Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Post-Development Bat Monitoring of Habitat Creation Areas along the Lower Colorado River — 2008 Capture Surveys

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

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Lower Colorado River
Multi-Species Conservation Program
Bureau of Reclamation
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Abstract

The Bureau of Reclamation is the lead implementation agency for the Lower Colorado River Multi-Species Conservation Program (LCR MSCP). One of the goals of the LCR MSCP is the creation of riparian habitat for covered species within the program area. Acoustic monitoring of covered bat species in habitat creation areas has been conducted since 2006. In 2007, a capture survey was initiated to determine the feasibility of capturing covered species to obtain more information than can be gathered from the acoustic monitoring surveys. This survey method was continued in 2008 with a total of five sites surveyed. Methods included the use of a harp trap and mist nets. Mist nets were set singly or stacked so that nets reached double or triple the height of a single net. A total of 169 bats of eight species were captured in 2008. Two covered species were captured including the western yellow bat (*Lasiurus xanthinus*) and California leaf-nosed bat (*Macrotus californicus*). Two of the sites have been dropped from the survey due to low capture rates. A new site will be added in 2009. Surveys will start in May rather than April in 2009 because of low capture rates in the April survey. Due to the success of the triple high net set, a second triple high pole set up will be used in 2009. Increasing the sample area and extending the survey to multiple years will ensure that enough data will be gathered to aid the adaptive management process for each habitat creation area.

Introduction

The Bureau of Reclamation (Reclamation) is the lead implementing agency for the Lower Colorado River Multi-Species Conservation Program (LCR MSCP). The LCR MSCP is a 50-year cooperative Federal-State-Tribal-County-Private effort to manage the natural resources of the LCR watershed, provide regulatory relief for the use of water resources of the river, and create native habitat types along the LCR. Implementation of the LCR MSCP began in October 2005. To restore native habitats, the LCR MSCP will create the following cover types: 1) 5,940 acres (2,404 ha) of cottonwood-willow, 2) 1,320 acres (534 ha) of honey mesquite, 3) 512 acres (207 ha) of marsh, and 4) 360 acres (146 ha) of backwaters (LCR MSCP 2004).

The LCR MSCP uses a variety of methods to monitor covered bat species in these habitat creation areas. In the fall of 2006 a post-development bat survey using acoustic bat detectors was begun by the Bureau of Reclamation Denver Technical Service Center (Broderick 2008). During these acoustic surveys in July and October 2007, a preliminary capture survey began at three of the locations in which acoustic data had been collected (Calvert 2009). In September, a fourth site was surveyed in which only exploratory acoustic work had been done. In 2008 a full season capture survey was conducted. Riparian habitat creation sites along the LCR have only been minimally surveyed for bats in the past (Brown 2006). This new survey is an attempt to increase effort, and thus increase the capture of bats to discover whether LCR MSCP covered species are utilizing habitat creation sites.

There are a variety of reasons why bat surveys should include both acoustic and capture techniques. Not all species are successfully surveyed using only one of the two methods (O'Farrell and Gannon 1999). Species such as Townsend's big-eared bats (*Corynorhinus townsendii)*, and California leaf-nosed bats (*Macrotus californicus)* are known to echolocate at low intensities, which are often missed using acoustic detectors. If there is a species identification question using acoustic data, then captures may confirm the presence of a species. Capturing bats allows for acoustic voucher calls to be made when releasing bats near a bat detector. The design of future habitat creation sites may also be aided by capturing bats. The location of mist nets and traps at current sites may allow a better understanding of how bats use riparian areas. Acoustic data shows that most bats avoid cluttered areas and forage along edges of riparian forests, in corridors, and openings in forest canopies which create flyways for bats (Broderick 2008). Capture techniques may allow for more refined specifications on how to create corridors and flyways in future sites. This will allow for bats to use a larger area of these sites, as well as allowing biologists to more easily find locations to capture bats during future surveys.

