Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Post-Development Bat Monitoring of Conservation Areas and the ‘Ahakhav Tribal Preserve Along the Lower Colorado River – 2015 Capture Surveys

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

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Lower Colorado River Multi-Species Conservation Program

Post-Development Bat Monitoring of Conservation Areas and the ‘Ahakhav Tribal Preserve Along the Lower Colorado River – 2015 Capture Surveys

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ACRONYMS AND ABBREVIATIONS

AKTP	‘Ahakhav Tribal Preserve
BCI	Bat Conservation International
BLCA	Beal Lake Conservation Area
Cibola NWR Unit #1	Cibola National Wildlife Refuge Unit #1 Conservation Area
CRIT	Colorado River Indian Tribes
CVCA	Cibola Valley Conservation Area
ft	foot/feet
ha	hectare(s)
in	inch(es)
km	kilometer(s)
LCR	lower Colorado River
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
m	meter(s)
mi	mile(s)
mm	millimeter(s)
PIT	passive integrated transponder
PVER	Palo Verde Ecological Reserve
Reclamation	Bureau of Reclamation
YEW	Yuma East Wetlands

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1 Common and Scientific Names of All Species Captured

2 Bat Capture Survey Protocol for Post-Development Monitoring of LCR MSCP Habitat Creation Areas

ABSTRACT

This report summarizes the results of bat capture surveys conducted within conservation areas and the ‘Ahakhav Tribal Preserve for the Lower Colorado River Multi-Species Conservation Program (LCR MSCP) in 2015. There are two bat species covered under the program and two evaluation bat species. The western red bat (*Lasiurus blossevillii*) and western yellow bat (*Lasiurus xanthinus*) are both tree-roosting species, and the California leaf-nosed bat (*Macrotus californicus*) and pale Townsend’s big-eared bat (*Corynorhinus townsendii* also known as *Plecotus townsendii pallescens and Corynorhinus townsendii townsendii*) are both mine- and cave-roosting species that utilize riparian areas as foraging habitat. Six sites were surveyed in 2015. All of the sites were surveyed once a month from May through September. A total of 910 bats of 12 species were captured in 2015. All four LCR MSCP species were captured. The western red bat was only captured at the Cibola Valley Conservation Area. The western yellow bat was captured at all sites except for the Beal Lake Conservation Area. The California leaf-nosed bat was captured at all six sites. The pale Townsend’s big-eared bat was only captured at the Beal Lake Conservation Area.

INTRODUCTION

The Lower Colorado River Multi-Species Conservation Program (LCR MSCP) is a partnership of Federal and non-Federal stakeholders that was created to respond to the need to balance the use of lower Colorado River (LCR) water resources and the conservation of native species and their habitats in compliance with the Endangered Species Act. This is a long-term (50-year) plan to conserve at least 26 species along the LCR from Lake Mead to the Southerly International Boundary with Mexico through implementation of a Habitat Conservation Plan. The LCR MSCP was implemented in October 2005. Implementing the LCR MSCP will create at least 8,132 acres of new habitat: (1) 5,940 acres (2,404 hectares [ha]) of cottonwood-willow (*Populus fremontii*, *Salix* spp.), (2) 1,320 acres (534 ha) of honey mesquite (*Prosopis glandulosa*), (3) 512 acres (207 ha) of marsh, and (4) 360 acres (146 ha) of backwaters (Bureau of Reclamation [Reclamation] 2004).

This report summarizes the results of bat capture surveys conducted within LCR MSCP conservation areas and the Colorado River Indian Tribes' (CRIT) 'Ahakhav Tribal Preserve (AKTP) in 2015. The western red bat (*Lasiurus blossevillii*) and western yellow bat (*Lasiurus xanthinus*) are covered species under the program. The California leaf-nosed bat (*Macrotus californicus*) and pale Townsend's big-eared bat (*Corynorhinus townsendii* also known as *Plecotus townsendii pallescens and Corynorhinus townsendii townsendii*) are evaluation species under the program. Herein, these four species will be known as LCR MSCP species. Genetic analyses on the pale Townsend's big-eared bat indicate that the LCR is likely in the range of the Pacific Townsend's big-eared bat (*Corynorhinus townsendii townsendii)* rather than the pale Townsend's big-eared bat (Piaggio and Perkins 2005). The LCR MSCP uses a variety of methods to monitor LCR MSCP bat species and monitors at varying intensities to address specific hypotheses about where and how LCR MSCP covered species are utilizing created habitat. Conservation areas containing riparian habitat along the LCR were surveyed for bats minimally prior to 2006 (Brown 2006). In fall 2006, a post-development bat survey using acoustic bat detectors was initiated by Reclamation (Broderick 2008). In 2007, acoustic surveys and capture surveys were conducted at the Beal Lake Conservation Area (BLCA), the Cibola National Wildlife Refuge Unit #1 Conservation Area (Cibola NWR Unit #1) Nature Trail site, the AKTP, and the Pratt Restoration Demonstration Area (Calvert 2009). In 2008, a full season capture survey was conducted at all four sites. The survey protocol was refined in 2009, and surveys following that protocol have continued since.

Pairing acoustic and capture techniques provides benefits over using a single method. Each method has limitations that can affect the ability to detect the presence of species at a site (O'Farrell and Gannon 1999). Species such as pale Townsend's big-eared bats and California leaf-nosed bats are known to echolocate at low intensities, so their presence is often missed using acoustic

detectors. Capturing bats may confirm the presence of a species when acoustic calls cannot be definitively identified to species on the recordings. This method also allows for acoustic reference calls to be recorded when releasing bats near a bat detector so that additional calls can be included in the reference call library, which allows easier identification of species using bat detectors. Capturing bats adds additional information such as age, gender, breeding status, and health of individuals.

STUDY AREAS

Palo Verde Ecological Reserve

The Palo Verde Ecological Reserve (PVER) is a large-scale LCR MSCP conservation area approximately 6 miles (mi) (10 kilometers [km]) north of Blythe, California (figure 1). The PVER is managed under a partnership between the landowner (California Department of Fish and Wildlife) and the LCR MSCP. Habitat is being created by replacing cultivated crops with native riparian plant species on agricultural fields, utilizing existing irrigation infrastructure. In the last 7 years, over 1,000 acres (405 ha) of habitat were created. Species that were planted include Fremont cottonwood, Goodding's willow (*Salix gooddingii*), coyote willow (*Salix exigua*), honey mesquite, willow baccharis (*Baccharis salicina*), desert broom (*Baccharis sarothroides*), and saltbush (*Atriplex* spp.). Most of the habitat is dominated by cottonwood and willow trees, including the area where surveys were conducted (figure 2). Two net sets were used within an area planted in 2006, and the other net set was used in an area planted in 2009 (figure 2).

Cibola Valley Conservation Area

The Cibola Valley Conservation Area (CVCA) is approximately 2 mi (3 km) north of Cibola, Arizona, and is also a large-scale LCR MSCP restoration project (figure 1). The CVCA is a managed under a partnership between the landowner (Arizona Game and Fish Department) and the LCR MSCP. The habitat is being developed in the same manner and planted with the same species as the PVER. Over 600 acres (243 ha) of habitat have been created. Once all phases have been planted, there will be over 1,000 acres (405 ha) of riparian habitat within the CVCA. The capture survey area was an 86-acre (35-ha) section with cottonwood and willow that was planted in 2006 (figure 3).

Figure 1.—Bat capture survey areas.

Figure 2.—Net locations (in red) at the PVER.

Figure 3.—Net locations (in red) at the CVCA.

Cibola National Wildlife Refuge Unit #1 Conservation Area

Cibola NWR Unit #1 is over 800 acres (323.7 ha) on the northern end of the refuge that includes several phases of habitat development (see figure 1). Capture surveys were conducted within two of these phases: Nature Trail (planted in 1999) and Mass Planting (planted in 2005). Capture surveys took place in areas where tall cottonwood lined the trail (figure 4). Goodding's willow, desert broom, screwbean mesquite (*Prosopis pubescens*), and honey mesquite are additional species found within the site.

Figure 4.—Net locations (in red) at Cibola NWR Unit #1.

'Ahakhav Tribal Preserve

The AKTP is a 150-acre (61-ha) site located 3 mi (5 km) southwest of Parker, Arizona, on CRIT land (see figure 1). This site consists of fields of cottonwood, willow, and honey mesquite planted as part of an agreement between the CRIT and Reclamation. The capture survey area was planted in 2001 and has the largest trees of the site (figure 5). Cottonwoods, Goodding's willows, and coyote willows were planted in the area. This site is not an LCR MSCP habitat conservation area, but it continues to be monitored not only because it serves as an example of an older restoration site but also because of its high bat diversity.

