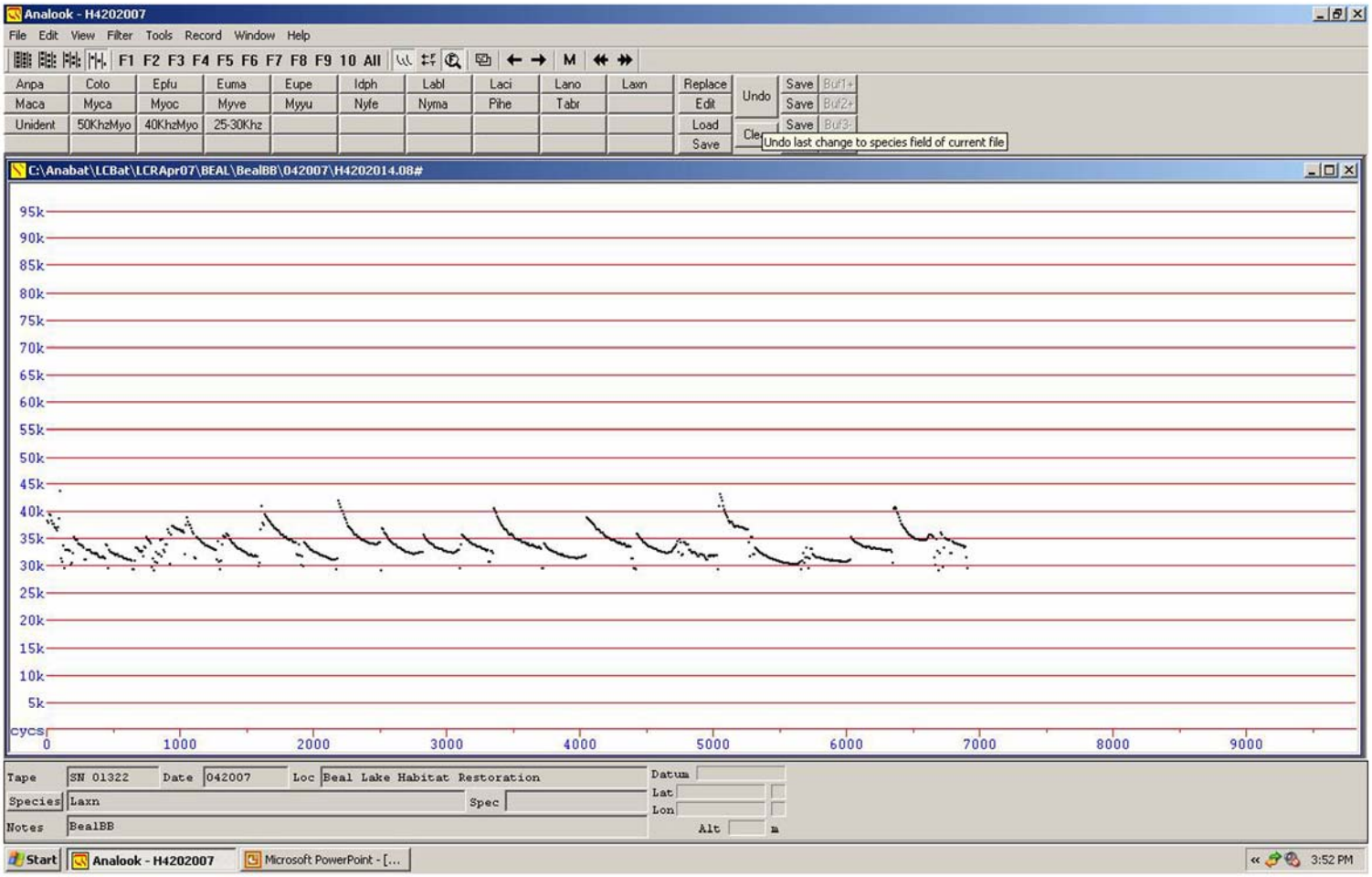
Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Post-Development Bat Monitoring of Habitat Creation Areas along the Lower Colorado River – 2007 Acoustic Surveys



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November 2008

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Lower Colorado River
Multi-Species Conservation Program

Post-Development Bat Monitoring of Habitat Creation Areas along the Lower Colorado River – 2007 Acoustic Surveys

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

November 2008

Abstract

Quarterly acoustic bat surveys were conducted by the Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Office at six habitat creation sites along the lower Colorado River and adjacent riparian habitats. Surveys were conducted during November 2006 and January, April, and July 2007 for a total of 180 detector nights, recording 49,834 bat calls. The primary focus of post-development bat monitoring is on the two covered bat species, western red bat *(Lasiurus blossevilli)* and western yellow bat (*Lasiurus xanthinus)*, and the two evaluation species, pale Townsend's big-eared bat (*Corynorhinus townsendii)* and California leaf-nosed bat (*Macrotus californicus).* All four species were detected at the Beal Lake Habitat Restoration Area and the Imperial Ponds Conservation Area. Three covered species were detected at the Palo Verde Ecological Reserve (all except the Townsend's big-eared bat), and three were detected at Cibola Valley Conservation Area (all except the yellow bat). Only one covered species (California leaf-nosed bat) was recorded at the Cibola National Wildlife Refuge Conservation Unit #1, and one covered species was recorded at the Pratt Restoration Demonstration area (western red bat). Habitat creation areas with complex habitats such as ponds, marshes, and various-age stands of cottonwood, willow, and mesquite appeared to attract the highest number of covered bat species.

Introduction

The Lower Colorado River Multi-Species Conservation Program (LCR MSCP) Habitat Conservation Plan includes four bat species as covered or evaluation species including: western red bat (*Lasiurus blossevillii*), western yellow bat (*Lasiurus xanthinus*), California leaf-nosed bat (*Macrotus californicus*), and pale Townsend's big-eared bat (C*orynorhinus townsendii pallescens*). Conservation measures for these bat species include evaluating habitat creation projects targeting the four covered bat species and providing information for the adaptive management of riparian habitat that will be created for the LCR MSCP.

Quarterly post-development acoustic bat monitoring was conducted in six LCR MSCP habitat creation areas during 2007. These areas included Beal Lake Habitat Restoration Project, Palo Verde Ecological Reserve, Cibola Valley Conservation Area, Cibola National Wildlife Refuge Conservation Unit #1, Pratt Restoration Demonstration area, and the Imperial Ponds Conservation Area. Additionally a capture program using mist netting and a harp trap was established in the summer of 2007. The first post-development capture effort was conducted during the July quarterly acoustic surveys. This program is described in a separate report (Calvert 2008).

The principal goal of this initial monitoring year is to assess seasonal use of the habitat creation areas by the two covered bat species, western red bat and western yellow bat, the two evaluation species, pale Townsend's big-eared bat and California leaf-nosed bat, and an indicator species, the hoary bat (*Lasiurus cinereus)*, which may be more common than the other two tree-roosting bats (red and yellow). The hoary bat may be a good indicator for native riparian tree habitat along the Lower Colorado River.

A secondary goal is to assess the current assemblage of bat species utilizing the habitat creation areas and to determine whether different habitats within each site are used at different levels and by which species or species groups. An understanding of the overall use of habitat creation areas by all species of bats can provide enhanced insight into the relative value of created habitats for bats. Because the four covered species are at such reduced population levels, this measure may act as a surrogate until these at-risk species begin to increase in population size.

As much as possible, all recently planted fields in a habitat creation area have been included in the acoustic bat sampling, along with any unique habitat features that may influence the bat assemblage in the area such as lakes, ponds, the LCR, and stands of mature cottonwood or saltcedar. Up to nine Anabat bat detectors were deployed simultaneously in a given habitat creation area. Whenever possible, pre-treatment surveys were conducted prior to implementation of restoration plans.

Study Areas

Beal Lake Habitat Restoration

The Beal Lake Restoration Project is located on Havasu National Wildlife Refuge in Needles, California, within the historic floodplain of the Lower Colorado River. It consists of over 200

acres (81 hectares) of cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii),* coyote willow (*S. exigua*), honey mesquite (*Prosopis glandulosa),* and screwbean mesquite in a series of plantings that began in 2001 and were completed in 2005 (Bureau of Reclamation 2005a). Improvements to irrigation features were made in 2006. Prior to restoration, Beal Lake was approximately 225 acres (91 ha) of shallow, low quality aquatic habitat. This lake was dredged beginning in 2001, and the dredge material was distributed over adjacent areas, to be planted at a later date with native vegetation. Container plants grown in nurseries, cuttings, and seeds have been used at the site. Plant species include naturally established arrowweed (*Tessaria sericea*) and saltcedar (*Tamarix* spp. occurs throughout the site) and/or wetland plants such as bulrush (*Scirpus californicus*). Areas that contain saline soils were planted with salt-tolerant shrubs (*Atriplex* spp., *Baccharis* spp.).

Nine sites (Figure 1 and Figure 2) were selected for acoustic bat monitoring, four of which are in fields with young, recently established native vegetation (cottonwood, willow, *Baccharis,* and mesquite). Also included is a mature Athel tamarisk site on the Sacramento Wash and a small mature cottonwood stand at the location of the Monitoring Avian Productivity and Survivorship (MAPS) station. Two sites were placed on the shorelines of the adjacent Topock Marsh and Beal Lake and on a channel connecting the two lakes. Following are the fields sampled and a habitat descriptor:

Fields K, C, and FF – cottonwood-willow
Field BB – honey mesquite
Sacramento Wash – mature Athel tamarisk (saltcedar)
Beal Lake – open water/marsh
MAPS Bird Banding Station – mature cottonwood
Beal Pump Station located on the channel connecting Topock Marsh and Beal Lake – open water/marsh
Topock Marsh near outflow – open water/marsh

Palo Verde Ecological Reserve

The Palo Verde Ecological Reserve (PVER) encompasses 1,352 acres (536 ha) of Colorado River historic floodplain near Blythe, California, of which 1,100 acres (445 ha) of active agricultural lands were identified for habitat restoration (BR 2006). During Phase 1 a riparian nursery was established to provide plant material for future riparian restoration efforts at PVER. The nursery consists of two fields – A and B. Field A consists of 20 acres (8 ha) planted mainly with Fremont cottonwood and a mix of coyote willow and Goodding's willow. There are also 2 acres (0.8 ha) planted with mule's fat (*Baccharis salicifolia*). Field B consists of 30 acres (12 ha), including 10 acres (4 ha) planted mainly with upland species consisting of desertbroom (*Baccharis sarothroides*) and honey mesquite, 1 acre (0.4 ha) planted with quailbush (*Atriplex lentiformis*), 1 acre (0.4 ha) planted with fourwing saltbush (*Atriplex canescens*), 1 acre (0.4 ha) planted with cattle saltbush (*Atriplex polycarpa*), 0.5 acres (0.2 ha) planted with brittlebush (*Encelia farinosa*), and a 10-acre (4-ha) understory of inland saltgrass (*Distichlis spicata*). Phase 2 developed approximately 80 acres (32.8 ha) of cottonwood-willow vegetation type I, III, and IV (Anderson and Ohmart 1984).