Study Areas

Beal Lake Riparian and Marsh Project

Beal Lake Riparian and Marsh is an approximately 100-acre (40.5-ha) site located in Arizona on Havasu National Wildlife Refuge (NWR) near Needles, California (Figure 1). Netting was conducted in two locations in the project area. The first location was on a small dike that crosses the ditch connecting Beal Lake with Topock Marsh. The second location was within the riparian re-vegetation area, on the edges of some of the fields. Vegetation at the site included areas planted with Fremont cottonwood (*Populus fremontii*), coyote willow (*Salix exigua*), Goodding's willow (*Salix gooddingii*), screwbean mesquite (*Prosopis pubescens*), and honey mesquite (*Prosopis glandulosa*). Arrowweed (*Pluchea sericea*) is also abundant in the understory throughout the site.

Bermuda Pasture Re-vegetation Area

The Bermuda Pasture is an approximately 20-acre (8-ha) area located within the Havasu NWR, near the refuge's maintenance facilities, about 1.5 mi (2.4 km) from the Beal Lake site (Figure 1). It was planted with Fremont cottonwood and Goodding's willow. Natural establishment of honey mesquite has also occurred at the site. This site was chosen as a possible replacement for the Beal Lake site due to low captures at Beal Lake in 2007. The way in which Beal Lake was designed makes it difficult to find areas to set nets where bat activity may be concentrated. The Bermuda Pasture was not included in the acoustic monitoring program.

'Ahakhav Tribal Preserve

The 'Ahakhav Tribal Preserve is a 150-acre (61-ha) site located south of Parker, Arizona, on Colorado River Indian Tribes (CRIT) land (Figure 1). This site consists of fields of cottonwood, willow, and mesquite planted as part of an agreement between CRIT and the Bureau of Reclamation. The area that was used for netting was planted in 2001 and has the largest trees on the site. Cottonwood, Goodding's willow, and coyote willow were planted in the area.