Beal Lake Conservation Area

The BLCA is an 100-acre (61-ha) site located 6 mi (10 km) southwest of Needles, California, within the Havasu National Wildlife Refuge (see figure 1). This site consists of fields of cottonwood, willow, and honey mesquite planted as part of an agreement between the U.S. Fish and Wildlife Service and Reclamation. The capture survey area was planted between 2003 and 2006, and the nets were set along the center road of the site (figure 6). Cottonwoods, Goodding's willows, and coyote willows were planted in the area.

Figure 5.—Net locations (in red) at the AKTP.

Figure 6.—Net locations (in red) at the BLCA.

Yuma East Wetlands

Yuma East Wetlands (YEW) is a 1,400-acre (566-ha) site within the city of Yuma and Quechan Tribal Land (approximately 350 acres [61 ha] have been restored and are being managed by the LCR MSCP) (see figure 1). It is a multi-partner project including the city of Yuma, the Quechan Tribe, the Arizona Game and Fish Department, and Reclamation. This site consists of cottonwood, willow, honey mesquite, and marsh habitat. The capture survey area (known as the "North Channel" area) was planted in 2010; nets were placed along a road that bisected two areas dominated by cottonwood plantings (figure 7).

Figure 7.—Net locations (in red) at YEW.

METHODS

Mist netting was the technique used to capture bats during surveys. Depending on net locations, five different net lengths were used, including 6-meter (m) (19.7-foot [ft]), 9-m (29.5-ft), 12-m (39.4-ft), 15-m (49.2-ft) and 18-m (60-ft) Avinet, Inc., nets, which were all 2.6 m (8.5 ft) tall with a 38-millimeter (mm) (1.5-inch [in]) mesh size. High net setups were 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 had been made to reach the higher stacked nets. The three nets were stacked on top of each other (known hereafter as a triple net set) (figure 8). The triple net set was used to capture bats that fly higher and where single nets were easily avoided. In general, a different length net was used for each triple net set within each site. Of the five different

Figure 8.—Two triple net sets in an "L" formation at the CVCA.

net lengths used, three different net lengths were used at each site, and the combination changed depending on the width of the corridors where the nets were set, which allowed for a diversity of foraging areas to be included in each survey. It was assumed that different net lengths for a given net height did not substantially affect survey effort (see below).

Nets were set up at a site in areas where bats may be easily captured below the canopy, such as corridors within the site where a space such as a road or trail was found between two planting areas. Netting perpendicular to an edge was also implemented at two sites (the PVER and CVCA). The length of the net was determined by the width of the corridor in order to maximize the area where bats could be captured. In some areas where it appeared that one triple net set may be easily avoided by a bat, two net sets were placed together to make avoidance less likely. Nets were set up in a "V" or "L" formation so that a bat avoiding one net might be funneled into the other (see figure 8). These techniques have been used successfully by Bat Conservation International (J. Tyburec 2007, personal communication).

During netting, a bat detector was used to obtain reference calls of captured bats when released as well as to determine whether bat activity in the area was changing over the course of the evening. Bat detectors record the calls, which are above the audible range of humans. Software is later used to analyze each call

for species-specific characteristics such as frequency, length, and slope. The detector used was an Anabat SD2 bat detector (Titley Electronics) connected to an HP iPAQ pocket personal computer running AnaPocket software.

Once a bat was captured, its species, age, gender, reproductive status and forearm length were determined. Measurements such as ear length were taken, if necessary, to identify the species. Surveys began a half hour after sunset and continued for 4 hours (weather permitting). Each site was surveyed once a month from May to September for a total of five survey sessions. Some sites had an additional survey in February for a radio tracking study that LCR MSCP was conducting to determine foraging distances of California leaf-nosed bats (Work Task D9). Three triple net sets were used at each site. These standardizations were derived from a protocol that was created using data from the 2007 and 2008 LCR MSCP bat surveys and has been updated periodically since then (attachment 2). Each site had three triple net sets. It was assumed that each triple net set had an equal chance of capturing bats regardless of net length. For example, a 12-m triple net set within a corridor at one site would not necessarily increase the survey effort compared to a 9-m triple net set within a corridor at a different site. In this manner, it was assumed that the survey effort was equal at each site.

Total captures per species, species richness, reproductive status, age, and gender ratios were summarized for each site.

RESULTS

See attachment 1 for a list of common and scientific names of all species captured (tables 1–20).

Palo Verde Ecological Reserve

A total of 173 bats from 9 species were captured in 2015 at the PVER (table 1). The big brown bat (*Eptesicus fuscus*) was the most commonly captured species (98), accounting for 57% of all captures. Two LCR MSCP bat species were captured: the western yellow bat and the California leaf-nosed bat. Two California leaf-nosed bats were captured during the winter survey at the PVER, indicating that the species is foraging at this site during winter. Radio transmitters were attached to the bats by personnel working on the foraging distance study. The highest capture rate (70) and species richness (9) were found during the July survey (table 1).

Table 1.—Species captured at the PVER during each survey month in 2015

Species	Feb.	May	June	July	Aug.	Sept.	Total
Big brown bat	0	7	12	45	26	8	98
California leaf-nosed bat*	2	0	0	1	0	2	5
California myotis	0	0	1	1	0	0	2
Canyon bat	0	0	0	1	0	0	1
Cave myotis	0	0	3	2	2	2	9
Mexican free-tailed bat	0	1	0	1	2	2	6
Pallid bat	0	5	2	8	2	3	20
Western yellow bat	**0**	**0**	**2**	**4**	**16**	**0**	**22**
Yuma myotis	0	0	0	7	2	1	10
Total bats captured	**2**	**13**	**20**	**70**	**50**	**18**	**173**
Total species (richness)	**1**	**3**	**5**	**9**	**6**	**6**	**9**

Note: Species in bold is a LCR MSCP covered species; * indicates an evaluation species.

Only two species (the California leaf-nosed bat and canyon bat) did not have any juveniles captured (table 2). Of the LCR MSCP species, the California leaf-nosed bat and the western yellow bat had a higher ratio of females captured versus males (table 2). Reproductive females were confirmed for the western yellow bat and California leaf-nosed bat.

Table 2.—Age and gender ratios for all species at the PVER in 2015 – summer season[1]

Species	Age (adult:juvenile)	Gender (male:female)
Big brown bat	52:44	23:73
California leaf-nosed bat*	3:0	1:2
California myotis	1:1	0:2
Canyon bat	1:0	0:1
Cave myotis	5:4	3:6
Mexican free-tailed bat	3:3	5:1
Pallid bat	13:6	5:14
Western yellow bat	**10:10**	**9:11**
Yuma myotis	6:4	1:9

[1] Two big brown bats, two western yellow bats, and one pallid bat escaped before the age and gender could be determined.

Note: Species in bold is a LCR MSCP covered species; * indicates an evaluation species.

Capture rates from 2010–15 were fairly consistent, except for in 2010 when there was a very high capture rate (table 3). A total of 12 species have been captured at the site, with 2014 being the only year when all 12 species were captured in a single year (table 3). Big brown bats were the most common species captured (599), accounting for 62% of all captures. Of the LCR MSCP species, western red bats were captured every year through 2014. Western yellow bat captures have been consistent each year since 2010, with 2015 having the most captures in a given year. California leaf nosed bats have been captured every year since 2011. Species richness was highest in 2014 but has been relatively consistent all other years (table 3).

Table 3.—All species captured across all years at the PVER

Species	2010	2011	2012	2013	2014	2015	All years
Big brown bat	154	75	70	106	96	98	599
California leaf-nosed bat*	0	5	1	2	2	3	13
California myotis	3	2	1	1	1	2	10
Canyon bat	0	0	0	1	1	1	3
Cave myotis	31	10	14	8	2	9	74
Mexican free-tailed bat	2	2	5	1	4	6	20
Pallid bat	7	23	10	10	24	20	94
Pocketed free-tailed bat	4	0	0	0	1	0	5
Western mastiff bat	0	1	0	0	1	0	2
Western red bat	**3**	**5**	**6**	**1**	**1**	**0**	**16**
Western yellow bat	**12**	**9**	**10**	**12**	**15**	**22**	**80**
Yuma myotis	16	4	7	4	7	10	48
Total bats captured	**232**	**136**	**124**	**146**	**155**	**171**	**964**
Total species (richness)	**9**	**10**	**9**	**10**	**12**	**9**	**12**

Note: Species in bold are LCR MSCP covered species; * indicates an evaluation species.