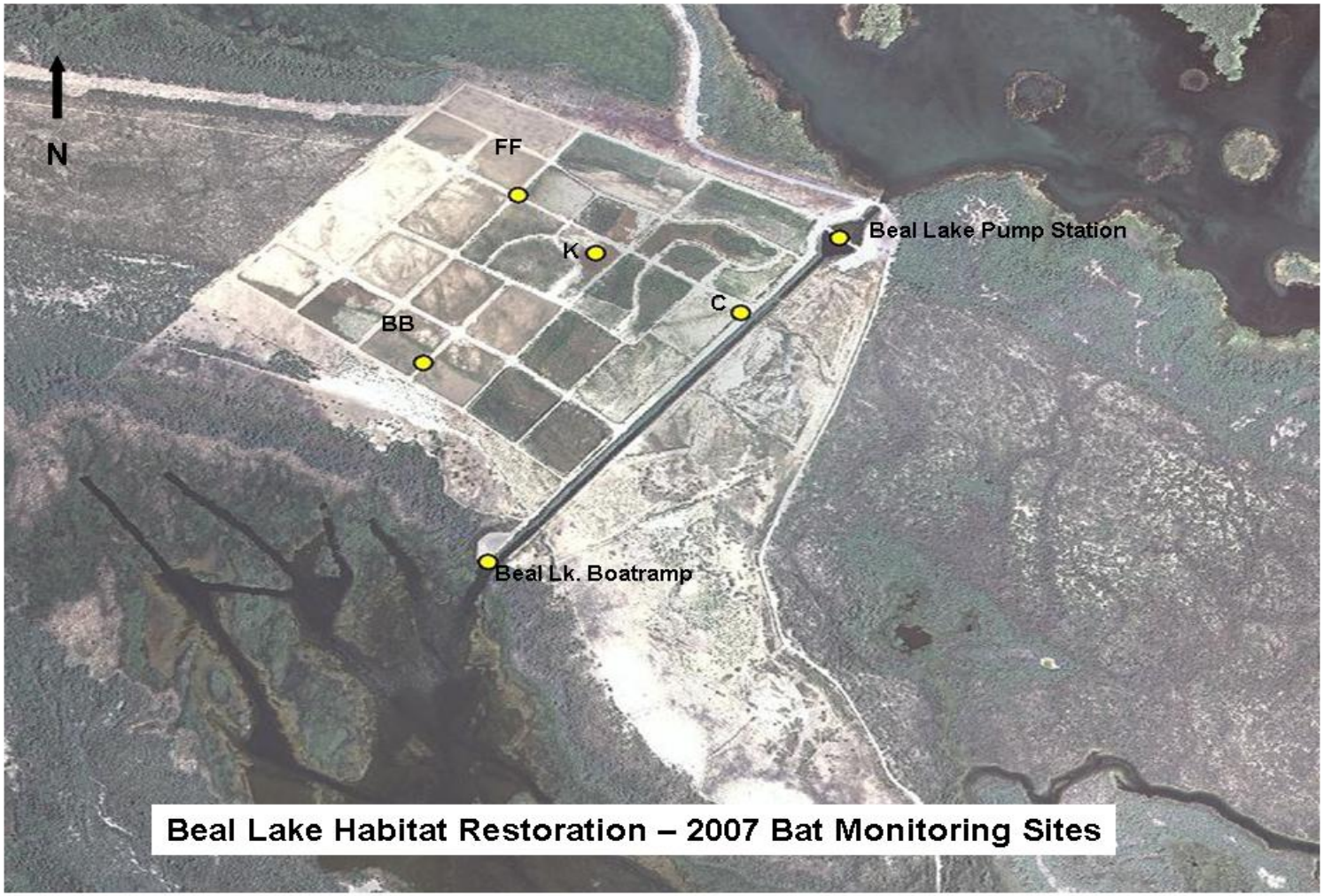


Figure 1. Beal Lake Habitat Restoration – 2007 Bat Monitoring Sites. Field FF – cottonwood/willow; Field K – cottonwood/willow; Field C cottonwood/willow; Field BB honey mesquite; Beal Lake Boat ramp – lake habitat; and Beal lake Pump Station – lake habitat.

Figure 2. Beal Lake Habitat Restoration – South Dike Area – 2007 Bat Monitoring Sites. MAPS Bird Banding Station, strip of mature cottonwoods; Topock Marsh – lake habitat.

Four sites were selected for acoustic bat monitoring at PVER (Figure 3). One site is located in the Phase I nursery in the center of the field on the edge between the cottonwood and willow (Phase I Nursery). This site has cottonwood and willows one growth year ahead of Phase II, which are spaced further apart than the trees in Phase II. Two sites are located on Phase II – one is located on the northwest corner of the field (Phase II Northwest) and another is located on the southeast corner of the field (Phase II Southeast). A fourth site is located on the Lower Colorado River shoreline (LCR Shoreline) located adjacent to the Phase II field. The purpose of this site is to determine the overall presence of bats likely to be concentrated along the river corridor immediately adjacent to the habitat creation area.

Cibola Valley Conservation Area

The Cibola Valley Conservation Area (CVCA) encompasses 1,019 acres (412.4 ha) of active agricultural lands. Phase I implemented in 2006 converted approximately 64 acres (25.9 ha) of active agricultural fields to cottonwood-willow habitat. The area consists of four fields: Field A, 17.8 acres (7.2 ha); Field B, 15.3 acres (6.2 ha); Field C, 13.6 acres (5.5 ha); and Field D, 15.8 acres (6.4 ha). *Baccharis* was planted mostly on the outermost edges. Mosaics of native riparian plantings in the four fields include Fremont cottonwood, Goodding's willow, and coyote willow. An alfalfa cover crop was planted to help control invasive plant species. Additionally, a 22 acre (8.9 ha) on-site native plant nursery was established (BR 2007b).

Phase II, originally scheduled for planting in 2007, was postponed due to invasion of ivyleaf morning glory in May 2007. Phase II fields will be mechanically disked and treated with herbicides in an attempt to control morning glory propagation prior to planting in 2008. The purpose of Phase II is to create approximately 80 acres (32.4 ha) of riparian habitat. Phase III was planted instead in 2007, converting approximately 105 acres (42.5 ha) of active agricultural fields to cottonwood-willow land cover type. There is also a control site consisting of active agricultural fields planted to alfalfa. For 2007 analysis purposes the Phase III site was combined with the Control site. The Phase III site consisted of an agricultural field for three of the sample periods. It was planted to cottonwood-willow in the spring of 2007, but for all practical purposes still could be considered agriculture.

Six sites were selected for acoustic monitoring as follows (Figure 4):

Phase I Fields A, B, C, and D – cottonwood/willow
Phase III – pre-treatment (considered agricultural field for most of 2007 in this analysis)
Control – agricultural field

Cibola NWR Conservation Unit #1

The Cibola National Wildlife Refuge consists of 16,600 acres (6,718 ha) along 12 miles (19.3 km) of the lower Colorado River. It is divided into six management units numbered from 1 to 6. Reclamation has several ongoing and planned projects in Unit #1 (BR 2007c). It is located on the northern end of the refuge and encompasses approximately 4,100 acres (1659 ha), with approximately 1,000 acres (404.7 ha) dedicated to agriculture and 3,100 acres (1,254.5 ha)

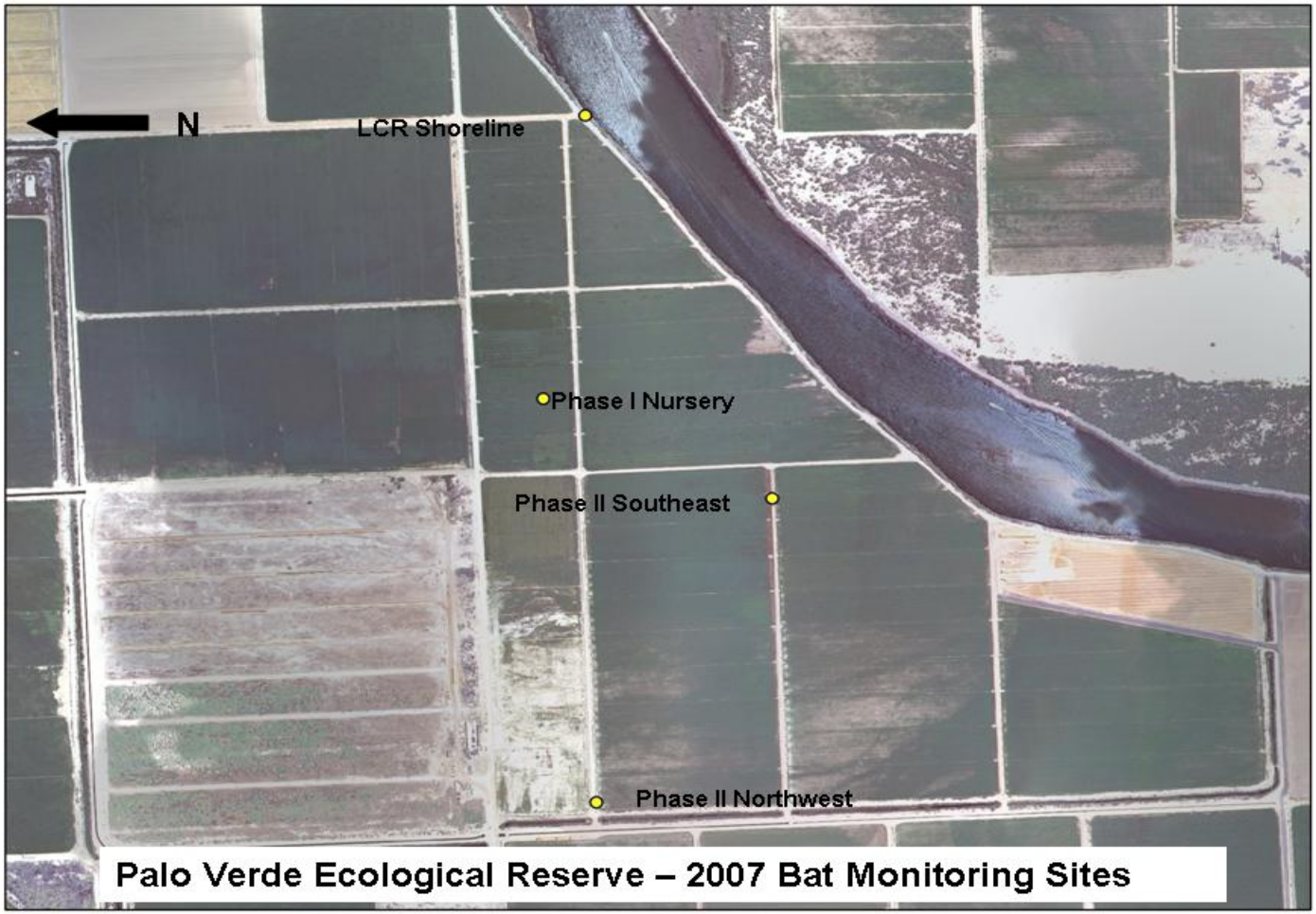


Figure 3. Palo Verde Ecological Reserve – 2007 Bat Monitoring Sites. Phase II Northwest – cottonwood/willow; Phase II Southwest – cottonwood/willow; Phases I Nursery – cottonwood/willow; LCR shoreline – river.