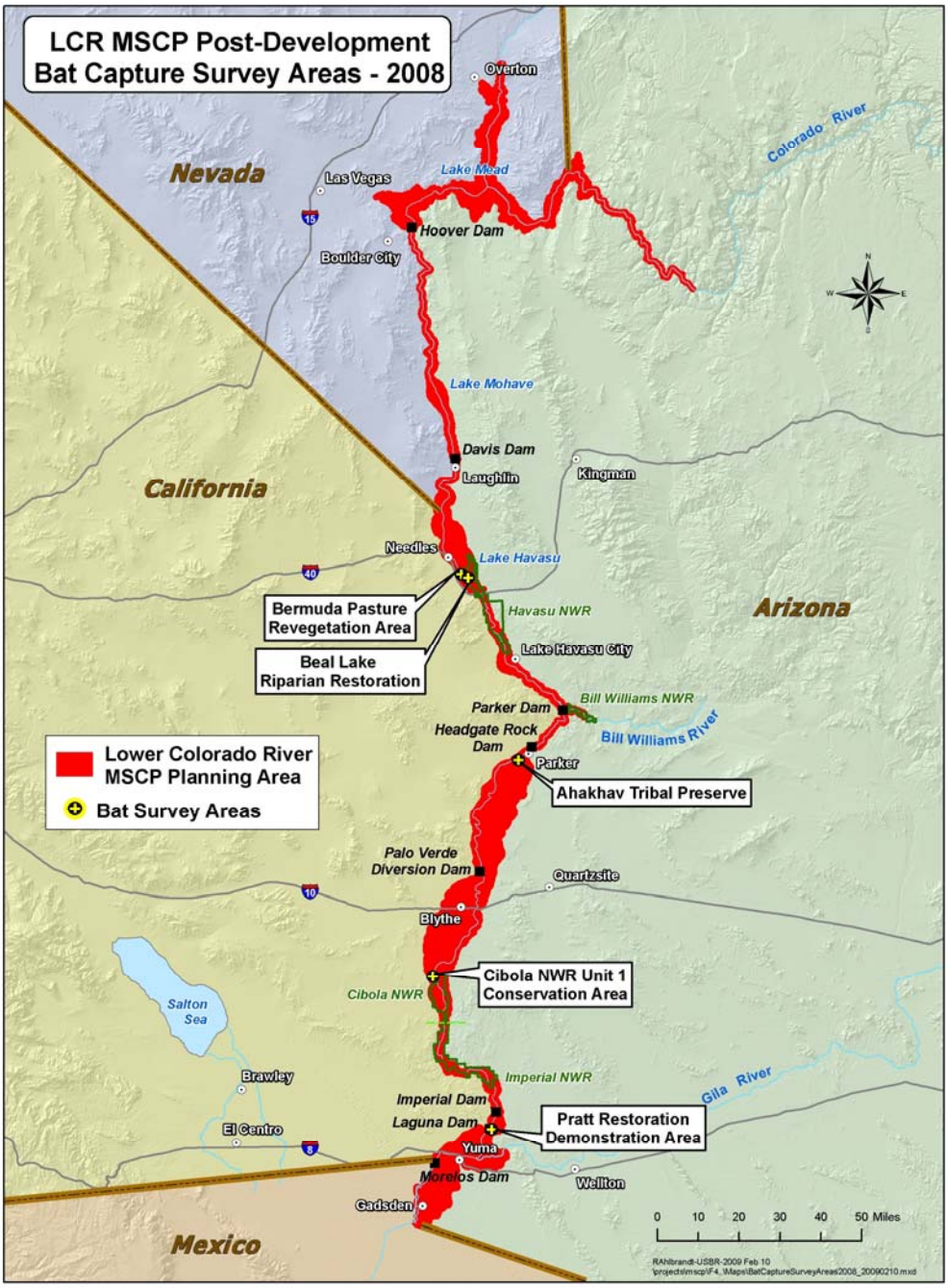
Cibola NWR Nature Trail

The Cibola Nature Trail is a 34-acre (13.8-ha) site located on the Cibola NWR south of Cibola, Arizona (Figure 1). Netting took place in areas of the Cibola Nature Trail where tall cottonwood trees lined the trail. Goodding's willow, screwbean mesquite, and honey mesquite are additional tree species found within the site.

Pratt Restoration Demonstration Site

The Pratt Restoration site is a 12-acre (4.9-ha) site located north of Yuma, Arizona, between Laguna Dam, and Mittry Lake (Figure 1). Netting was conducted at two areas of the site. The first area consisted of a corridor formed in the interior of the site along a small access road with a completely enclosed canopy of cottonwoods and willows. The second area was along a dirt road on the south boundary of the site. One side of the road contained a dense stand of *Baccharis* spp. interspersed with small cottonwoods. On the other side of the road, there were a few established Goodding's willows mixed with saltcedar (*Tamarix* spp.) and some mesquite. The rest of the Pratt Restoration site comprises cottonwood, Goodding's willow, and coyote willow.

Figure 1. Bat capture survey areas



Methods

Capture techniques used for this survey included mist nets and harp traps. The number and size of mist nets varied between sites depending on habitat in the site. Generally, the optimum number of nets and traps used at each site corresponded to what could be handled by the number of personnel available. Three net lengths were used including 6-m (19.7-ft), 9-m (29.5-ft), and 12-m (39.4-ft) Avinet Inc. nets, which were all 2.6 m (8.5 ft) tall with a 38-mm (1.5-in) mesh size. One 30.5-m (100-ft) wide by 6-m (20-ft) tall mist net was used when a joint effort between Reclamation and Arizona Game and Fish Department (AGFD) was conducted at the Pratt site.

A high net set up was used at all of the sites. These high nets were constructed by stacking regular nets (8.5 ft (2.6 m) tall) on top of each other using poles in which a pulley system was made to reach the higher stacked nets. The set up uses three nets stacked on top of each other, referred to as a triple (Figure 2). This pole set up was made by Bat Management and Conservation Inc. Depending on the width of the corridor, either 6-m, or 12-m wide nets were used in this system. A harp trap was also used to capture bats. The Faunatech, Austbat harp trap is 1.8 m (6 ft) wide and has 4.2 m^2 (45 ft^2) of capture area. It is used when a corridor narrows in an area where bats would be funneled into a tighter area (Figure 3).