Cibola Valley Conservation Area

A total of 247 bats from 11 species were captured in 2015 at the CVCA (table 4). The big brown bat was the most commonly captured species (128), accounting for 52% of all captures. Three LCR MSCP bat species were captured: the western red bat, the western yellow bat, and the California leaf-nosed bat. A survey was conducted in February as part of a California leaf-nosed bat foraging study (Work Task D9), which resulted in the capture of one California leaf-nosed bat and two western red bats. When the western red bats were scanned for passive integrated

Table 4.—Species captured at the CVCA during each month in 2015

Species	Feb.	May	June	July	Aug.	Sept.	Total
Arizona myotis	0	0	0	1	1	0	2
Big brown bat	0	17	10	63	36	2	128
California leaf-nosed bat*	1	2	0	1	2	0	6
California myotis	0	0	0	0	1	0	1
Canyon bat	0	1	0	0	0	0	1
Cave myotis	0	1	2	3	1	1	8
Mexican free-tailed bat	0	0	0	0	0	1	1
Pallid bat	1	13	9	37	9	0	69
Western red bat	**2**	**1**	**2**	**0**	**0**	**0**	**5**
Western yellow bat	**0**	**0**	**0**	**4**	**4**	**2**	**10**
Yuma myotis	0	0	1	9	2	4	16
Total bats captured	**4**	**35**	**24**	**118**	**56**	**10**	**247**
Total species (richness)	**3**	**6**	**5**	**7**	**8**	**5**	**11**

Note: Species in bold are LCR MSCP covered species; * indicates an evaluation species.

transponder (PIT) tags, it was found that one of them had been tagged during an exploratory survey at the CVCA in February 2014. This is the first known example of annual winter site fidelity for the western red bat. The February foraging study survey not only produced a single California leaf-nosed bat that was able to be radio tracked, but it also included two western red bats, indicating that the CVCA is still a wintering site for the species. The highest capture rate (118) was found during the July survey, and the highest species richness (8) was found during the August survey (see table 4).

Western yellow bat juveniles were captured as were juvenile bats from four other species (table 5). Western red bats had more males captured than females, and more female western yellow bats and California leaf-nosed bats were captured than males (table 5). Of the LCR MSCP species, one pregnant California leaf-nosed bat, one lactating western yellow bat, and one lactating western red bat were captured. Two post-lactating California leaf-nosed bats and one post-lactating western yellow bat were captured. No reproductively active male LCR MSCP bat species were observed.

Over the past 7 years, a total of 1,291 bats of 13 species have been captured (table 6). Capture rates across all species combined have varied between years, with 2015 having the second highest capture rate (table 6). The big brown bat had the highest capture rate every year except for 2014. Of the LCR MSCP species, western red bats and western yellow bats have been regularly captured. California leaf-nosed bats had the highest capture rate in 2015, and for the first time they were detected in two consecutive years (table 6). Also, for the first time since 2010, the Arizona myotis was captured at the CVCA.

Table 5.—Age and gender ratios for all species at the CVCA in 2015 – summer season[1]

Species	Age (adult:juvenile)	Gender (male:female)
Arizona myotis	2:0	0:2
Big brown bat	43:79	64:58
California leaf-nosed bat*	5:0	2:3
California myotis	1:0	0:1
Canyon bat	1:0	0:1
Cave myotis	7:1	3:5
Mexican free-tailed bat	1:0	0:1
Pallid bat	51:16	26:42
Western red bat	3:0	2:1
Western yellow bat	4:6	2:8
Yuma myotis	13:3	9:7

[1] Six big brown bats escaped before the age and gender could be determined. One pallid bat was released before the age could be determined.

Note: Species in bold are LCR MSCP covered species; * indicates an evaluation species.

Table 6.—All species captured across all years at the CVCA – summer season

Species	2009	2010	2011	2012	2013	2014	2015	All years
Arizona myotis	0	2	0	0	0	0	2	4
Big brown bat	86	101	139	76	63	38	128	631
California leaf-nosed bat*	1	0	3	0	0	2	5	11
California myotis	2	10	9	8	2	2	1	34
Canyon bat	1	3	0	0	0	2	1	7
Cave myotis	4	16	17	17	13	22	8	97
Hoary bat	1	0	0	3	0	0	0	4
Mexican free-tailed bat	2	0	2	1	2	1	1	9
Pallid bat	9	8	35	35	21	58	68	234
Pocketed free-tailed bat	0	0	0	0	0	5	0	5
Western red bat	**3**	**0**	**7**	**4**	**10**	**7**	**3**	**34**
Western yellow bat	**5**	**4**	**14**	**7**	**5**	**12**	**10**	**57**
Yuma myotis	7	37	34	37	12	21	16	164
Total bats captured	**121**	**181**	**260**	**188**	**128**	**170**	**243**	**1,291**
Total species (richness)	**11**	**8**	**9**	**9**	**8**	**11**	**11**	**13**

Note: Species in bold are LCR MSCP covered species; * indicates an evaluation species.

Cibola National Wildlife Refuge Unit #1 Conservation Area

A total of 88 bats of 8 species were captured in 2015 at Cibola NWR Unit #1 (table 7). The big brown bat was the most commonly captured species (34), accounting for 38% of all captures. Three LCR MSCP bat species were captured: the western red bat, the western yellow bat, and the California leaf-nosed bat. The western red bat was only captured during a winter season survey as part of a California leaf-nosed bat foraging study (Work task D9). The western yellow bat was only captured during the August survey. The California leaf-nosed bat was caught during the February survey as well as in June, July, and September during the summer season. The highest capture rate (36) and species richness (6) were found during the July survey (table 7).

Table 7.—Species captured at Cibola NWR Unit #1 during each month in 2015

Species	Feb.	May	June	July	Aug.	Sept.	Total
Big brown bat	0	4	0	21	12	1	34
California leaf-nosed bat*	2	0	2	2	0	1	7
California myotis	2	0	0	2	1	3	8
Cave myotis	0	0	0	1	2	0	3
Pallid bat	0	0	2	9	15	0	30
Western red bat	**1**	**0**	**0**	**0**	**0**	**0**	**1**
Western yellow bat	**0**	**0**	**0**	**0**	**4**	**0**	**4**
Yuma myotis	0	0	0	1	0	0	1
Total bats captured	**5**	**4**	**4**	**36**	**34**	**5**	**88**
Total species (richness)	**3**	**1**	**2**	**6**	**5**	**3**	**8**

Note: Species in bold are LCR MSCP covered species; * indicates an evaluation species.

Juvenile bats were detected for all but two species (California leaf-nosed bat and California myotis) (table 8). Gender ratios were equal or almost equal for the big brown bat and pallid bat; all other species had slightly more females captured versus males (table 8). For the LCR MSCP species, reproductive activity was detected for one pregnant and one lactating California leaf-nosed bat.

Since 2009, a total of 630 bats of 11 species have been captured at Cibola NWR Unit #1 during the summer season (table 9). The big brown bat was the most commonly captured species (344), accounting for 54% of all captures. Of the LCR MSCP species, western red bats were only captured in 2012 and 2013. Western yellow bats were captured in 2012, 2014, and 2015. California

leaf-nosed bats were captured every year except for 2013. Species richness varied between 6 and 10 in a given year, with 2012 and 2014 having the highest richness in a given year (table 9).

Table 8.—Age and gender ratios for all species at Cibola NWR Unit #1 in 2015 – summer season[1]

Species	Age (adult:juvenile)	Gender (male:female)
Big brown bat	9:23	16:16
California leaf-nosed bat*	5:0	1:5
California myotis	6:0	1:5
Cave myotis	2:1	1:2
Pallid bat	23:6	14:15
Western yellow bat	1:2	1:2
Yuma myotis	0:1	0:1

[1] Two big brown bats, one pallid bat, and one western yellow bat escaped before the age and gender could be determined.

Note: Species in bold is a LCR MSCP covered species; * indicates an evaluation species.