currently undeveloped. Only about 900 acres (364 ha) of Unit #1 is designated as part of the conservation area. Two fields within the Cibola NWR Conservation Unit #1 were selected for bat monitoring – the Nature Trail and the Mass Planting Demonstration site (Figure 5).

Pratt Restoration Demonstration Area

The 12-acre (4.9-ha) Pratt Restoration Demonstration site was planted with cottonwood and willow in 1999 (BR 2003). At present this has matured into a healthy gallery forest. Some selective harvesting was conducted in 2005, 2006, and 2007 to create a mosaic of uneven aged, structurally diverse habitat. This site was selected for bat monitoring because it is a restoration site that contains mature cottonwood/willow habitat that is potentially suitable for the western red bat and western yellow bat.

Two sites were selected for monitoring – a site along the edge of the 12-acre (4.9-ha) stand (Pratt Edge) and a site within the stand that has an adequate swoop zone (open area) to enable bat use (Pratt Interior) (Figure 6).

Imperial Ponds Conservation Area

The Imperial Ponds, located on Imperial NWR previously referred to as the DU2 Ponds, were originally constructed to provide a mixture of habitat types, including isolated backwater for native fish, marsh, and riparian land cover types. Those ponds were expanded to six ponds in 2007 creating an additional 80 acres of backwater habitat for native fish (Figure 7). Also present in the area is a mature cottonwood-willow stand planted in 1993 referred to as the "nursery" (BR 2005b). The riparian component of the design was largely unsuccessful, despite multiple plantings of cottonwood, willow, and mesquite trees in the terraced areas surrounding the ponds. High soil salinity was identified for the lack of success in establishing trees. The soil removed from pond expansion has been spread on adjacent fields and is bare dirt at present. Thirty-four acres will be planted with cottonwood-willow adjacent to the nursery. Field 18 was included for pre-treatment bat monitoring as it is scheduled for development into marsh habitat for black rails (*Laterallus jamaicensis).* In 2007, it is untreated and has a mix of saltcedar, *Phragmites*, and saltgrass. Also included for bat monitoring is McAllister Lake, 32 acres (12.9 ha); and Butler Lake, 43 acres (17.4 ha). Both are floodplain lakes and are seepage driven with no connection to the LCR. These two lakes are being used as demonstration areas for reducing salinity and improving water quality; however, no reconstruction activities have taken place.

Eight sites were selected for bat monitoring at the Imperial Ponds Conservation Area in five general categories as follows:

1) Reconstructed Ponds (Treated)—Pond 1, Pond 2 (replaced by a site on Pond 5 in July), open water/marsh
2) Untreated Ponds (some modification of water quality only)—McAllister Lake, Butler Lake North and South, open water/marsh
3) Riverine—LCR shoreline across from Pond 1, riverine
4) Nursery—Edge of cottonwood stand-mature cottonwood/willow
5) Untreated Saltcedar—Field 18: untreated saltcedar, *Phragmites*, saltgrass

Additional exploratory samples were taken as follows:

Nursery Interior—interior opening in the cottonwood nursery, mature cottonwood/willow
Marsh Channel—a marshy channel in Field 24
Nursery Channel—opening in the trees in the nursery that may be used by red bats and other species
Control—saltcedar, *Phragmites* site adjacent to the river across from Beal Lake

Methods

Acoustic Bat Surveys

Acoustic bat surveys were conducted using Anabat II bat detectors coupled to zero-crossing analysis interface modules (ZCAIMs) and SD1 detectors (ZCAIM and detector combined in a single unit), as outlined by Brown (2006). Bat calls were recorded directly onto compact flash cards. Up to nine units were deployed simultaneously in adjacent habitats and run continuously from dusk to dawn, recording all bat calls during an approximate 10-hour period from dusk to dawn. Two nights were sampled in each restoration area either consecutively or within four days of the first sample night. Sampling was conducted quarterly during the dark phase of the moon in November 2006 and January, April, and July 2007. The initial sampling in November was the only quarter in which only one sample night was conducted.

Sampling multiple nights provides an assessment of the level of temporal variation within and among habitats (Williams et al. 2006). Sampling all sites within a habitat creation area simultaneously also insures that any variation in conditions that affect bat activity is consistent among sampling sites. To develop an index of relative bat activity, one replicate of each habitat type was simultaneously sampled passively for two nights each quarter to account for potential nightly temporal variation. Each habitat was sampled continuously from before sunset to after sunrise. A site is defined as any single location and a replicate is a group of sites, one from each predominant habitat type in a restoration area based on Williams et al. (2006).

It is important to clearly state assumptions before data collection and to address biases and limitations of research equipment and methods during the design phase of habitat use studies (Hayes 2000, Sherwin et al. 2000). For this monitoring study it is assumed that all habitats were equally accessible to all bats, all bats were randomly distributed vertically from just above the ground to the upper canopy layers, and any particular species was equally detectable from each habitat type. It is also assumed that all acoustic equipment has an equal ability of detecting bat echolocation calls. Another major assumption is that sampling simultaneously in a habitat creation area for a minimum of two nights per quarter is adequate to account for nightly variations in activity patterns of bats.

The minimum frequency, duration, and shape of each call sequence (bat pass) was compared with reference calls from libraries of positively identified bats from throughout the western United States, as well as reference calls recorded on the LCR following the method outlined in

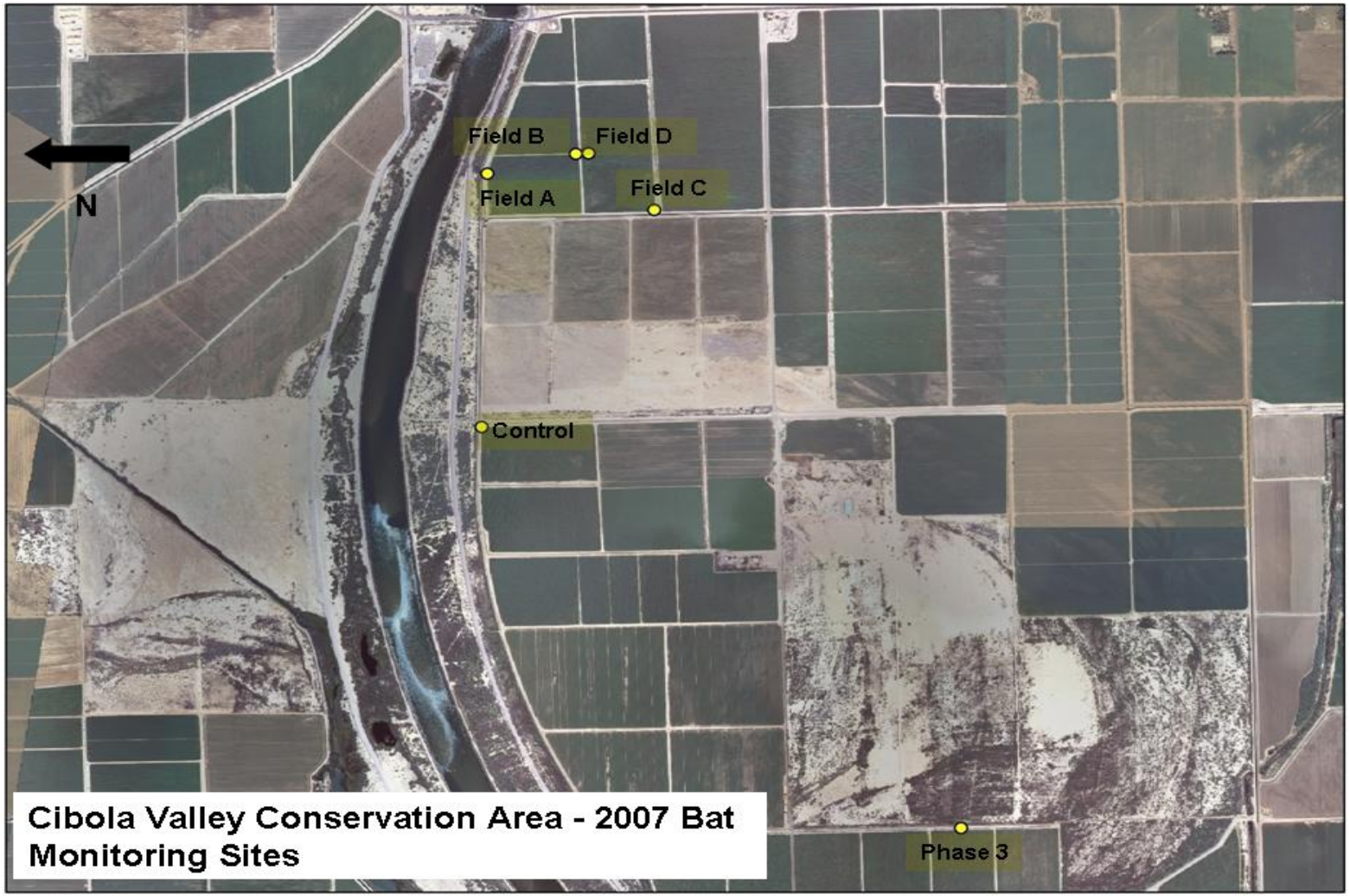


Figure 4. Cibola Valley Conservation Area – 2007 Bat Monitoring Sites. Field A – cottonwood/willow; Field B – cottonwood willow; Field C – cottonwood/willow; Field D – cottonwood/willow, Control – agricultural field (alfalfa); Phase III – cotton.