Nets and traps were set up at a site where bats were most likely to be using an area as a flyway. Usually this involved natural corridors within a site, or roadways and trails that divided areas of habitat creating artificial corridors. The size of the net or trap used was determined by the width of the corridor, maximizing the area where bats could be captured. In some areas where it appeared that one single net may be easily avoidable by a bat, nets were placed together in a manner that would basically confuse the bat.

The first method was to set the nets parallel to each other in hopes that bats would avoid the first net by flying up and over, and then be captured in the second net when they would drop back down into their original flight pattern. The other method was to set nets up in a V or L formation, where bats might be funneled into the capture area by avoiding one net, and being captured in the other. These techniques have been used successfully by Bat Conservation International (personal observation[1]). The triple was used in corridors to capture bats that fly higher and where single nets are easily avoidable.

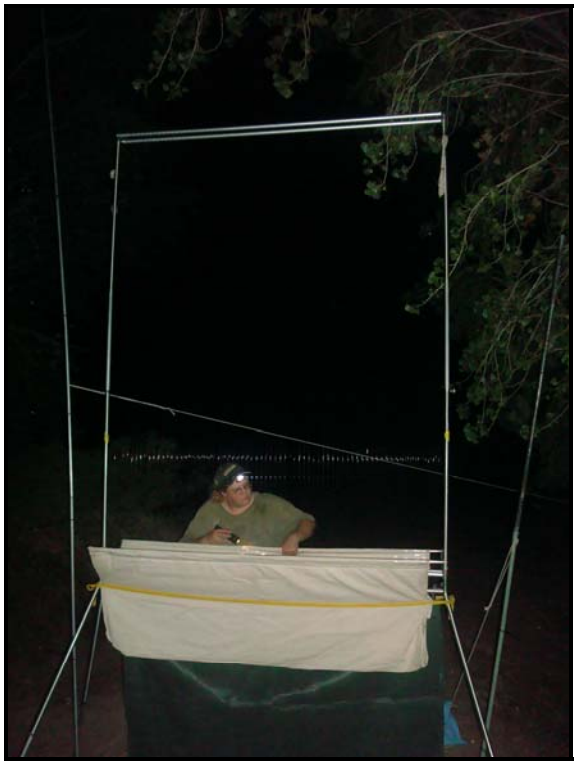
Nets were generally set up near dusk and stayed open for around 4 hours, depending on the activity of the bats. During netting, an Anabat SD-1 bat detector (Titley Electronics) was connected to an HP iPAQ Pocket PC in order to obtain reference calls of captured bats when they were released, as well as to discover whether bat activity in the area was changing over the course of the evening. This acoustic data was also used later to determine whether any MSCP covered species were in the area of the nets, but not captured.

[1] Allen Calvert can be contacted at acalvert@usbr.gov

Once a bat was captured, it was taken back to the processing area to determine species, age, sex, and reproductive status. Measurements such as forearm and hind foot were also taken if it was necessary to identify species. If the species was one for which acoustic reference calls were needed, a small 1-inch (2.5-cm) long glow stick was glued onto the ventral fur to be used as a light tag. Once the bat was released, it was followed by someone with the bat detector until it flew too far to be recorded by the detector. All acoustic file names saved on the HP iPAQ were written on the data sheet for species confirmation and then added to the acoustic reference library.

Figure 2. Triple high net set up at the Beal Lake site

Figure 3. Harp trap set up at the Cibola Nature Trail site



Results

Beal Lake Riparian and Marsh Project

The Beal Lake site was surveyed three times in 2008. A dike that crosses a large ditch along the side of the site was trapped using a combination of a harp trap set in the middle of the dike with a net set on each side of the harp trap to increase the capture area to the entire width of the ditch. The triple set up was used with 12-m (39-ft) long nets within the re-vegetation area. During the July survey a double high set up was used in an L-formation with the triple.

A total of 12 bats of three species were captured, with most captures occurring in July (Table 1). No covered species were captured. All bats were captured over the dike with the exception of the cave myotis (*Myotis velifer*), which was captured in the triple that was set within the re-vegetation area. Yuma myotis (*Myotis yumanensis*) was the most captured species.

