coverage of CRIT 9 (Bart in press).

Monitoring avian population, especially focal species on habitat creation projects, is of high importance. Intensive area search surveys will be conducted on all habitat creation projects in 2008 and future years, including CRIT 9. This will allow for a complete census of each bird's territories on habitat creation projects. This will eliminate detection error and also should allow for additional data, such as nest success, to be collected on focal species (personal communication, J. Bart, U.S. Geological Survey Boise, ID).

Two LCR MSCP covered species, summer tanager and vermilion flycatcher, were detected at CRIT 9 in 2007. The project consists of mature mesquite and cottonwood-willow habitat, which could potentially provide habitat to these species. Adjacent to CRIT 9 is a park with mature mesquite and Fremont cottonwood that is fairly open. There is a layer of grass underneath the trees that gets watered with a sprinkler system daily. Surveyors have seen four to five male vermilion flycatchers at the park during the breeding season (the park was not officially surveyed). Only one vermilion flycatcher was detected in non-created habitat along the LCR during the 2007 system-wide surveys (Bart in press). CRIT 9 consists of very sandy soil, where flood-irrigated water does not even reach all portions of the habitat. The portion of the habitat the water does reach stays inundated for less than a day. This may be one reason why more vermilion flycatchers and summer tanagers are not utilizing CRIT 9. Soil amendments have been added to CRIT 9 and coyote willows were planted around the amendments in 2006, which may improve conditions of saturated soils in future years and attract more riparian obligate species (Raulston and Sabin in press).

CRIT 9 consists of tall cottonwood-willow trees, with little mid-story canopy. This may be one of the reasons why yellow warblers (*Dendroica petechia sonorana*) and Bell's vireos (*Vireo bellii arizonae*) are not utilizing the habitat at CRIT 9. Coyote willow trees were planted in 2006 to provide a mid-story component, which may provide better habitat for these two species as well as other LCR MSCP covered species in future years (Raulston and Sabin a in press).

The following non-covered sensitive avian riparian obligate species were also detected at CRIT 9: Abert's towhee, blue grosbeak (*Passerina caerulea*), brown-crested flycatcher (*Myiarchus*

tyrannulus), Bullock's oriole (*Icterus bullockii*), common yellowthroat (*Geothlypis trichas*), and Lucy's warbler (*Vermivora luciae*).

3.2 Southwestern Willow Flycatcher Surveys

Methods

To elicit responses from willow flycatchers (*Empidonax trailli*), conspecific vocalizations from previously recorded southwestern willow flycatcher's (*Empidonax traillii extimus*) were broadcasted. Surveys were performed according to established methods from Sogge et al. (1997). Surveyors used a portable LifeSong Bird Call Recorder by Summit Doppler, similar to an MP3 player or "iPod", with an external speaker as part of the device. Biologists performed 10 surveys during the breeding season (May-August) at least five days apart, beginning one-half hour before sunrise and ending by 0900 hours. Biologists broadcasted the willow flycatcher song (*fitz-bew*) and call (*breets*) for 40 seconds, listened two minutes for a response, and then moved 98 ft (30 m) to broadcast the vocalizations again. If a willow flycatcher was observed and did not respond to the initial song and call, other territorial calls (*breets, creets, wee-oos, whitts,*) were played. Surveyors recorded all willow flycatchers observed visually and audibly, behavioral activities, and location. If territories were established or pairs observed, nest searches were conducted. Biologists utilized standard detection forms to record observations. The presence of brown-headed cowbirds, livestock, water, and moist soils were noted during all surveys as they may affect the presence of the willow flycatcher (McKernan 1997, McKernan and Braden 1998, 1999, 2001a, 2001b, 2002, USFWS 2002, Koronkiewicz et al. 2004, McLeod et al. 2005). All survey forms and data were given to the Arizona Game and Fish Department (AGFD).

Results

No willow flycatchers were detected at CRIT 9 during the 2007 breeding season during tape playback southwestern willow flycatcher surveys (personal communication, Jen Cleland, Ahakhav Tribal Preserve). One migratory willow flycatcher was detected at CRIT 9 during general avian bird surveys in 2007.

Discussion

The habitat at CRIT 9 contains little mid-story vegetation. Reclamation is currently experimenting with soil amendments and an irrigation strategy that would keep a portion of the habitat inundated during the breeding season (Raulston and Sabin in press). Coyote willows were planted in 2006 to establish a mid-story component at CRIT 9 (Raulston and Sabin in press). These two additions may make the habitat more suitable as breeding southwestern willow flycatcher habitat in the future (McLeod et al. 2007).

3.3 Yellow-billed Cuckoo Surveys

Methods

Yellow-billed cuckoo (*Coccyzus americanus occidentalis*) tape-playback surveys were conducted at CRIT 9 during the 2007 breeding season. Surveys were conducted once in June,

once in July, and once in August. Surveys were conducted according to protocol established by Johnson et al. (2007).