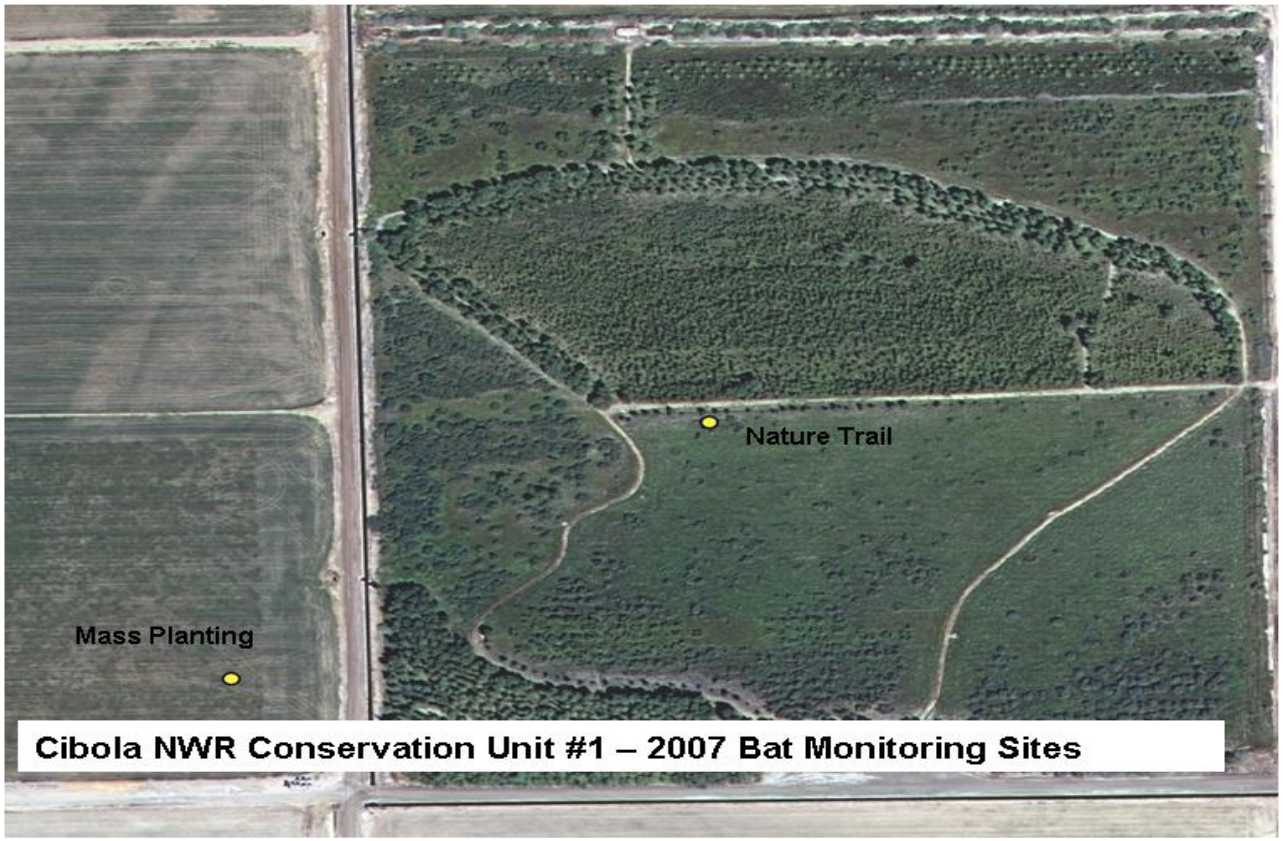


Figure 5. Cibola NWR Conservation Unit #1 – 2007 Bat Monitoring Sites. Nature Trail – mature cottonwood/mesquite/willow; Mass Planting – Cottonwood.

Figure 6. Pratt Restoration Demonstration Site – 2007 Bat Monitoring Sites. Pratt Interior – cottonwood/willow; Pratt Edge – cottonwood/*Baccharis*.

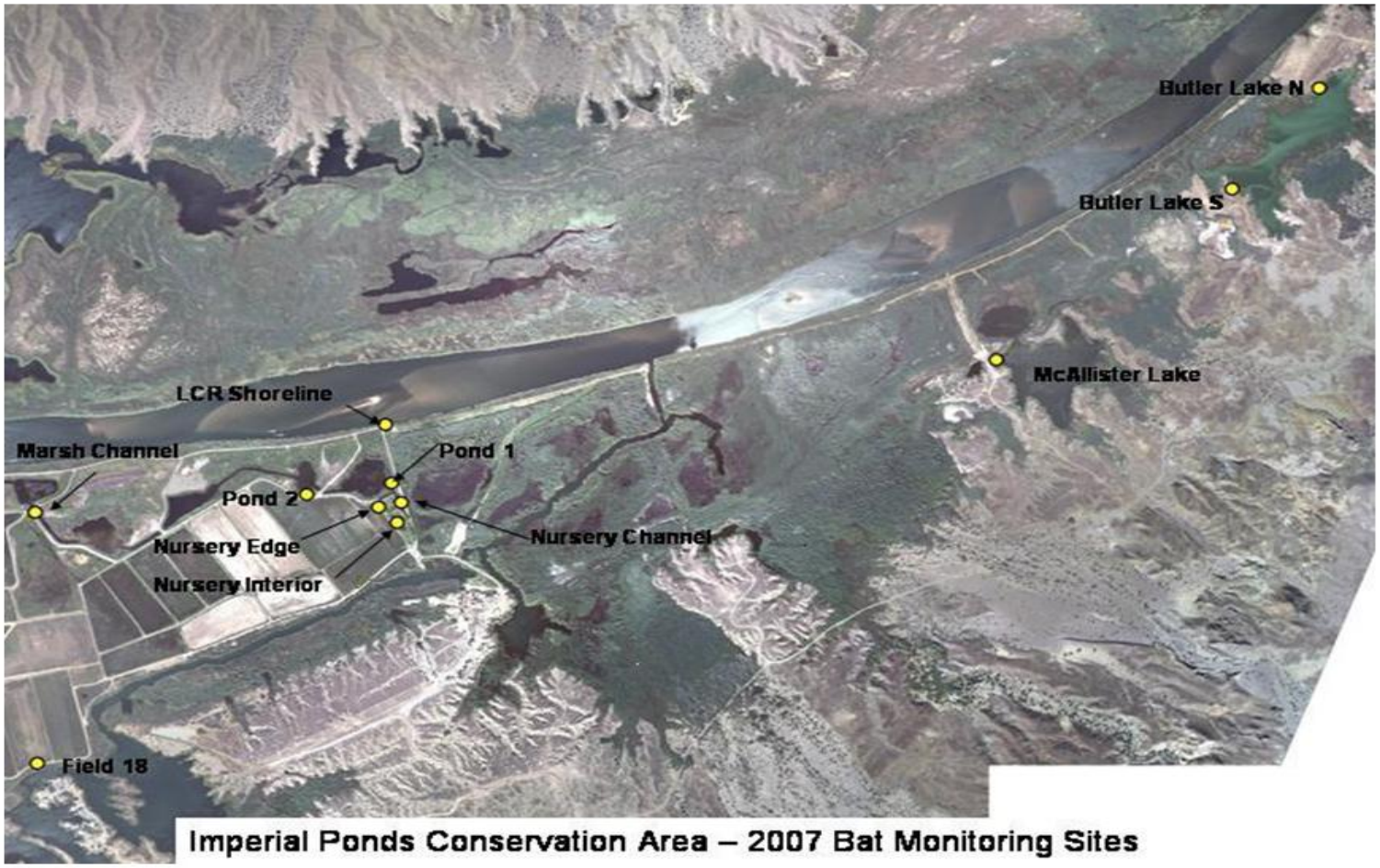


Figure 7. Imperial Ponds Conservation Area – 2007 Bat Monitoring Sites. Pond 1 – lake; Pond 2 – lake; LCR Shoreline – river; Nursery Edge – cottonwood/willow; Nursery Interior – cottonwood/willow; Nursery Channel – cottonwood/willow; Marsh Channel – marsh; Field 18 – saltcedar/*Phragmites*; McAllister Lake – lake; Butler S – lake; Butler N – lake.

Thomas et al. (1987). A bat pass is defined as a call sequence of duration greater than 0.5 ms and consisting of more than two individual calls (Thomas 1988, O'Farell and Gannon 1999).
Call minutes is a relative activity index that eliminates the bias of over estimating bat relative abundance if multiple files of the same individual were recorded in a short period of time, or under-estimating bat abundance because of multiple individuals recorded within a single file (Kalcounis et al. 1999, Brown 2006). A call minute indicates that a given species is present if it was recorded at least once within a 1-minute period regardless of the number of call sequences recorded within that minute. The highest rating a bat species can have is 60 in an hour, indicating that the species (but not necessarily the same individual) is recorded continuously during the hour (Brown 2006, Williams 2001, Miller 2001).

Capture Program

A capture program utilizing mist nets and a harp trap was established during the July 2007 quarterly monitoring period. During this quarter we sampled for one night at two habitat creation areas, Beal Lake Habitat Restoration and Cibola NWR Conservation Unit #1 Area, and two nights at Pratt Restoration. The rationale for establishing mist netting/harp trapping along with acoustic detection is that each method has limitations. Together these two sampling methods increase the odds of accurately detecting bats using a given habitat. Acoustic detection is more effective than capture methods for determining presence of many species (Kalco et al. 1996, O'Farrell and Gannon 1999). It is less invasive, allows a large number of sites to be sampled over the entire night without the researcher being present (passive sampling), and samples bats outside the reach of conventional sampling methods. However, acoustic bat detection has a set of limitations because some species are identified more easily than others (O'Farrell et al. 1999) and some bats such as the California leaf-nosed bat and Townsend's big-eared bat produce vocalizations of low intensity and are difficult to detect at distances greater than a few meters (also known as the whispering bats). Additionally, these species have good eyesight and do not always echolocate (Brown 2006). Capture methods also provide information on sex, age, and reproductive status. A combination of capture devices and acoustic detection also increases the accuracy of species verification within local bat assemblages (Williams et al 2006).