Table 9.—All species captured across all years at Cibola NWR Unit #1 – summer season

Species	2009	2010	2011	2012	2013	2014	2015	All years
Big brown bat	121	37	28	73	28	23	34	344
California leaf-nosed bat*	4	5	8	6	0	1	5	29
California myotis	27	6	13	13	7	10	6	82
Canyon bat	0	1	2	3	0	1	0	7
Cave myotis	0	3	1	2	0	4	3	13
Hoary bat	0	0	0	0	0	2	0	2
Mexican free-tailed bat	1	0	0	1	1	1	0	4
Myotis species	1	0	0	0	0	0	0	1
Pallid bat	8	7	11	17	13	22	30	108
Western red bat	**0**	**0**	**0**	**1**	**3**	**0**	**0**	**4**
Western yellow bat	**0**	**0**	**0**	**1**	**0**	**3**	**4**	**8**
Yuma myotis	4	4	7	8	3	1	1	28
Total bats captured	**166**	**63**	**70**	**125**	**55**	**68**	**83**	**630**
Total species (richness)	**6**	**7**	**7**	**10**	**6**	**10**	**7**	**11**

Note: Species in bold are LCR MSCP covered species; * indicates an evaluation species.

'Ahakhav Tribal Preserve

A total of 181 bats from 9 species were captured in 2015 at the AKTP (table 10). The big brown bat was the most commonly captured species (64), accounting for 35% of all captures. Two LCR MSCP bat species were captured: the western yellow bat and the California leaf-nosed bat. Western yellow bats were captured in every month except for September. California leaf-nosed bats were captured in May, July, and August. The highest capture rate (73) and species richness (9) were found during the July survey (table 10).

Table 10.—Species captured at the AKTP during each month in 2015

Species	May	June	July	Aug.	Sept.	Total
Arizona myotis	3	10	5	4	0	22
Big brown bat	5	11	30	15	3	64
California leaf-nosed bat*	1	0	4	1	0	6
Canyon bat	0	0	2	0	0	2
Cave myotis	1	0	1	2	0	4
Mexican free-tailed bat	0	3	1	0	1	5
Pallid bat	0	13	24	22	1	60
Western yellow bat	**1**	**2**	**3**	**2**	**0**	**8**
Yuma myotis	1	2	3	1	3	10
Total bats captured	**12**	**41**	**73**	**47**	**8**	**181**
Total species (richness)	**6**	**6**	**9**	**7**	**4**	**9**

Note: Species in bold is a LCR MSCP covered species; * indicates an evaluation species.

Juveniles were captured for all but three species (table 11). The gender ratio for the big brown bat, western yellow bat, and Yuma myotis was relatively even, while the pallid bat had a higher ratio of males. The remaining species had a higher ratio of females captured (table 11). One lactating western yellow bat was detected in June, and another was detected in July. Three lactating California leaf-nosed bats were detected in July, and one post-lactating California leaf-nosed bat was detected in August.

Since 2009, a total of 1,208 bats of 14 species have been captured at the AKTP (table 12). Big brown and pallid bats were the most common species captured (370 each), accounting for over 60% of all captures. Seven species have been detected every year, including the western yellow bat and California leaf-nosed bat. Western red bats have only been captured in two years (2009 and 2012). It should be noted that due to access issues, no surveys were conducted in 2010.

Table 11.—Age and gender ratios for all species at the AKTP in 2015 – summer season[1]

Species	Age (adult:juvenile)	Gender (male:female)
Arizona myotis	17:5	4:18
Big brown bat	55:7	24:28
California leaf-nosed bat*	6:0	2:4
Canyon bat	2:0	0:2
Cave myotis	3:1	1:3
Mexican free-tailed bat	5:0	4:1
Pallid bat	54:3	41:16
Western yellow bat	**5:2**	**4:3**
Yuma myotis	8:2	5:5

[1] Three pallid bats, two big brown bats, and one western yellow bat escaped before the age and gender could be determined.

Note: Species in bold is a LCR MSCP covered species; * indicates an evaluation species.

Table 12.—All species captured across all years at the AKTP – summer season

Species	2009	2011	2012	2013	2014	2015	All years
Arizona myotis	12	36	32	45	37	22	184
Big brown bat	35	82	57	50	82	64	370
California leaf-nosed bat*	13	19	8	4	9	6	59
California myotis	1	1	1	2	1	0	6
Canyon bat	0	0	7	2	0	2	11
Cave myotis	5	15	14	16	10	4	64
Hoary bat	1	0	1	0	0	0	2
Mexican free-tailed bat	0	0	1	5	13	5	24
Pale Townsend's big-eared bat*	0	1	0	0	0	0	1
Pallid bat	52	98	60	56	44	60	370
Pocketed free-tailed bat	0	0	1	0	0	0	1
Western red bat	**1**	**0**	**1**	**0**	**0**	**0**	**2**
Western yellow bat	**6**	**11**	**4**	**2**	**6**	**8**	**37**
Yuma myotis	23	8	16	7	13	10	77
Total bats captured	**149**	**271**	**203**	**189**	**215**	**181**	**1,208**
Total species (richness)	**10**	**9**	**13**	**10**	**9**	**9**	**14**

Note: Species in bold are LCR MSCP covered species; * indicates an evaluation species.

Beal Lake Conservation Area

A total of 115 bats from 8 species were captured in 2015 at the BLCA (table 13). The big brown bat was the most commonly captured species (35), accounting for 30% of all captures. Two LCR MSCP species were captured: the California leaf-nosed bat and the pale Townsend's big-eared bat. The highest capture rate (58) and species richness (6) were found during the July survey (table 13).

Table 13.—Species captured at the BLCA during each month in 2015

Species	May	June	July	Aug.	Sept.	Total
Big brown bat	6	4	18	6	1	35
California leaf-nosed bat*	1	0	3	1	0	5
California myotis	1	0	0	1	2	4
Canyon bat	0	0	1	0	0	1
Cave myotis	5	8	14	2	1	30
Pale Townsend's big-eared bat*	0	1	0	0	1	2
Pallid bat	0	2	14	3	0	19
Yuma myotis	1	3	8	2	5	19
Total bats captured	**14**	**18**	**58**	**15**	**10**	**115**
Total species (richness)	**5**	**5**	**6**	**6**	**5**	**8**

Note: * indicates an evaluation species.

Juvenile bats were detected in five of the eight species (table 14). Most species had a higher ratio of females captured compared to males, though the pallid bat had an almost equal gender ratio and the Yuma myotis had a higher ratio of males compared to females (table 14). A lactating female pale Townsend's big-eared bat was captured in June, and a post-lactating female was captured in September. Female California leaf-nosed bats were detected in pregnant, lactating, and post-lactating reproductive conditions across the survey season.

Table 14.—Age and gender ratios for all species at the BLCA in 2015 – summer season[1]

Species	Age (adult:juvenile)	Gender (male:female)
Big brown bat	22:11	7:26
California leaf-nosed bat*	5:0	0:5
California myotis	4:0	1:3
Canyon bat	0:1	1:0
Cave myotis	25:3	8:20
Pale Townsend's big-eared bat*	2:0	0:2
Pallid bat	13:4	9:8
Yuma myotis	15:4	14:5

[1] Two big brown bats, two pallid bats, and two cave myotis escaped before the age and gender could be determined.
Note: * indicates an evaluation species.

Over the last 4 years of surveys, 300 bats of 10 species have been captured (table 15). Big brown bats were the most common species captured (101), accounting for 34% of all captures. Five species have been captured over all four years. Of the LCR MSCP species, the pale Townsend's big-eared bat has been captured the last 3 years. The California leaf-nosed bat has been captured in three of the four years, with 2015 having the highest capture rate. No western red bats or western yellow bats have been captured at the BLCA.

Table 15.—All species captured across all years at the BLCA – summer season

Species	2012	2013	2014	2015	All years
Big brown bat	23	16	27	35	101
California leaf-nosed bat*	1	0	2	5	8
California myotis	5	5	3	4	17
Canyon bat	19	0	0	1	20
Cave myotis	6	12	17	30	65
Hoary bat	1	0	1	0	2
Mexican free-tailed bat	2	0	2	0	4
Pale Townsend's big-eared bat*	0	2	1	2	5
Pallid bat	8	4	13	19	44
Yuma myotis	5	1	9	19	34
Total bats captured	**70**	**40**	**75**	**115**	**300**
Total species (richness)	**9**	**6**	**9**	**8**	**10**

Note: * indicates an evaluation species.

Yuma East Wetlands

A total of 115 bats from 6 species were captured in 2015 at YEW (table 16). The big brown bat was the most commonly captured species (77), accounting for 67% of all captures. Two LCR MSCP species were captured: the California leaf-nosed bat and the western yellow bat. The highest capture rate (68) was found during the July survey, and the highest species richness (5) was found during the August survey (table 16).