Table 1. Total captures at Beal Lake

Species	April	May	July	Totals
Yuma Myotis	4	0	4	8
Cave Myotis	0	0	1	1
Pallid Bat	0	0	2	2
Myotis spp.	0	0	1	1
Totals	4	0	8	12

Bermuda Pasture Re-Vegetation Area

The Bermuda Pasture site was surveyed four times in 2008. All nets and traps were set within corridors that had formed from the original planting design. The harp trap was used in combination with a net set across a corridor during the April, July, and August surveys. The triple was used with 12-m (39-ft) long nets across two small corridors in April. The triple was used with 9-m (29.5-ft) long nets with a double set up in an L-formation in a different corridor during the July and August surveys. During the September survey, the triple was set up in the same location without the double, and two nets were set in parallel with each other where the harp trap/net combo had been set.

A total of 19 bats of four species were captured, with most captures occurring in July (Table 2). All captures except one were either in the triple or double of the L-formation. No covered species were captured. The pallid bat (*Antrozous pallidus*) had the highest capture rate.

Table 2. Total captures at Bermuda Pasture

Species	April	July	August	September	Totals
Pallid Bat	0	12	1	0	13
Yuma Myotis	0	0	2	1	3
Cave Myotis	0	2	0	0	2
Big Brown Bat	0	1	0	0	1
Totals	0	15	3	1	19

‘Ahakhav Tribal Preserve

The ‘Ahakhav Preserve was surveyed five times in 2008. During the April and May surveys, a harp trap was combined with a single net, with a second net set in parallel to the first set up. In the other three surveys a double net set up was used with the harp trap without a second parallel net. The triple was set across a corridor using 12-m (39-ft) long

nets between two fields of planted trees during all five surveys. The August survey, which was performed at the end of the month, was ended early due to a rainstorm that came through after the nets were opened for one hour (with one bat captured). The following week, which was the first week of September, a makeup survey was conducted with the same set up as the previous week. These two surveys were combined into one survey session.

A total of 65 bats of six species were captured, with the highest number of captures occurring in July (Table 3). Two covered species were captured at the preserve. The western yellow bat (*Lasiurus xanthinus*) was captured in July and September. Three of the captures were in the triple and the other was in the double. Two of the July captures were juveniles, and the other escaped before the age could be determined. The one yellow bat captured in September was an adult male that was reproductively active. One of the California leaf-nosed bats (*Macrotus californicus*) captured in July was a post-lactating female, and the other escaped before its sex and reproductive status could be determined. One of the leaf-nosed bats captured in September was an adult female, and the other escaped before age and sex could be determined. The majority of all captures (80%) were in the triple set up, with 52% of those in the highest net. The pallid bat was the species with the highest number of captures.

Table 3. Total captures at ‘Ahakhav Tribal Preserve

Species	April	May	July	Aug.-Sept.	September	Totals
Pallid Bat	0	1	23	3	8	35
Yuma Myotis	0	2	10	0	0	12
Big Brown Bat	0	0	7	2	0	9
Western Yellow Bat	0	0	3	0	1	4
California Leaf-Nosed Bat	0	0	2	0	2	4
California Myotis	0	0	1	0	0	1
Totals	0	3	46	5	11	65

Cibola NWR Nature Trail

The Cibola Nature Trail site was surveyed five times in 2008. During all surveys a harp trap/net combo was set at the beginning of the west trail. In all but the July survey a double set up (12-m (39-ft) long nets) was used with the harp trap and a single net on the other side of the net. In July, single nets were used on both sides of the harp trap. A single net was also set where poles were already set up as part of a bird mist-netting station. The triple was set across the trail using 6-m (20-ft) long nets near a bend.

A total of 37 bats of six species were captured (Table 4). Two covered species were captured. Both western yellow bats were captured in August, both in the triple set up.

One bat was a juvenile male and the other escaped before being processed. The leaf-nosed bat captured in May was an adult male. Two males and one female leaf-nosed bat were captured in September. One of the males showed signs of being reproductively active. Two hoary bats (*Lasiurus cinereus*), which are considered an indicator species for tree roosting bats, were also captured. Of the 37 bats captured, 65% of those were from the triple set up.