The capture program was initiated in July 2007. The description of that effort and the results are detailed in a separate report (Calvert 2008).

Results

A total of 16 bat species were identified by calls in the study areas (Table 1). Eleven bat species were identified to species based on the presence of characteristic, diagnostic calls in the recordings. In addition, four species groups were created consisting of overlapping, similar call characteristics as described by Betts (1998), Rainey et al. (2003), and the Western Bat Working Group (2004). The 25-30 Khz group includes big brown bat, Mexican free-tailed bat, and the pallid bat. The 35-Khz species group is a catch-all designation consisting of a mix of mostly pallid bats and some cave myotis calls, all of which end at 35 Khz. The 45-55 Khz species group includes the California myotis, Yuma myotis, and some calls of the western pipistrelle and California leaf-nosed bat.

There are four abundant “flagship” species: western pipistrelle, Mexican free-tailed bat, California myotis, and Yuma myotis (Brown and Berry, personal communication). These abundant species are widespread in a large array of habitats along the LCR and are considered to have stable or increasing populations. While they are important members of the mammalian community, the focus of habitat creation efforts is on restoring habitat for the two covered species, western red bat and western yellow bat, as well as for the two evaluation species, the California leaf-nosed bat and the pale Townsend’s big-eared bat.

Table 1. Bat species and species groups identified in the Lower Colorado habitat creation areas.

Common Name	Scientific Name	Species Code
Individual Species		
Townsend’s big-eared bat	*Corynorhinus townsendii*	Coto
Western red bat	*Lasiurus blossevilli*	Labl
Yellow bat	*Lasiurus xanthinus*	Laxn
California leaf-nosed bat	*Macrotus californicus*	Maca
Hoary bat	*Lasiurus cinereus*	Laci
Silver-haired bat	*Lasionycteris noctivagans*	Lano
Pocketed free-tailed bat	*Nyctinomops femorosaccus*	Nyfe
Big free-tailed bat	*Nyctinomops macrotis*	Nyma
Mastiff bat	*Eumops perotis*	Eupe
Western pipistrelle	*Pipistrellus hesperus*	Pihe
Cave myotis	*Myotis velifer*	Myve
Species Groups:		
20-25 Khz	Overlapping calls of Nyfe, Nyma, Laci, Tabr	
25-30 Khz	Overlapping calls of Epfu, Tabr, Anpa	
35 Khz	Various calls at 35 khz primarily Anpa & Myve	
40 Khz	Primarily Myve	
45-55 Khz	Overlapping calls of Myca, Myyu, and some Pihe	
Species included in the groups listed above:		
Pallid bat	*Antrozous pallidus*	Anpa
Big brown bat	*Eptesicus fuscus*	Epfu
Mexican free-tailed bat	*Tadarida brasiliensis*	Tabr
California myotis	*Myotis californicus*	Myca
Yuma myotis	*Myotis yumanensis*	Myyu

Four metrics are used to characterize bat use of the riparian restoration and adjacent habitats: total number of bat minutes for the four covered and evaluation species and one indicator species, mean number of bat minutes per site for all bat species, an index of relative bat activity, and mean number of bat minutes and standard errors for quarterly sampling for all riparian restoration and adjacent untreated habitat sites.

The total number of bat minutes consists of all the minutes recorded for the four covered and evaluation species and one indicator species for all of the riparian restoration sites and for all of the adjacent untreated habitat sites. These totals are displayed for each quarterly sampling period for all six habitat creation areas. The overall number of bat minutes for the four covered and evaluation bat species is very small when compared to the numbers for the more abundant bat

species. Use of total bat minutes allows for an analysis of seasonal habitat use for these rare bat species.

The mean number of bat minutes per site is calculated for all bat species by dividing the total number of bat minutes per species by the number of sample sites for both major categories: riverine restoration sites and adjacent untreated habitat sample sites. This metric shows the overall bat activity by species for the entire bat species assemblage. The rarity of the four covered species and the evaluation bat species becomes readily apparent when looking at the figures displaying mean number of bat minutes. This metric also highlights the fact that the amount of use by the entire bat species assemblage differs between the riverine restoration sites and the adjacent untreated habitats for all of the habitat creation areas.

The index of relative bat activity is calculated by dividing the total number of bat minutes for all species into the total number of bat minutes for each species. While acoustic sampling does not allow the calculation of bat populations, it does provide a useful measure of the relative amount of bat activity by species and species group for a given habitat category.

The last metric is the mean number of bat minutes for quarterly sampling for all riparian restoration and adjacent untreated habitat sites along with the standard errors. This gives a concise picture of the overall bat activity by season. The standard error represents a description of confidence that the mean represents the true value for the mean minutes of bat activity. In general, the larger the sample size, the smaller the standard error. The principal goal for post-restoration bat monitoring is to assess use of the newly created habitat areas by the four covered bat species. Details of seasonal and habitat use are discussed for each site in the next sections.

Beal Lake Habitat Restoration Area

A total of 57 detector nights were completed on nine monitoring sites in the Beal Lake Habitat Restoration area. A total of 17,204 call files were collected and edited, and valid call files identified to species or species groups. Bat minutes were calculated for each species and species group. A total of 479 bat minutes were recorded for the four covered bat species, most of which were of California leaf-nosed bats. The quarterly summaries of bat minutes recorded for the first and second sample periods in nine sites at Beal Lake are included in tables 1 and 2 in the Appendix.

Total Number of Bat Minutes for Covered and Evaluation Species

July was the only time western red bats were recorded at the Beal Lake Habitat Restoration Project during sampling. Nine bat minutes were obtained for the riparian restoration sites compared with four for the adjacent habitat sites (Figure 8).

In contrast most of the western yellow bat minutes were recorded during the spring sample period (Figure 9). Five bat minutes were obtained for the riparian restoration site in Field BB (a young mesquite stand) and 5 minutes were recorded in the open water/marsh habitats in the adjacent ponds. One minute was also recorded in the saltcedar site during summer and over open water/marsh during fall. It is possible that yellow bats were migrating through the area during the spring.

The lowest number of bat minutes occurred for the pale Townsend's big-eared bat (Figure 10). Only 1 minute was detected for this species during July in the riparian restoration site in Field FF. Since this is a "whispering" bat, that is not unexpected since a bat has to be very close to the detector microphone to be picked up. Detections likely under represent actual bat activity by this species.

The most bat minutes were recorded for the California leaf-nosed bat, with a total of 166 minutes. Most of the minutes occurred during the spring sample period with 77 minutes taking place in the open water/marsh habitats and 29 minutes occurring in the riparian restoration sites. The other major activity period happened in the open water/marsh habitats during the fall with 30 bat minutes. California leaf-nosed bats were also widespread in the saltcedar habitat in the Sacramento Wash with 10 minutes recorded in the fall, 1 minute in winter, 2 minutes in spring, and 15 minutes in summer (Figure 12). Most of the hoary bat minutes were recorded in riparian restoration sites during the spring (2 minutes) and summer (6 minutes). Five minutes occurred in open water/marsh habitats in spring (Figure 12).

Mean Number of Bat Minutes for Entire Bat Assemblage

The mean number of bat minutes for all riparian restoration sites combined was compared qualitatively with those for all adjacent habitat sites (Figure 13). The riparian restoration sites consisted of five fields planted in cottonwood, willow, and mesquite (including one pre-existing stand of mature cottonwood), and the adjacent habitats consisted of three areas on Beal Lake and Topock Marsh and a mature Athel tamarisk stand in the Sacramento Wash. The "flagship" species are much in evidence at the Beal Lake Habitat Restoration Area for both the restoration sites and the adjacent habitats. The most minutes of bat activity were recorded for the 45-55 Khz and 25-30 Khz species groups and the western pipistrelles (Pihe). Beal Lake and Topock Marsh are major activity areas for these species and species groups and greatly influence the amount of bat activity in the general area. These three species and species groups also dominate the riparian restoration sites, but to a lesser extent. Also commonly recorded is the cave myotis (Myve).

Seasonal habitat use of riparian and adjacent habitats by the four covered and evaluation bat species and one indicator bat species for Beal Lake Habitat Restoration Project are shown in figures 8-12.

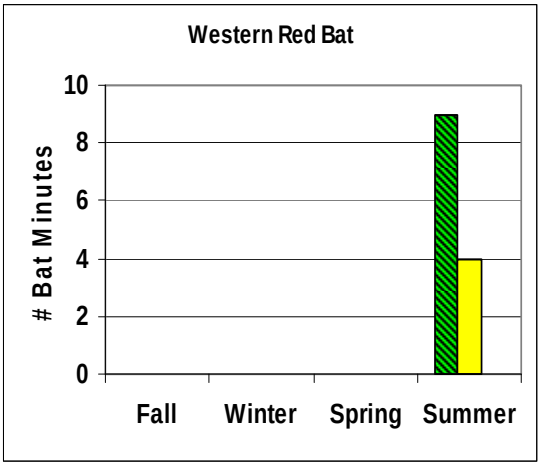


Figure 8. Western red bat.

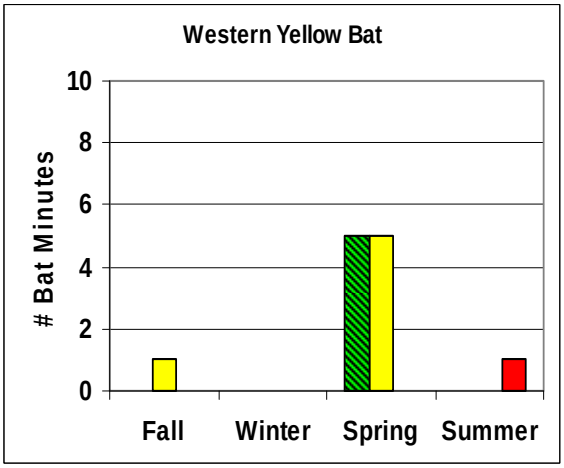


Figure 9. Western yellow bat.

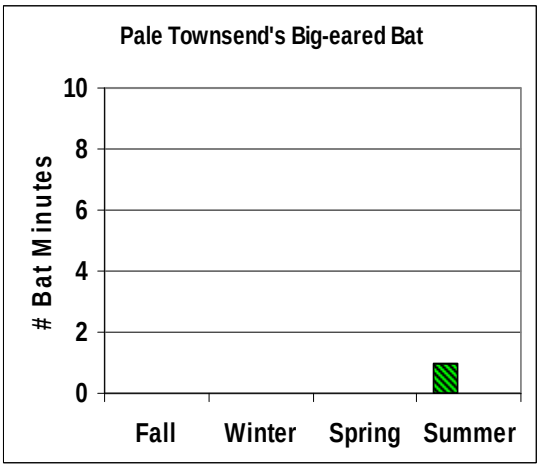


Figure 10. Pale Townsend's big-eared bat.