Table 16.—Species captured at YEW during each month in 2015 – summer season

Species	May	June	July	Aug.	Sept.	Total
Big brown bat	11	4	49	6	7	77
California leaf-nosed bat*	0	0	0	0	1	1
Mexican free-tailed bat	0	0	0	2	0	2
Pallid bat	0	5	3	2	0	10
Western yellow bat	**0**	**0**	**5**	**6**	**0**	**11**
Yuma myotis	0	1	11	2	0	14
Total bats captured	**11**	**10**	**68**	**18**	**8**	**115**
Total species (richness)	**1**	**3**	**4**	**5**	**2**	**6**

Note: Species in bold is a LCR MSCP covered species; * indicates an evaluation species.

The big brown bat had a much higher ratio of females compared to males, and most were adults (table 17). Adults were captured for all species except for the Mexican free-tailed bat. The one California leaf-nosed bat that was captured was a reproductive male.

Table 17.—Age and gender ratios for all species at YEW in 2015 – summer season[1]

Species	Age (adult:juvenile)	Gender (male:female)
Big brown bat	48:28	9:67
California leaf-nosed bat*	1:0	1:0
Mexican free-tailed bat	0:2	1:1
Pallid bat	4:5	3:6
Western yellow bat	**3:6**	**2:7**
Yuma myotis	7:6	5:8

[1] Two western yellow bats, one pallid bat, one big brown bat, and one Yuma myotis escaped before the age and gender could be determined.

Note: Species in bold is a LCR MSCP covered species; * indicates an evaluation species.

Across all 4 years, a total of 338 bats of 10 species were captured at YEW (table 18). Big brown bats were the most commonly captured species (269), accounting for 80% of all captures. Three species have been captured every year, including one LCR MSCP species: the western yellow bat. The California leaf-nosed bat has been captured during the last 3 years. The western red bat has only been captured once in 2012. Species richness per year has not varied much among years (table 18).

Table 18.—All species captured across all years at YEW – summer season

Species	2012	2013	2014	2015	All years
Big brown bat	77	46	69	77	269
California leaf-nosed bat*	0	1	1	1	3
California myotis	0	1	0	0	1
Canyon bat	0	0	2	0	2
Cave myotis	1	1	0	0	2
Mexican free-tailed bat	1	1	0	2	4
Pallid bat	0	2	5	10	17
Western red bat	**1**	**0**	**0**	**0**	**1**
Western yellow bat	**3**	**2**	**3**	11	**19**
Yuma myotis	2	1	3	14	20
Total bats captured	**85**	**55**	**83**	**115**	**338**
Total species (richness)	**6**	**8**	**6**	**6**	**10**

Note: Species in bold are LCR MSCP covered species; * indicates an evaluation species.

Site Comparisons

A total of 910 bats of 12 species were captured in 2015 at all sites (table 19). The big brown bat was the most commonly captured species, accounting for 48% of all captures. All four LCR MSCP species were captured. The western red bat was only captured at the CVCA in 2015, and the pale Townsend's big-eared bat was only captured at the BLCA. The only site that the western yellow bat was not captured was at the BLCA. Species composition varied at each site, with only four species (California leaf-nosed bat, big brown bat, pallid bat, and Yuma myotis) overlapping across all sites surveyed (figure 9). Capture rates were highest at the CVCA and lowest at Cibola NWR Unit #1. Species richness was highest at the CVCA and lowest at YEW (table 19).

Table 19.—All species captured across all sites in 2015

Species	BLCA	AKTP	PVER	CVCA	Cibola NWR Unit #1	YEW	Total
Arizona myotis	0	22	0	2	0	0	24
Big brown bat	35	64	98	128	38	77	440
California leaf-nosed bat*	5	6	5	5	5	1	27
California myotis	4	0	2	1	6	0	13
Canyon bat	1	2	1	1	0	0	5
Cave myotis	30	4	9	8	3	0	54
Mexican free-tailed bat	0	5	6	1	0	2	14
Pale Townsend's big-eared bat*	2	0	0	0	0	0	2
Pallid bat	19	60	20	68	26	10	203
Western red bat	**0**	**0**	**0**	**3**	**0**	**0**	**3**
Western yellow bat	**0**	**8**	**22**	**10**	**4**	**11**	**55**
Yuma myotis	19	10	10	16	1	14	70
Total bats captured	**115**	**181**	**173**	**243**	**83**	**115**	**910**
Total species (richness)	**8**	**9**	**9**	**11**	**7**	**6**	**12**

Note: Species in bold are LCR MSCP covered species; * indicates an evaluation species.

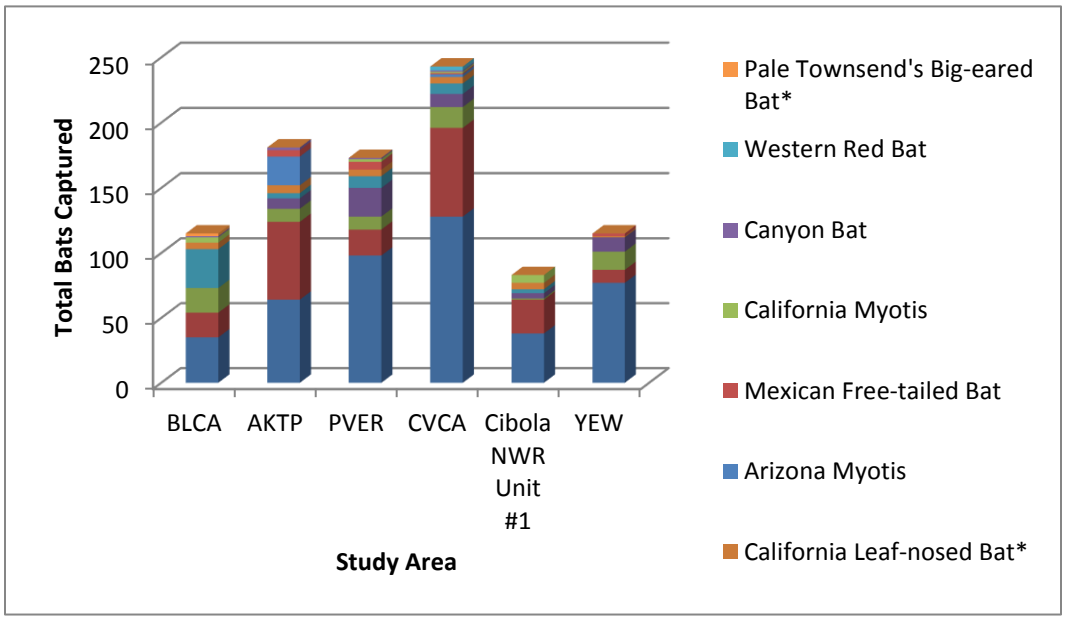

Figure 9.—Species composition at all sites in 2015.

Across the last 4 years, 3,450 bats of 15 species have been captured when all sites are combined (table 20). The PVER had the highest capture rate (964), and the BLCA had the lowest capture rate (300). Of the LCR MSCP species, California leaf-nosed bats were captured at every site, whereas pale Townsend's big-eared bats were only captured at the BLCA. Western red and western yellow bats were captured at every site except for the BLCA. The AKTP and CVCA were tied for the highest species richness (13), and the BLCA and YEW were tied for the lowest species richness (10) (table 20).

Table 20.—All species captured across all sites: 2012–15

Species	BLCA	AKTP	PVER	CVCA	Cibola NWR Unit #1	YEW	Total
Arizona myotis	0	136	0	2	0	0	138
Big brown bat	101	253	599	305	162	269	1689
California leaf-nosed bat*	8	27	13	7	12	3	70
California myotis	17	4	10	13	36	1	81
Canyon bat	20	11	3	3	4	2	43
Cave myotis	65	44	74	60	9	2	254
Hoary bat	2	1	0	3	2	0	8
Mexican free-tailed bat	4	24	20	5	3	4	60
Pale Townsend's big-eared bat*	5	0	0	0	0	0	5
Pallid bat	44	220	94	182	78	17	635
Pocketed free-tailed bat	0	1	5	5	0	0	11
Western mastiff bat	0	0	2	0	0	0	2
Western red bat	**0**	**1**	**16**	**24**	**4**	**1**	**46**
Western yellow bat	**0**	**20**	**80**	**34**	**8**	**19**	**161**
Yuma myotis	34	46	48	86	13	20	247
Total bats captured	**300**	**788**	**964**	**729**	**331**	**338**	**3,450**
Total species (richness)	**10**	**13**	**12**	**13**	**11**	**10**	**15**

Note: Species in bold are LCR MSCP covered species; * indicates an evaluation species.