Table 4. Total captures at the Nature Trail site

Species	April	May	July	August	September	Totals
Pallid Bat	2	8	1	0	2	13
Big Brown Bat	0	3	9	0	1	13
California Leaf-Nosed Bat	0	1	0	0	3	4
California Myotis	2	0	1	0	0	3
Western Yellow Bat	0	0	0	2	0	2
Hoary Bat	0	0	0	0	2	2
Totals	4	12	11	2	8	37

Pratt Restoration Demonstration Site

The Pratt site was surveyed five times in 2008. The harp trap was set at the beginning of the interior corridor during all surveys. The triple was used with 12 m (39 ft) long nets in the interior corridor during the first three surveys. In August and September two nets set in parallel were used in the corridor instead of the triple. During all but the August survey an extra-long 30.5 m long by 6 m high (100 ft by 20 ft) net was set diagonally across the road that runs along the side of the site where the *Baccharis* spp. stand is. During the first three surveys a double high set was used with 6-m (20-ft) long nets in a V-formation with this extra-long net. During the August survey, the triple high set was used with 12-m (39-ft) long nets instead of the extra-long net with the double in a V-formation. During the September survey the triple was used with 6-m (20-ft) long nets in the V-formation with the extra-long net instead of the double high.

A total of 36 bats of four species were captured, with the pallid bat being the most captured species (Table 5). All but one of the leaf-nosed bats was an adult, including one reproductive female. No other covered species were captured.

Table 5. Total captures at the Pratt Restoration site

Species	April	May	July	August	September	Totals
Pallid Bat	1	6	2	5	6	20
Big brown Bat	0	2	1	1	4	8
California Leaf-Nosed Bat	0	1	1	1	2	5
Yuma Myotis	0	1	0	2	0	3
Totals	1	10	4	9	12	36

Summary of all sites for both years

A total of 31 survey nights were conducted for 2007 and 2008 combined, with 263 bats of nine species captured (Table 6). The Beal Lake and Bermuda Pasture sites had the lowest capture rates and the ‘Ahakhav Tribal Preserve had the highest capture rates. In general, higher species richness correlated with higher capture rates, although the Cibola Nature Trail site had a lower capture rate and higher species richness than the Pratt Restoration site. Eight of the nine species captured in 2007 were also captured in 2008. The Mexican free-tailed bat (*Tadarida brasiliensis*) was the only species not captured in 2008. This was the first year that western yellow bats were captured at the Cibola Nature Trail. The pallid bat had the most captures.

Table 6. Total captures for all sites, 2007-2008. N = number of survey nights

Species	Beal N = 5	Bermuda Pasture N = 4	‘Ahakhav N = 7	Cibola NWR N = 7	Pratt N = 8	Totals
Pallid bat	3	13	39	14	25	94
Big Brown Bat	0	1	9	15	41	66
Yuma Myotis	12	3	16	1	4	36
California Leaf-Nosed Bat	0	0	5	18	10	33
Western Yellow Bat	0	0	8	2	1	11
Cave Myotis	1	2	6	0	0	9
California Myotis	0	0	2	3	0	5
Myotis spp.	0	0	5	0	0	5
Hoary Bat	0	0	0	3	0	3
Mexican Free-Tailed Bat	0	0	1	0	0	1
Totals	16	19	91	56	81	263

Discussion

The ‘Ahakhav Tribal Preserve has been shown both by acoustic and capture methods to be the most successful habitat creation area for covered bats species as well as the general bat community (Broderick in press). This is probably due to a combination of its size and age as well as its location on the river, being the closest site to the Bill Williams River. The Bill Williams River has been shown to have a high diversity of bats due to the numerous roosting opportunities in the area and how intact its riparian corridor is compared to the mainstem Colorado River (Brown 1996). While the Cibola Nature Trail and Pratt Restoration areas are a few years older than the preserve, the preserve is much larger in size. The preserve is the only site where yellow bats have been captured in more than one session. During capture surveys, yellow bats were observed visually and acoustically flying around the site at dusk. It is assumed that this tree roosting species is either roosting within the habitat creation area or extremely close by. Yellow bats are known to prefer roosting in palm trees within the dead fronds that hang like a skirt around the trunk of the tree. They have been observed roosting in other trees on a regular basis (Brown 2006). One other reason that captures may be higher at the preserve is the location of the triple high net set. It is a defined corridor that appears wide enough for most species to utilize for foraging