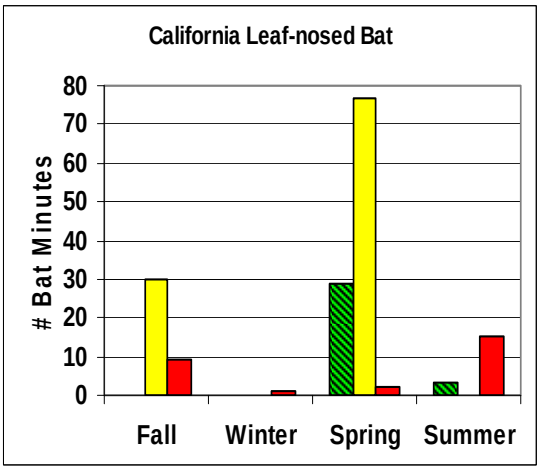


Figure 11. California leaf-nosed bat.

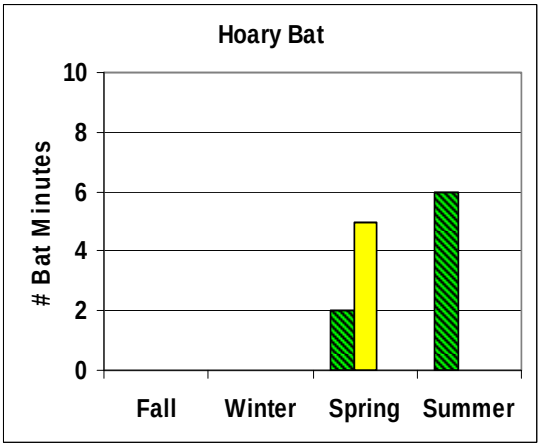
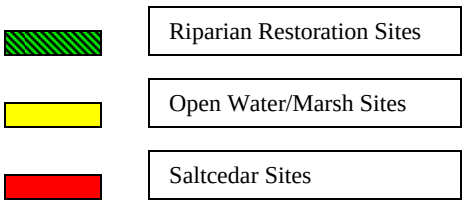


Figure 12. Hoary bat.



The molossids also occur in small numbers throughout the habitats. The pocketed free-tailed bat (Nyfe) was recorded in the Sacramento Wash (Athel tamarisk) in April (14 minutes), in Field BB in July (17 minutes), in the mature cottonwood stand at the MAPS station (11 minutes), and at Topock Marsh in January (23 minutes). The greater mastiff bat (Eupe) was recorded at Beal Lake in November (13 minutes) and in Field C in July (6 minutes). The big free-tailed bat (Nyma) was recorded at Field BB in July (6 minutes).

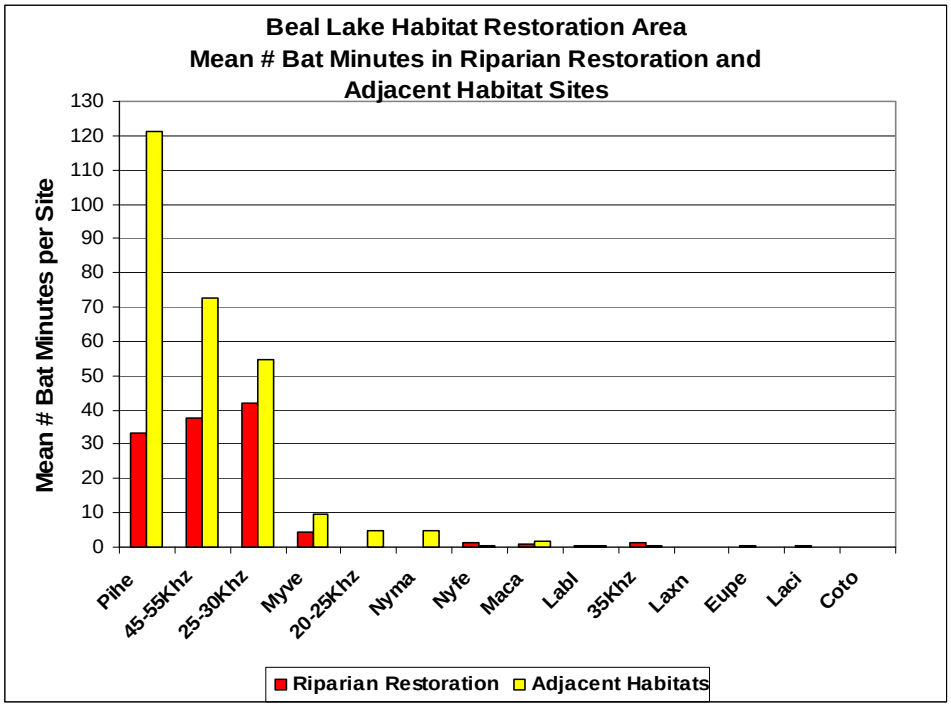


Figure 13. Mean number of bat minutes in riparian restoration and adjacent habitats for the Beal Lake Habitat Restoration Project.

Index of Relative Bat Activity

An index of relative bat activity was developed for riparian restoration sites and for the adjacent habitats using the total number of bat minutes for each species and species group (Table 2). The 45-55 Khz species group (which consists primarily of Yuma myotis and California myotis) and the 25-30 Khz species group (which consists mostly of Mexican free-tailed bats, some big brown bats, some pallid bats, and possibly a few silver-haired bats), along with the western pipistrelles, had the highest bat activity at both riparian restoration sites and the adjacent habitat sites. The 40-Khz species group (mostly cave myotis) was the fourth most active. As can be seen in Figure 13 and Table 2, California leaf-nosed bats comprise the fifth-most abundant species; however, the western red bat, western yellow bat, and pale Townsend's big-eared bats make up an extremely small component of the overall bat community.

Table 2. Index of relative bat activity-riparian restoration sites compared with adjacent habitat sites.

Riparian Restoration Sites		Adjacent Habitats	
Species/Species Groups	**%**	**Species/Species Groups**	**%**
45-55 Khz	40.24	45-55 Khz	44.81
25-30 Khz	30.47	25-30 Khz	26.81
Pihe	21.39	Pihe	20.30
40 Khz	3.51	40 Khz	3.61
Maca	1.70	Maca	1.83
35 Khz	1.06	35 Khz	1.81
Nyfe	0.76	Nyfe	0.30
Eupe	0.37	Eupe	0.22
Labl	0.16	Laxn	0.10
Laci	0.16	20-25 Khz	0.08
Laxn	0.09	Laci	0.07
Nyma	0.09	Labl	0.05
Coto	0.01	Coto	0.00
20-25 Khz	0.00	Nyma	0.00

Seasonal Bat Activity for Entire Bat Community

The highest bat activity for all species and species groups occurred during the summer sampling period in July with a mean value of 280 bat minutes per detector night[1] for the riparian restoration sites, and 426 minutes for the adjacent habitats (Table 3). The lowest bat activity occurred during January with a mean value of 1.9 bat minutes per detector night for the riparian restoration sites and 6.5 minutes for the adjacent habitats. The spring sampling period in April had the second-highest bat minutes for riparian restoration sites of 175 and 463 minutes for the adjacent habitats. November numbers showed a transition to winter conditions for bats with only 42 mean bat minutes per riparian restoration site and a slightly higher 159 mean bat minutes for the adjacent habitats. The standard errors are relatively high because of the small sample size, and presence of several sample periods with no bat minutes (usually in January). In 2008, sampling effort will be increased, which may decrease the standard errors.

Table 3. Means and standard errors of bat minutes for quarterly sampling for all Beal Lake sites.

Riparian Restoration Sites			Adjacent Habitats		
Month	**Mean Bat Minutes ± SE**	**# Detector Nights**	**Month**	**Mean Bat Minutes ± SE**	**# Detector Nights**
November	42.2 ± 19.2	4	November	159 ± 19.7	4
January	1.9 ± 1.3	10	January	6.5 ± 4.8	8
April	175.0 ± 47.5	9	April	462.9 ± 131.8	7
July	280 ± 26.9	15	July	426.5 ± 87.1	8

[1]A detector night is defined as one Anabat detector per site, sampling from dusk until dawn.

Palo Verde Ecological Reserve

Thirteen detector nights were completed on four monitoring sites in the Palo Verde Ecological Reserve. A total of 3,733 bat call files were collected and edited. Valid call files were identified to species or species groups and bat minutes were calculated. A total of 32 bat minutes were recorded for the four covered bat species, most of which were California leaf-nosed bats with some western red bats. The quarterly summaries of bat minutes recorded for the first and second sample periods in four sites at PVER are included in tables 3 and 4 in the Appendix.

Total Number of Bat Minutes for Covered and Evaluation Species

July was the only time western red bats were recorded at the Palo Verde Ecological Reserve during sampling (Figure 14). Six bat minutes were obtained for the riparian restoration sites compared with one for the adjacent habitat site, in this case the LCR.

Only one minute for the western yellow bat was recorded during the summer sample period in the LCR site (Figure 15). No bat minutes for the pale Townsend's bat were recorded at Palo Verde (Figure 16).

As at other habitat creation areas, the California leaf-nosed bat is the most numerous of the covered and evaluation bat species with 24 minutes (Figure 17). Twenty-three minutes were obtained in the fall in the riparian restoration sites and 1 minute occurred on the LCR.

A total of 81 minutes were recorded for hoary bats, most during July on the LCR shoreline, during which 67 call minutes were recorded in a single night (Figure 18). While it is not possible to determine whether many hoary bats were passing along the river corridor or only one or a few bats were foraging over one area, it still remains a relatively large number of bat minutes for this rarely detected species. Six bat minutes were also recorded for this species during April at the LCR Shoreline, 1 minute at the Phase I Nursery, and 1 minute at Phase II Southeast.