DISCUSSION

Palo Verde Ecological Reserve

Of the LCR MSCP species, the western yellow bat had its highest capture totals in 2015. Overall, 2015 had the second highest total capture rate since surveys at the PVER began in 2010. This was the first year that no western red bats were captured.

Cibola Valley Conservation Area

A western red bat, captured and tagged 1 year prior (February 2014), was recaptured. As far as it is known, this is the first known record of winter site fidelity for the western red bat. During the summer season, western red bats were captured in two of the five survey sessions in 2015. Based on previous telemetry data, red bats are roosting onsite and are detected across enough months to be considered a resident species. It is unknown if the western red bats residing at the CVCA in winter are non-migratory and stay year round or if they are migratory and have established patterns. Both western red and yellow bats are being PIT tagged, and California leaf-nosed bats are being banded in an attempt to determine the seasonal use of the CVCA and other sites. The latter is the preferred method because bands are immediately visible when a bat is recaptured and do not require equipment to read. Western red and western yellow bats were PIT tagged instead because there is evidence that they incur increased wing damage from bands (P. Brown 2014, personal communication).

Cibola National Wildlife Refuge Unit #1 Conservation Area

The Cibola NWR Unit #1 netting area at the Nature Trail site had the lowest capture rate compared to the other sites in 2015. Two California leaf-nosed bats were captured during the winter survey and were also radio tracked for the foraging study. A western red bat was also captured during the February survey and may indicate, like the CVCA and AKTP, that Cibola NWR Unit #1 supports wintering habitat. With the four western yellow bats being captured during the August survey, it appears that the site continues to provide summer roosting and foraging habitat and/or migratory stop-over habitat for the species.

'Ahakhav Tribal Preserve

Similar to other years, the AKTP has consistently had both high species richness and capture rates as compared to other sites along the LCR. Western red bats have only been captured in August or September during the summer survey season; that the data cannot confirm whether western red bats forage or roost at the AKTP or whether it may be used only as a migration stopover site during the summer months. Winter capture surveys in previous years, as well as acoustic data, show that the AKTP has winter resident habitat for western red bats (Calvert 2013). Of the LCR MSCP species, both western yellow bats and California leaf-nosed bats are captured every year and over multiple months, indicating they are residents of the area.

Beal Lake Conservation Area

The BLCA had its highest capture rate in 2015 since surveys were reinitiated. While overall capture rates are low compared to most other sites, they are much higher than during the first 2 years of monitoring (2007 and 2008). It is likely that the capture rate increased in part due to the use of three triple high net sets. The vegetation within the site has also matured greatly since 2008.

California leaf-nosed bats were captured during three different months in 2015. The most important information gathered over the last 3 years was the consistent capture of female pale Townsend's big-eared bats at the BLCA, including lactating females during the June 2014 and 2015 surveys. It is likely that a maternity colony is located somewhere within foraging distance of the site. The site of the maternity colony is not known. The AKTP site is the only other site where this species has been captured in the past.

Yuma East Wetlands

YEW has the youngest vegetation of any of the sites surveyed, which probably played a role in its lower species richness. Western yellow bats appear to be a resident at YEW, with at least two captures in two different months every year and juvenile bats being detected. Only one western red bat has ever been captured at YEW (in 2012), which suggests that they may not be residents of the site and may only use the site during migration. YEW will not be surveyed in 2016 because conservation measures for the LCR MSCP species are restricted to LCR Reaches 3–5. Capture surveys may be done in future years as a part of system monitoring.

All Sites

Captures across all years remain relatively unchanged for all of the sites surveyed. The survey methods and results were evaluated in 2015. Data from all sites were reviewed to determine if a shortened survey season would cause a loss in species detections, especially for LCR MSCP species. The vast majority of captures occur during the July survey period (figure 10), followed by August and June. All four LCR MSCP bat species has been captured at least once during the June – August survey period (figure 11). Western red bats have had the highest captures in July and September, and the western yellow bat has had the highest captures in August, with July being a close second (figure 11). California leaf-nosed bats have been captured the most in July. The pale Townsend's big-eared bat has been captured in the June and August surveys (figure 11). As a result of this evaluation, Reclamation determined that the LCR MSCP bat survey season should be shortened to monitor for the presence of LCR MSCP bat species during peak summer use, which is also being monitored with acoustic detectors. Capture surveys will now be conducted once a month from June – August, for a total of three surveys per site.

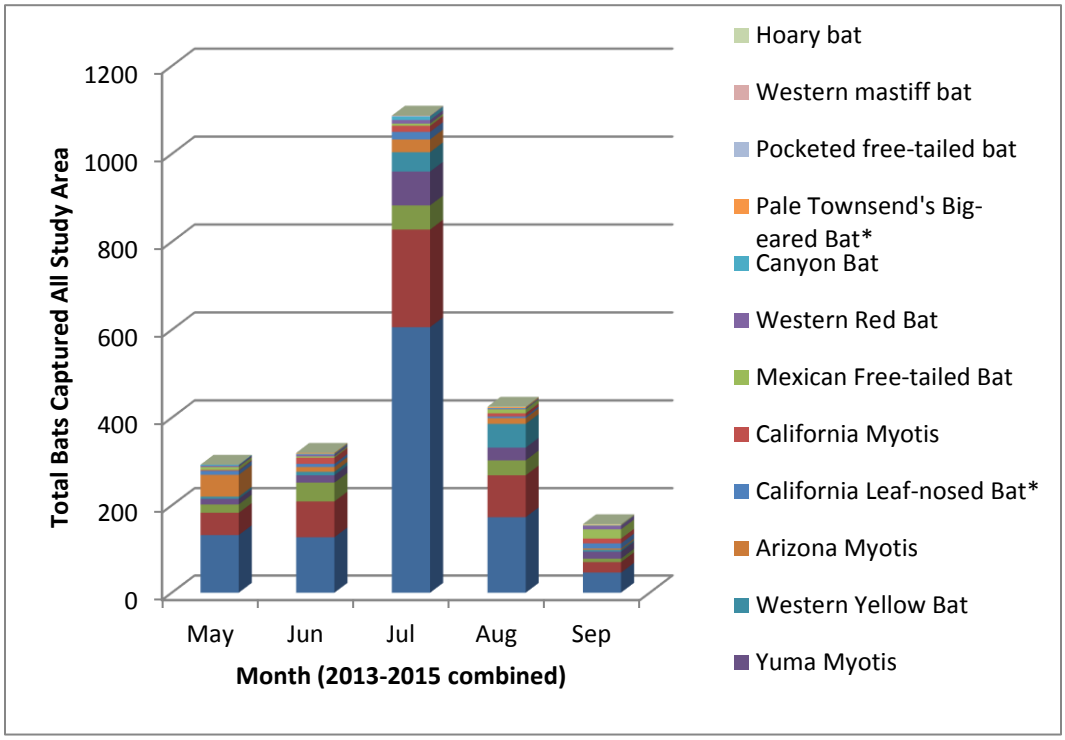

Figure 10.—Species composition between months, 2013–15 data combined for all sites.

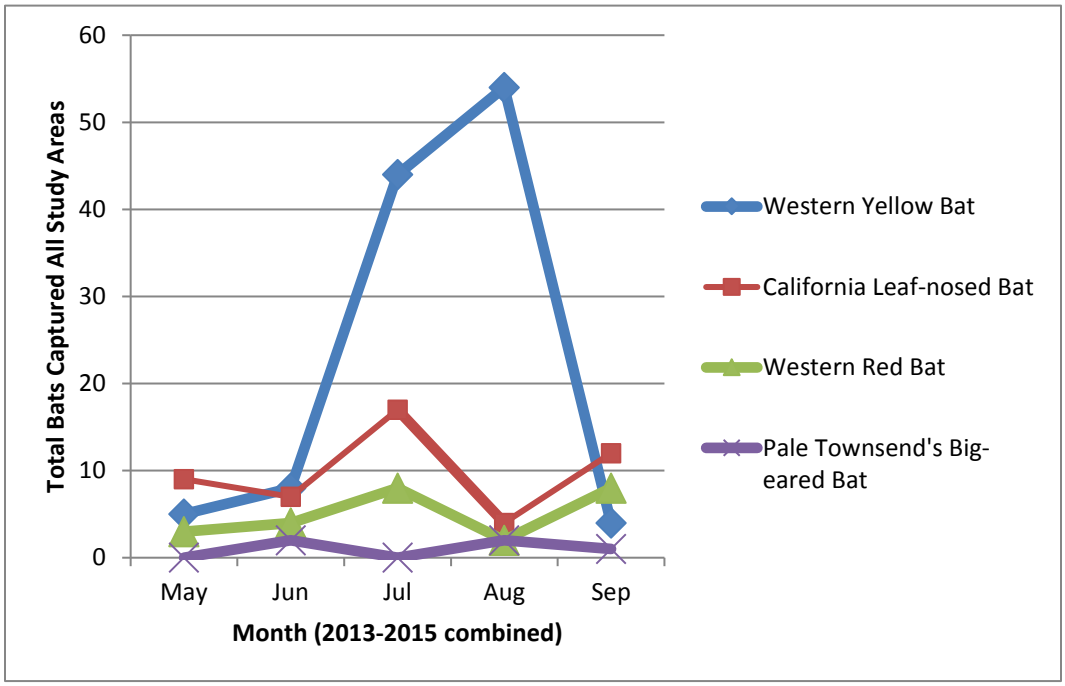

Figure 11.—Capture comparisons across month for the four LCR MSCP species: all sites 2013–15 combined.