Results

One yellow-billed cuckoo was detected at CRIT 9 during June surveys. There were no individuals detected during a follow-up visit in June or during July and August surveys (Johnson et al. 2007).

Discussion

The yellow-billed cuckoo detected in June was probably a migrant as no other yellow-billed cuckoos were detected during the remainder of the breeding season (Johnson et al. 2007). Habitat for migrating yellow-billed cuckoos is important to the species and use of this site by the birds is encouraging. Future surveys will be conducted in FY 2008 as habitat matures.

3.4 Bat Mist-Netting

Monitoring for covered bat species at CRIT 9 was not in the original monitoring plan; however, an Anabat was set out at CRIT 9 overnight during system-wide, interagency surveys. The calls for the western red and yellow bats were detected; therefore, mist-netting bat surveys were conducted during 2007.

Methods

Mist-netting surveys for bat species were conducted at CRIT 9 on 10 September 2007 from 1900 to 2330 hours, and on 12 September 2007 from 1910 to 2330 hours for a total of approximately nine hours. On the first night, one harp trap was set up near an opening in the habitat where trees had created a narrow corridor between two areas. Two 20-ft (6-m) nets were also set up across a lined irrigation canal that had water in it. One additional 20-ft (6-m) net was set up across a small corridor, which separated two open areas. Also, two high net set-ups were used along two wide corridors lined with tall cottonwood trees on two sides of a road. One set-up was a quad stack with 39-ft (12-m) nets, while the other was a triple stack with 20-ft (6-m) nets. On the second night, only one triple stack 39-ft (12-m) net set-up was used. Mist netting was conducted according to established survey protocol (Calvert in press).

Results

A total of 26 bats of seven to eight species were captured over the two nights. On the first night, one post-lactating female California myotis (*Myotis californicus*) and one non-reproductive female cave myotis (*Myotis velifer*) were captured in the quad set-up. One non-reproductive male Brazilian free-tailed bat (*Tadarida brasiliensis*) and one post-lactating female California leaf-nosed bat (*Macrotus californicus*) were captured in the triple set-up. Three Yuma myotis (*Myotis yumanensis*) were captured. One juvenile female was caught in the harp trap and two non-reproductive (one male and one female) adults were captured in the triple set-up. Three pallid bats (*Antrozous pallidu*) were also captured. One scrotal male was captured in one of the 20-ft (6-m) nets set over the irrigation ditch; a second scrotal male was captured in the quad set-up. The third pallid bat was a non-reproductive female caught in the triple set-up. Four western yellow bats (*Lasiurus xanthinus*) were captured. Two each were

captured in the quad and triple set-ups. Two escaped without identifying sex or reproductive status. The other two were both juveniles (one male and one female).

On the second night of netting, one scrotal male pallid bat was captured and one non-reproductive female Yuma myotis were captured. Five cave myotis (*Myotis velifer*) were captured. Three were non-reproductive females, and the other two were adult males, one being scrotal. Five *Myotis* spp. were also captured that could not be identified to species. Of these unidentified *Myotis* spp., three were non-reproductive females and two were scrotal males.

Discussion

CRIT 9 is a multi-year riparian restoration demonstration project designed to test different planting techniques. This was not a focused effort to provide habitat for covered and evaluation bat species. One LCR MSCP covered species, the yellow bat, and one evaluation species, the California leaf-nosed bat, was captured at CRIT 9.

4.0 Adaptive Management Recommendations

4.1 Developed Conservation Area Operations and Maintenance

The site will be operated and maintained by the ‘Ahakhav Tribal Preserve staff with input from the Bureau of Reclamation.

Soil Management

Data from system-wide southwestern willow flycatcher surveys along the LCR determined the following micro-habitat characteristics for this species: 1) mean soil moisture >17%, 2) mean diurnal temperature between 26°C and 33°C, 3) mean maximum diurnal temperature between 32°C and 45°C, and 4) mean diurnal relative humidity between 33% and 63% (McLeod et al. 2005; McLeod et al. 2006). Sandy soil textures at this site will make it difficult to maintain moist soil conditions throughout the area.

Yellow-billed cuckoo microhabitat requirements may include moist soil conditions, but research on this subject is not yet conclusive (Hughes 1999; Hamilton and Hamilton 1965; Gaines and Laymon 1984; Laymon 2000; Gaines 1974). These parameters will be measured as the site develops and additional management actions may take place in future years as needed, and as more information on habitat requirements becomes available.

Water Management

The intent of the small plastic pools installed in 2007 is to maintain moist soil patches within the habitat. The area is extremely sandy and does not hold moisture long after irrigation. These areas will continue to be irrigated weekly during the breeding season in 2008 to determine whether microhabitat conditions are affected by the presence of these pools. The remainder of the site will be irrigated to control salt buildup and to maintain the health of the trees (approximately once per month).