Mean Number of Bat Minutes for Entire Bat Assemblage

The mean number of bat minutes for all riparian restoration sites combined was compared qualitatively with the adjacent habitat (LCR shoreline site) (Figure 9). The riparian restoration sites consisted of four fields planted to cottonwood and willow. A single site was monitored in the adjacent LCR shoreline. Western pipistrelles (Pihe) dominated both the riparian restoration sites as well as the LCR shoreline site. Mean bat minutes for the 45-55 Khz and 25-30 Khz species groups dropped off quickly in the restoration sites, but remained fairly high in the LCR shoreline site. Also present along the river corridor were cave myotis (Myve) and hoary bats (Laci). The pocketed free-tailed bat (Nyfe) was also present throughout the sites in lower numbers. A small number of California *Macrotus* were recorded on the restoration sites. Figure 9 illustrates the importance of the river, which most likely serves as a migratory corridor for bats. This is one of the few monitoring sites in which pocketed free-tailed bats (Nyfe), cave myotis (Myve), and hoary bats (Laci) figure prominently in the detected calls.

Seasonal habitat use of riparian and adjacent habitats by the four covered and evaluation bat species and one indicator bat species for Palo Verde Ecological Reserve is shown in figures 14-18.

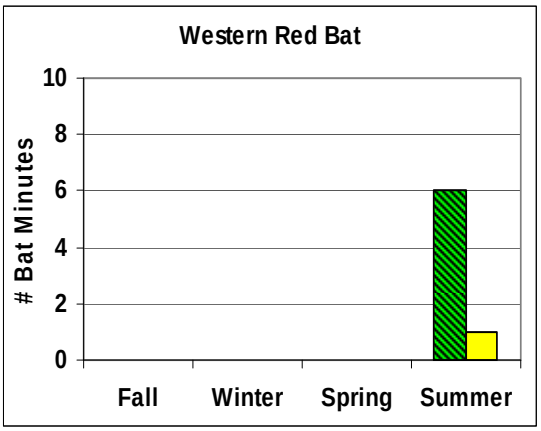


Figure 14. Western red bat.

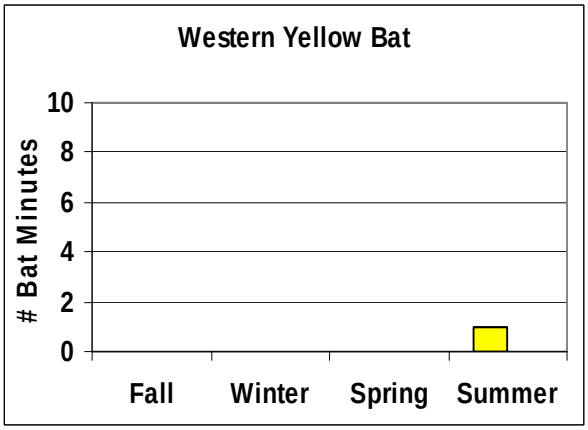


Figure 15. Western yellow bat.

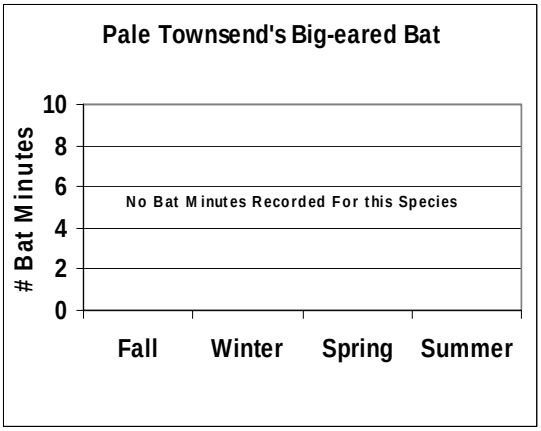


Figure 16. Pale Townsend's big-eared bat.

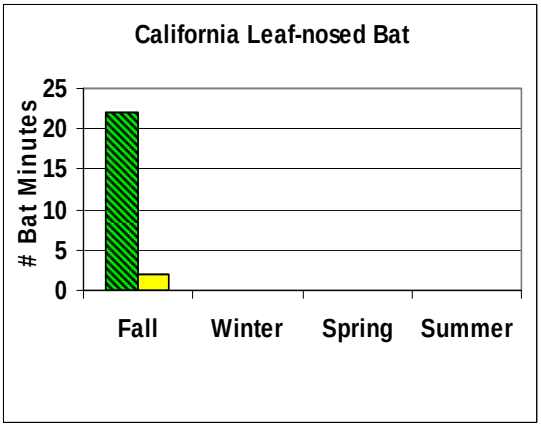


Figure 17. California leaf-nosed bat.

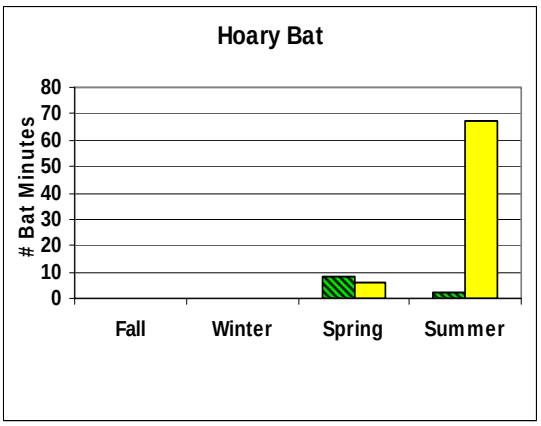
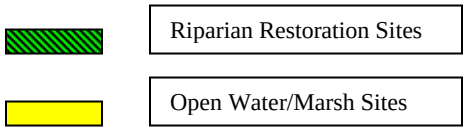


Figure 18. Hoary bat (indicator).



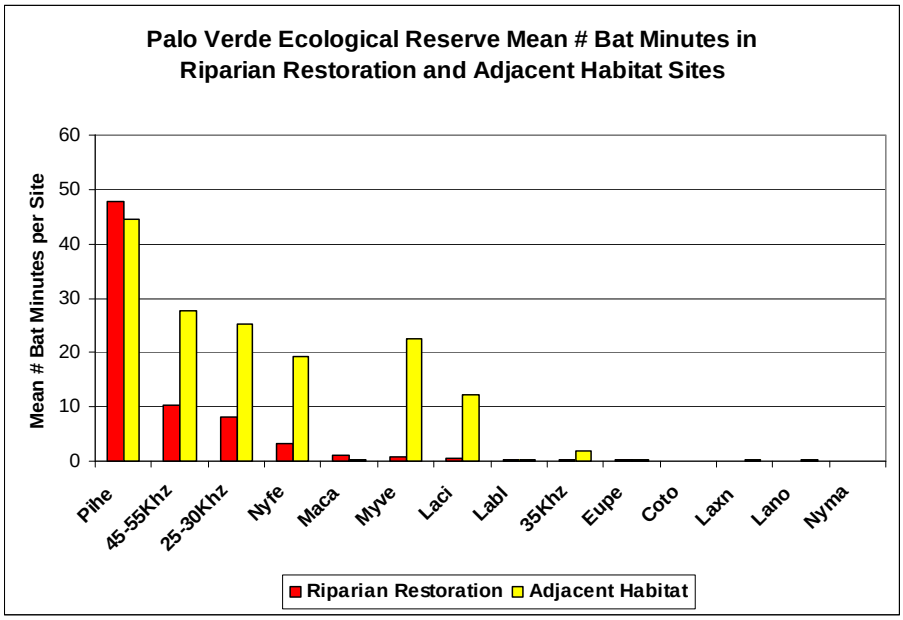


Figure 19. Mean number bat minutes in riparian restoration and adjacent habitat - Palo Verde Ecological Reserve.

Index of Relative Bat Activity

An index of relative bat activity was developed for riparian restoration sites and the adjacent habitats using the total number of bat minutes for each species and species group (Table 4). Western pipistrelles formed a disproportionately high amount of total bat activity at the riparian restoration sites at Palo Verde (65.8%) compared to 28.8% of the activity along the LCR.

Table 4. Index of relative bat activity for riparian restoration sites and adjacent habitats for Palo Verde Ecological Reserve.

Riparian Restoration Sites		Adjacent Habitat (LCR)	
Species/Species Groups	%	Species/Species Groups	%
Pihe	65.80	Pihe	28.80
45-55Khz	14.35	45-55Khz	17.91
25-30Khz	11.09	25-30Khz	16.29
Nyfe	4.35	Nyfe	12.51
Maca	1.59	Maca	0.22
Myve	1.23	Myve	14.67
Laci	0.58	Laci	7.87
Labl	0.43	Labl	0.11
35Khz	0.36	35Khz	1.29
Eupe	0.22	Eupe	0.11
Nyma	0.00	Nyma	0.00
Laxn	0.00	Laxn	0.11
Lano	0.00	Lano	0.11
Coto	0.00	Coto	0.00

Seasonal Bat Activity for Entire Bat Community

The highest bat activity for all species and species groups occurred in July with a mean value of 190 bat minutes per detector night for the riparian restoration sites and 797 for the adjacent habitat site on the LCR shoreline (Table 5). The lowest number of bat minutes was recorded during the January sample with only a 0.3 mean bat minute for six detector nights recorded at the riparian restoration sites. No calls were recorded in January on the LCR shoreline site. April had nearly the same low numbers of bat minutes, with only 4.3 minutes recorded in six detector nights in the riparian restoration sites and 7.5 mean bat mean bat minutes recorded on the LCR shoreline site. There were a few bat minutes recorded in November in the riparian restoration sites with a fair number recorded on the LCR shoreline site.

Table 5. Means and standard errors of bat minutes for quarterly sampling for all Palo Verde Ecological Reserve sites.

Riparian Restoration Sites			Adjacent Habitats		
Month	**Mean Bat Minutes ± SE**	**# Detector Nights**	**Month**	**Mean Bat Minutes ± SE**	**# Detector Nights**
November	23.0 ± 8.6	3	November	149.0 ± 0	1
January	0.3 ± 0.3	6	January	0 ± 0	2
April	4.3 ± 2.2	6	April	7.5 ± 7.5	2
July	190 ± 109.8	4	July	797 ± 0	1

Cibola Valley Conservation Area

A total of 42 detector nights were completed for six CVCA sites. A total of 3,052 call files were obtained, edited, and identified to species or species group. Bat minutes were calculated for each species and species group. Forty-five bat minutes were recorded for the four covered bat species; in this case all were California leaf-nosed bats (Figure 8). The quarterly summaries of bat minutes recorded for the first and second sample periods in seven sites at CVCA are included in tables 5 and 6 in the Appendix.

Total Number of Bat Minutes for Covered and Evaluation Species

July was the only time western red bats were recorded at the Cibola Valley Conservation Area during sampling (Figure 20). Four bat minutes were obtained for the riparian restoration sites. No minutes of bat activity were recorded for the western yellow bat for either the riparian restoration sites or the adjacent habitat sites (Figure 21). One minute of bat activity was obtained for the pale Townsend's big-eared bat during spring in the riparian restoration sites (Figure 22).