Overall, the bat capture surveys have been very successful over the years, with detections of most bat species that occur along the LCR, including the four LCR MSCP species. Captures have validated the presence of the species that were detected acoustically and provided additional information on demographic and reproductive status of populations that are utilizing the conservation areas.

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ATTACHMENT 1

Common and Scientific Names of All Species Captured

Common name	Scientific name
Arizona myotis	*Myotis occultus*
Big brown bat	*Eptesicus fuscus*
California leaf-nosed bat	*Macrotus californicus*
California myotis	*Myotis californicus*
Canyon bat[1]	*Parastrellus hesperus*
Cave myotis	*Myotis velifer*
Hoary bat	*Lasiurus cinereus*
Mexican free-tailed bat	*Tadarida brasiliensis mexicanus*
Pallid bat	*Antrozous pallidus*
Pocketed free-tailed bat	*Nyctinomops femorosaccus*
Pale Townsend's big-eared bat	*Corynorhinus townsendii* also known as *Plecotus townsendii pallescens* and *Corynorhinus townsendii*
Unknown myotis	*Myotis* spp.
Western mastiff bat	*Eumops perotis*
Western red bat	*Lasiurus blossevillii*
Western yellow bat	*Lasiurus xanthinus*
Yuma myotis	*Myotis yumanensis*

[1] *Parastrellus hesperus* is formerly known as *Pipistrellus hesperus*, the western pipistrelle.

ATTACHMENT 2

Bat Capture Survey Protocol for Post-Development Monitoring of Lower Colorado River Multi-Species Conservation Program Habitat Creation Areas

INTRODUCTION

The western red bat (*Lasiurus blossevillii*) and western yellow bat (*Lasiurus xanthinus*) are covered species, and the California leaf-nosed bat (*Macrotus californicus*) and pale Townsend's big-eared bat (*Corynorhinus townsendii* also known as *Plecotus townsendii pallescens and Corynorhinus townsendii townsendii*) are evaluation species under the Lower Colorado River Multi-Species Conservation Program (LCR MSCP). Bat capture surveys are conducted at habitat creation areas for both general monitoring purposes as well as to provide confirmation of covered species recorded using acoustic monitoring. When covered species are captured, acoustic calls are obtained to augment call reference libraries for these species that will aid future species identification from acoustic data. A minimum of four habitat creation areas, herein known as sites, are chosen each year so that the maximum number of sites can be surveyed in a given workweek. Additional sites may be added as exploratory sites if acoustic data show the possibility of an LCR MSCP species (e.g., red or yellow bat) with high activity levels. This protocol is based on adaptations of similar protocols, lessons learned during training courses with Bat Conservation International (BCI), and past experience conducting bat capture surveys in 2007 and 2008 (Calvert 2009).

METHODS

Timing of Surveys

The summer months have generally been found to have the highest bat capture rates (Manley et al. 2006). Surveys are to be conducted at each site once per month from May – September, for a total of five survey sessions for each of the four sites. Multiple surveys are important because bats can and will forage at a variety of areas within a site and may not necessarily use all areas every night (Manley et al. 2006). Surveys from month to month should be spaced 3–4 weeks apart. If the third week of May is selected as the start week for that year, then each subsequent monthly survey should also stick to that same week each month. Due to winter active western red bats and California leaf-nosed bats, winter season surveys are also conducted on an exploratory basis. Winter surveys should be conducted in January or February when the daily high temperature is forecasted to exceed 18 degrees Celsius (65 degrees Fahrenheit). These temperatures have been found to provide nighttime temperatures that are warm enough for moderate bat foraging activity (unpublished data). The week before a full moon should be avoided if possible, as California leaf-nosed bats have been found to be lunar phobic (Brown 2010). Surveys are to begin a half hour after sunset and continue for 4 hours (adapted from an Arizona Game and Fish Department unpublished protocol [Arizona Game and Fish Department, unpublished]). Nets should be checked every 10–20 minutes depending on activity. Netting will be cancelled if the average windspeed exceeds

16 kilometers per hour (10 miles per hour) and/or precipitation is more than a light sprinkle. Netting will also be cancelled if a thunderstorm is approaching the area regardless of precipitation due to the potential for lightning strikes. If a weather system appears to be temporary (less than 2 hours), the survey can be stopped and then restarted after conditions improve.

Capture Techniques

A minimum of three triple high net sets should be used at each site. Pole sets that use a pulley system to raise and lower the stacked nets will be used to accomplish this. The size of the nets used for each triple will vary depending on the area being netted. A minimum field crew of two people is mandatory, and it is highly recommended to use a crew of at least three during the July survey due to high capture rates. Five net lengths are currently being used, including 6-meter (m) (19.7-foot [ft]), 9-m (29.5-ft), 12-m (39.4-ft), 15-m (49.2-ft), and 18-m (59.1-ft) Avinet, Inc., nets, which were all 7.8 m (25.6 ft) tall with a 38-mm (1.5-inch [in]) mesh size. Additional "single" high (2.6-m) (8.5-ft) tall net sets can be added to the survey if areas of pooled water are found within the site that may attract bats for drinking.

The field crew must arrive at the site at least 1.5 hours before sunset to set the nets. The nets are set up at a site where bats are most likely to be using an area as a flyway (Manley et al. 2006) – usually this involves natural corridors within a site or roadways and trails that divide areas of habitat creating artificial corridors. The size of the net used is determined by the width of the corridor, maximizing the area where bats can be captured. Corridors where a triple stacked net set can be used will be the focus for net placement because this allows for bats to be sampled higher in the canopy. Some sites may not have enough corridors for three triple high nets. When this is the case, a triple high set can be used on the edge of a row of plantings so that any bats foraging near the edge will be captured. It is recommended that the longest net possible be used for an edge set. Some corridors may have an area that fits a triple high nicely but has an open area that bats could use as an escape route. Two triple highs can then be used together in an "L" formation, which will allow bats to be funneled into one of the nets (BCI 2007). Every attempt should be made to set nets and traps the same way during every survey session for the entire year. The number of nets and traps can be increased from a previous survey as long as the original net sets are used and the additional effort can be focused on a different area of the site that was not included in the original setup.

Data Collection

A bat capture data sheet and a Trimble Global Positioning System (GPS) unit with a data dictionary will be used for every survey. This data sheet includes the

following general information categories: location, date, start time, end time, recorder, GPS Universal Transverse Mercators (UTMs), GPS datum, start temperature, end temperature, percent clouds, habitat, weather/wind, capture technique, and set over/near water. All of these categories should be filled out for every survey. As long as a GPS UTM was entered for the first survey of the year, this category does not need to be repeated for future surveys. Use a Kestrel weather station to obtain temperature and humidity data. An area is given to describe the net set. Be sure to do this on the first survey of the year.

Bats must be handled only by persons that have received rabies vaccinations. Leather gloves must be worn at all times; the thickness of glove will depend on the size/species of bat being handled. If the bat was captured in one of the triple high stacked nets, the net location will correspond with which triple setup and which net in the stack. Stacked nets will be numbered from the ground so that the lowest net is # 1 and the highest net is # 3. Each triple net set will be named numerically starting with #1 for the closest net set to the processing area. So, if a bat was captured in the net that was second closest to the processing area in the highest net, it would be labeled 2-3.