Microclimate monitoring will be conducted at this site before any recommendation to alter soil and water management is made. Management recommendations for the 2009 breeding season will be based on results of microclimate monitoring. These may include changing management to target species that do not require as much irrigation as southwestern willow flycatchers.

Structural Management

Data analysis from system-wide southwestern willow flycatcher surveys along the LCR determined that the following structural habitat characteristics provide suitable breeding habitat: 1) canopy height greater than 4.0 m, 2) canopy closure greater than 70%, and 3) vertical foliage density greatest between 1 m and 4 m. The site currently does not provide the recommended tree density in the mid-story, vertical foliage density, and canopy cover (McLeod et al. 2005; McLeod et al. 2006).

In November 2006, areas to be managed for LCR MSCP covered species were determined based on irrigation testing and the potential for moist conditions. The distribution of irrigation water was timed and mapped as it flowed over the site. The areas that could be irrigated within four hours were mapped and flagged. Plastic pools (twenty-two 4-ft (1.2-m) diameter and fifty 3-ft (0.9-m) diameter) were installed throughout the area by burying them to the rim and filling them with sand, creating miniature lined ponds. In January 2007, coyote and Goodding's willow and Fremont cottonwood poles were planted approximately 5 ft apart throughout these areas to increase vegetation density. During the breeding season, these areas will be flooded weekly to maintain wet conditions within and around the pools.

By increasing the density of the vegetation and maintaining patches of moist soil, these areas may develop into habitat suitable for covered species. They will be monitored to document conditions over time.

Data from yellow-billed cuckoo studies on the Bill Williams and Kern rivers found the following structural habitat characteristics at breeding sites: 1) mean nest tree height 9.7 m (Bill Williams) and 9.4 m (Kern), 2) mean nest tree DBH 19.1 cm (Bill Williams) and 22.9 cm (Kern), 3) total canopy cover 79.8% (Bill Williams) and 85% (Kern), 4) mean number of saplings per hectare 0.9 (Bill Williams), 5) mean number of trees per hectare 42.5 (Bill Williams), 6) mean DBH of trees 18.9 cm (Bill Williams), 7) mean height of trees 8.8 m (Bill Williams) and 9.1 m (Kern), 8) understory height of 1-6 m, and 9) patch size of greater than 80 ha and wider than 600 m was optimal, and patch size between 41-80 ha and wider than 200 m was suitable (Halterman 1991, 2001; Laymon and Halterman 1989; Laymon 2000).

No changes in management to this site will be made specifically for the yellow-billed cuckoo until system-wide research currently being conducted on the LCR defines specific quantitative structural habitat requirements for suitable yellow-billed cuckoo habitat. Vegetation will continue to be monitored as quantitative structural habitat requirements are determined and Reclamation has the data necessary to make management decisions.

4.2 Future Habitat Creation Development

Operation and Maintenance

The cottonwood, willow, and mesquite in CRIT 9 will continue to be managed through irrigation until at least December 2009. Repairs of ditches, gates, roads, and berms will continue as needed.

Future Development

Possible future development on the Preserve includes a 58ac site (CRIT 10) and a 30-ac site (CRIT 11). The purpose of the sites is to create habitat for LCR MSCP covered species and to research alternative planting and irrigation methods. Reclamation will be developing a Land and Water Use Agreement with CRIT over the next year, and subsequent restoration development plans will precede any future activities.

Soil Management

Extremely sandy soils on CRIT 10 and 11 may prohibit maintenance of large moist soil areas. The results of monitoring soil moisture, vegetation density, and other microhabitat parameters will guide future restoration activities that occur on CRIT 10 and 11. CRIT 10 will be planted with a cover crop in 2007, which will help condition soils for planting riparian vegetation later. Soil amendments will also be considered for CRITs 10 and 11.

Water Management

Because potential areas to be developed are very similar in soil type to CRIT 9, irrigation of future sites will depend on the results of surveys for the presence of LCR MSCP covered species, microclimate monitoring, and vegetation monitoring in CRIT 9. Reclamation is also considering options for additional demonstration areas in CRIT 10 to explore soil amendments, mulches, and irrigation techniques to better manage sandy soil types for LCR MSCP activities.

Structural Management

Planting density, whether using poles, potted plants, or seeds does not correlate directly with stem density as the site develops. Many other factors contribute to future stem density, such as irrigation and other management activities, soil types and textures, and possible soil amendments. Southwestern willow flycatcher habitat consists of several layers of dense vegetation (understory, mid-story, and overstory) (McLeod et al. 2005; McLeod et al. 2006). This could be maintained by cutting overstory trees and planting new trees periodically. Most yellow-billed cuckoo habitat consists of mature cottonwood and willow habitat with a closed canopy. Areas managed for this species will be allowed to grow into suitable habitat. These two habitat types will be in close proximity and/or overlap within the Preserve, creating a mosaic of structural types throughout the area.

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