Location of nets and traps is important for successful capture of bats. Most netting surveys take place over or near water sources where nets can be positioned to capture bats as they fly down to drink. In most riparian re-vegetation sites along the LCR, there are very few open water sources, except for irrigation ditches, which can be difficult to set nets over. Most bat species avoid foraging in cluttered areas of forests (Lacki et. al 2007). The best location to set nets and traps at these sites seems to be where corridors or flyways occur within a large stand of trees (Manley et al. 2006). These corridors can either be roads between fields, or a break in the planting scheme between two areas of trees. Corridors may need a minimum width to create a large enough flyway for bats to use the area.

The narrowest corridor surveyed was at the Pratt site, which was around 5 m (16 ft) across. This corridor not only enables enough of a flyway to create a corridor, but it also was narrow enough that the canopy of the trees had begun to partially cover the top of the corridor. This makes the corridor similar to a tunnel, which may aid in capturing bats by keeping them from flying up and out of the corridor and avoiding nets. The netting data and acoustic data indicate that this corridor may only be used by agile flying species such as California leaf-nosed bats and pallid bats. A variety of different-sized corridors may be best to provide foraging habitat for different species. While these corridors aid biologists in determining where to attempt to capture bats, it is also assumed that these are the areas where bats are using the habitat the most, given that bats tend to avoid cluttered areas. Netting in these areas allows for a better understanding of bat use of riparian restoration areas, which may be useful in the future design of habitat creation areas. The creation of bat corridors may be used in the future if blocks of habitat have been planted without any other corridors such as roads or trails.

The Bermuda Pasture site was added in 2008 to determine whether there was another re-vegetation area near Beal Lake that would provide higher capture rates. Because neither of these sites provided high enough capture rates, it has been decided that neither site will be surveyed in 2009. If high activity levels for any covered species are indicated at Beal Lake from acoustic data (or from data for any other site not currently included in the capture survey), exploratory capture surveys will be conducted to confirm the presence of the species and to acquire reference calls. In replacement of these two sites, capture surveys will take place at the Cibola Valley Conservation and Wildlife Area in 2009. The first phase of this site will be in its fourth growing season and most of the trees are already greater than 25.0 ft (7.6 m) in height.

Other changes include the timing of survey sessions and additions of nets. Captures in April have been low both in 2007 and 2008; thus, in 2009 surveys will begin in May and continue once each month through September. The use of the triple high net has been extremely successful compared to single nets, especially with the capture of western yellow bats; thus, a second triple high set up will be used in 2009 to allow for greater captures in upper canopy areas. Because the goals of the capture surveys are to capture covered species and acquire reference calls, maximizing captures is needed.

Surveys will continue for at least 5 years so that a multiyear data set can be obtained. Year to year variation can be quite high due to a number of factors including wind, temperature, precipitation, and insect activity. As in any scientific study, increasing sampling area and time allows more information to be gathered, which can be used in the adaptive management process for habitat creation areas. A review of protocol and data will be conducted to determine whether sufficient data have been collected for appropriate analysis, and collection of adequate voucher calls has been achieved.

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Appendix 1. Common and scientific names of all species captured

Common Name	Scientific Name
California Leaf-Nosed Bat	*Macrotus californicus*
Pallid Bat	*Antrozous pallidus*
Hoary Bat	*Lasiurus cinereus*
Western Yellow Bat	*Lasiurus xanthinus*
Big Brown Bat	*Eptesicus fuscus*
California Myotis	*Myotis californicus*
Yuma Myotis	*Myotis yumanensis*
Cave Myotis	*Myotis velifer*
Unknown Myotis	*Myotis* spp.
Mexican Free-Tailed Bat	*Tadarida brasiliensis*