Bats should be processed as soon as possible after capture, if multiple bats are caught during a single net check, and pregnant and lactating females should be processed first (Manley et al. 2006). Species that do not need to be kept for marking or genetic sampling can be processed immediately after being removed from the net and released without being placed in a bag. Gender, age, and reproductive status will be determined for each bat captured. Age is determined by shining a headlamp on the knuckle of the third and fourth finger bones for full (adult) or partial (juvenile) ossification (Manley et al. 2006). Reproductive status for females includes: pregnant (P), lactating (L), or post-lactating (PL). Reproductive males are those for which the testes have descended, known as scrotal (S) on the data sheet. If the bat does not have these characteristics, it is considered non-reproductive (NR). If a bat escapes before it can be processed fully, write down as much information as possible and explain in the “Notes” section of the data form that the bat escaped. The data form includes various measurements for each bat, including forearm size, ear size, tragus size, hind foot size, and weight. For our purposes, only forearm measurements will be recorded unless additional measurements are needed for identification purposes. Bats will be identified using a key to the bats of Arizona provided by BCI (BCI 2007). Once a bat has been processed, it will be immediately released unless reference acoustic calls are needed.

Genetic Sampling

If a bat either cannot be identified to species or is a species that genetic information is lacking (e.g., red bats), then a genetic sample can be taken from each wing using a biopsy punch. These directions are adapted from a protocol

by the American Museum of Natural History (American Museum of Natural History 2009) and on-the-ground training by Dr. Patricia Brown.[1] For small bats (forearm size 40 mm [1.6 in] or less), use the 2-mm (0.08-in) punch. Samples from larger bats can be taken using a 3-mm (0.12-in) punch. The wing punch kit contains everything needed to obtain a genetic sample. The wing punch is done right before the bat is released. Fill one of the small NUNC tubes about half way with 95-percent ethanol using a sterile pipette. Keep the tube somewhere it can be left open and not be tipped over. Using an alcohol wipe, wipe off the top of the plastic lid that is found in the kit and also wipe off the area of the wing where the punch will be taken, which is usually the area of the wing in between the fingers where the least amount of blood vessels can be seen. Once the wing has been wiped, lay the wing flat on top of the lid. Then, open up the correct biopsy punch and be careful not to touch the end of the punch anywhere before the samples are taken. Place the punch in the area chosen and twist the handle of the punch back and forth a couple times to ensure the punch has cut all the way around. Remove the punch from the wing and determine if the genetic sample is lying on the lid or still attached to the punch. If still attached, gently tap the punch over the tube until the sample drops into the tube. If it is still on the lid, use a pair of tweezers that have been sterilized using the alcohol wipe to pick up the sample and place it into the tube. Then, repeat the process on the other wing using the same biopsy punch. Place the cap back on and shake the tube to make sure both pieces of skin are within the ethanol solution. Label the sample tube with the initials of the survey crew lead and the corresponding number based on how many samples that person has collected. If the person's initials were AWC and this was the 14th sample taken by that person, the ID code would be AWC-14. The date, species code, and site code are also written on the tube. The tube ID is written on the data sheet, and the other information is written down in the crew lead's field notebook where all other genetic samples are being recorded.

Marking Individuals

Western red and yellow bats may be marked using a passive integrated transponder (PIT) tag. PIT tags allow for individuals to be determined between survey seasons and years. While one person holds the bat, another takes their fingers and lifts up the skin of the bat between the shoulder blades, making sure that you have skin and not just hair so that you make a "tent" with the skin. It may be necessary to clip off hair in the insertion area. Place the needle of the injection syringe into the skin toward the head of the bat in a horizontal manner, making sure to not inject it into the deep tissue. Quickly depress the plunger of the syringe, making sure the tag has been completely ejected into the skin, and then pull the needle out. Apply antibiotic ointment onto the injection site and

[1] Pat Brown can be contacted at patbobbat@aol.com

massage the area to make sure the tag does not back out. Scan the bat with the PIT tag reader to make sure the tag can be scanned easily. Once the PIT tag ID has been recorded, the bat may be released (Kunz and Weise 2009).

All California leaf-nosed bats will be marked using a numbered wing band. They are marked with a band instead of a PIT tag because they are far less prone to injury from a band compared to red bats and other tree-roosting species, and it is easy to spot a banded bat while doing mine surveys, enabling individuals to potentially be recaptured at both roosting and foraging sites. Only lipped bands should be used. Once a bat is in hand, one wing is pulled out and the band is placed over the forearm of the bat. Using your thumb and forefinger, gently close the band so that it cannot be pulled off the arm but can still slide up and down the arm freely. Write down both the band number and which wing was banded on the data sheet (Kunz and Weise 2009).

Collecting Acoustic Calls

Acoustic calls are collected using a bat detector such as an Anabat (Titley Electronics) or an AR 125 (Binary Acoustic Technology). To allow for longer call files once a bat is released, a small (1-in long) cyalume light tag is attached using a non-toxic glue stick to the ventral side of the bat. Light tags and glue sticks can be found inside the small, yellow tool box labeled “wing punch kit.” The directions below are taken from how BCI personnel light tag bats at their acoustic monitoring workshop. Light tagging is done by rubbing the light tag onto the glue stick until a small dollop of glue is on one end of the light tag. The fur on the underside of the bat is then spread apart, the light tag is placed vertical against the bat’s body, and the fur is spread over the area of the light tag where the glue is. Once the light tag appears to be attached firmly, the bat can then be released. One person should be holding the bat detector a short distance away from the person holding the bat in the direction where the bat is most likely to fly away. All lights and head lamps should be turned off so that the light tag can be easily seen. Once the person holding the bat releases it, the person(s) with the detector(s) will aim the detector at the bat and follow it until it can no longer be seen or is too far away. The file names of the calls that were collected should be written on the data form in the “Notes” section for that bat as well as the color of light tag used. The same color light tag should be used for the same species so that if a bat returns to the area and more calls are collected, they can be written down as the correct species. If more species need to be light tagged than the number of colors available on a given night, then the same color can be used on a different species as long as the two species have very few, if any, overlapping calls.

Data Entry

The data can be entered into an Excel spreadsheet either in the field (during downtime in the hotel room) or after returning to the office. Each site will have its own spreadsheet, with each survey month on a separate tab of the worksheet. A new spreadsheet will be used at the beginning of each year. Everything written on the data form will be transferred onto the spreadsheet. The spreadsheets should then be posted onto the F-4 SharePoint site.

Utilizing the Trimble GPS units, data will also be transferred onto a computer using the program Pathfinder. The process for transferring, quality assurance/ quality control, and database management can be found in the Mobile Electronic Field Forms documentation for bat capture surveys (Reclamation 2013).

EQUIPMENT CHECKLIST

- Nets:
  - Triple 6-m
  - Triple 9-m
  - Triple 12-m
  - Triple 15-m
  - Triple 18-m
- 3 triple high pole sets
- Sledge hammer, rubber mallet
- Hand pruners
- Long-arm branch pruner
- 3–5 chairs
- 2 tables
- Kestrel weather station
- Spotlight
- Headlamps
- Ziplock bags
- Weigh scale
- Data sheets
- AA and AAA batteries
- Clipboard
- PIT tag kit:
  - PIT tags
  - Injection syringes
  - Antibiotic ointment
  - PIT tag reader
  - Alcohol
- Bat species keys
- Rulers
- Bat bags
- Gloves
- Camera
- Light sticks
- Glue stick
- Wing punch kit:
  - Biopsy punches
  - Tissue tubes
  - Ethanol
  - Tweezers
  - Cutting board/lid
  - Plastic pipettes
  - Alcohol swabs
- Anabat detectors and iPAQ with GPS
- AR 125 and tablet
- Field laptop
- Extra rope
- Arizona permit
- California permit
- U.S. Fish and Wildlife Service permit
- Protocol

LCR MSCP Bat Capture Data Sheet

Location (site name): Trimble file name:

Date: Start Time: End Time: Observers:

Start Temp: End Temp: % clouds: Start Wind: End Wind: Start Humidty: End Humidty:

Habitat Type:

Set over/Near water: YES / NO If yes; pool or stream if pool; size W x L Winds gusty? YES / NO

Capture Technique (length of set): Triple: Triple: Triple: Double: Single: Single: Single: Other:

Description of set-up:

Net location UTM's:

BAT #	TIME	NET #	SPECIES	SEX (M/F)	AGE (J/A)	REPRO	FOREARM	WING	TISSUE ID	Other (PIT tag, band #, ref calls, measurements)

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