As at other habitat creation areas, the California leaf-nosed bat was the most numerous of the covered and evaluation bat species with 35 minutes (Figure 23). Twenty-nine minutes were obtained in the winter for the riparian restoration sites. This was an unusual finding because in general there was very little bat activity in January. These calls were all social calls (Brown, personal communication). One minute was recorded in fall and 5 minutes were recorded during the summer in the riparian restoration sites. Only four calls were recorded in summer in the

adjacent untreated agricultural sites. The only hoary bat minutes were recorded during summer in the agricultural field with a total of three calls (Figure 24).

Mean Number of Bat Minutes for Entire Bat Assemblage

The mean number of bat minutes for all riparian restoration sites combined was compared qualitatively with the adjacent habitat, which in the case of the Cibola Valley Conservation Area, consists of agricultural fields (Figure 25). The riparian restoration sites consisted of four fields planted to cottonwood and willow. The adjacent habitat areas consisted of a control site that was an alfalfa field. The Phase III cottonwood-willow site is included in the agricultural control sites for analysis in this report. During most of the sample periods it was an agricultural field and had not been planted to cottonwood-willow. When it was planted the young plants were small and functioned similarly to an agricultural field from a bat habitat perspective. Overall the mean number of bat minutes per site was lower than either Beal Lake or Palo Verde Ecological Reserve for both riparian restoration sites as well as the adjacent agricultural sites. Western pipistrelles and the 45-55 Khz and 25-30 Khz species groups had the highest number of mean bat minutes per site for the riparian restoration sites. Similarly, these three species and species groups dominated the bat minutes for the agricultural sites. However, there were also a large number of cave myotis bat minutes recorded for the agricultural fields.

Seasonal habitat use of riparian and adjacent habitats by the four covered and evaluation bat species and one indicator bat species for Cibola Valley Conservation Area are shown in figures 20-24.

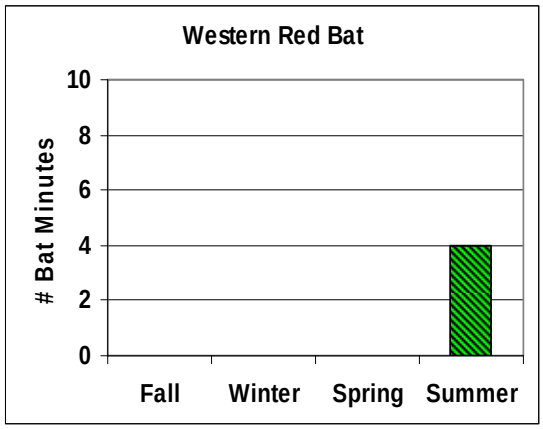


Figure 20. Western red bat.

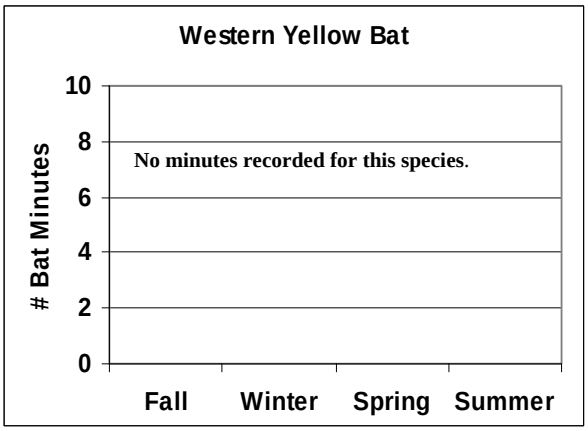


Figure 21. Western yellow bat.

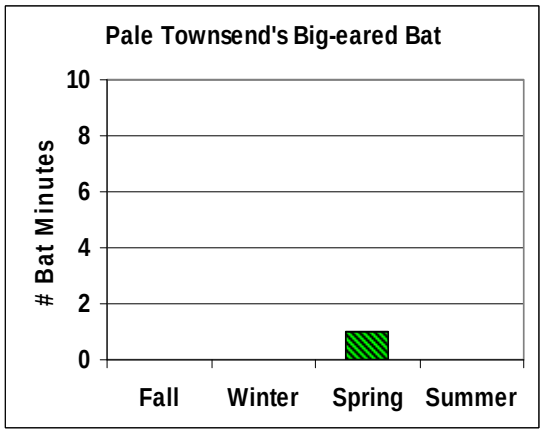


Figure 22. Pale Townsend's big-eared bat.

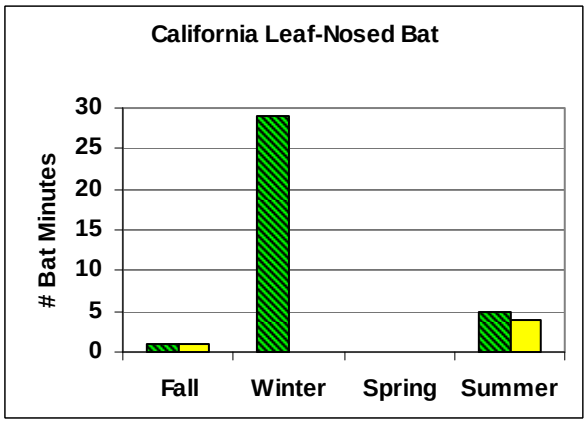


Figure 23. California leaf-nosed bat.

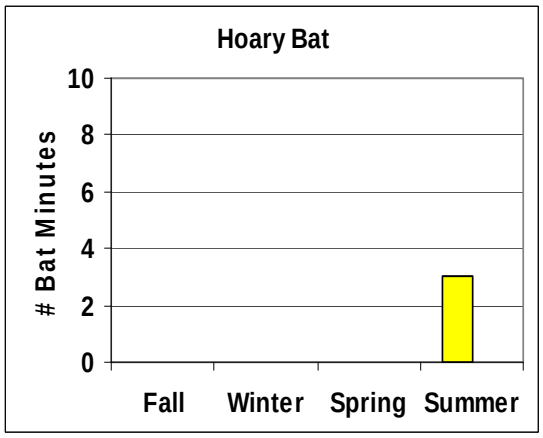
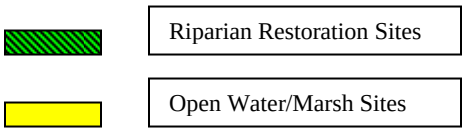


Figure 24. Hoary bat (indicator).



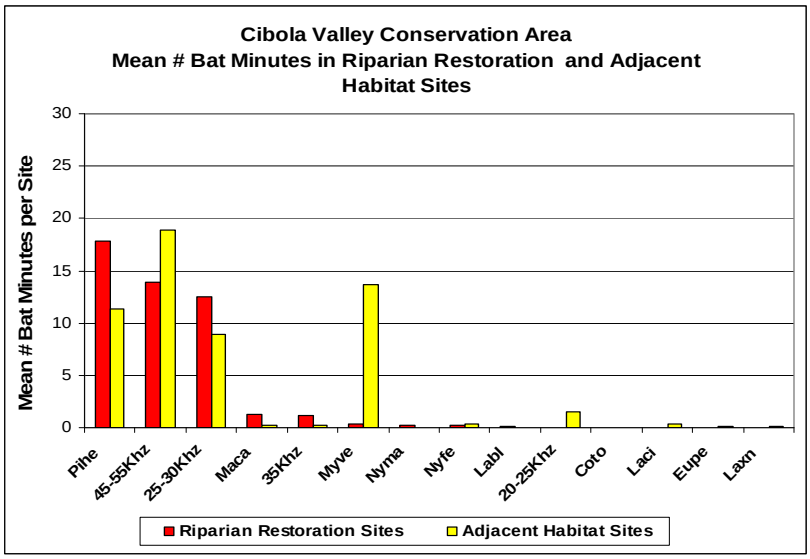


Figure 25. Mean number of bat minutes in riparian restoration and adjacent habitats for the Cibola Valley Conservation Area.

Index of Relative Bat Activity

An index of relative bat activity was developed for riparian restoration sites and for the adjacent habitats using the total number of bat minutes for each species and species group (Table 6). Western pipistrelles and the 25-30 Khz and 45-55 Khz species groups were the highest percentages of the overall bat community for the riparian restoration sites, and California leaf-nosed bats and the 35-Khz species groups were the fourth- and fifth-highest percentages, respectively. The adjacent agricultural sites were somewhat different in that the cave myotis figured prominently in the top percentages at 24.5%.

Table 6. Index of relative bat activity for riparian restoration sites compared with adjacent habitat sites for the Cibola Valley Conservation Area.

Riparian Restoration Sites		Adjacent Habitat Sites	
Species/Species Groups	**%**	**Species/Species Groups**	**%**
Pihe	37.28	45-55 Khz	33.93
25-30 Khz	29.19	Myve	24.46
45-55 Khz	26.27	Pihe	20.36
Maca	2.62	25-30 Khz	16.01
35 Khz	2.47	20-25 Khz	2.69
Myve	0.75	Laci	0.64
Nyma	0.52	Nyfe	0.64
Nyfe	0.37	35 Khz	0.51
Labl	0.30	Maca	0.51
20-25 Khz	0.07	Laxn	0.13
Coto	0.07	Eupe	0.13
Eupe	0.07	Coto	0.00
Laxn	0.00	Labl	0.00
Laci	0.00	Nyma	0.00

Seasonal Bat Activity for Entire Bat Community

The highest number of mean bat minutes per night was recorded in July at CVCA for both the riparian restoration areas (156.6 bat minutes) and the adjacent agricultural habitats (189.0) (Table 7). The other three quarterly samples had very low mean bat minutes per night: November was 8.5 minutes per night in the riparian restoration areas and 10.5 in the agricultural habitats, January was 3.6 minutes for the riparian restoration areas and 0 minutes for the agricultural habitats, and April was surprisingly low with only 2.5 minutes for the riparian restoration areas and 1.5 minutes for the adjacent agricultural areas. While it is reasonable to expect a low number of minutes per night in November and January due to cooler weather, April's low number was unexpected. A possible explanation for the low numbers of bat minutes in April is that the fields were newly planted with very little structure. In July, the cottonwoods and willows had shown tremendous growth, providing complex structure where little had existed before. This may not have had much influence on the number of bat minutes recorded, as the adjacent agricultural fields also had their highest number of bat minutes recorded.

Table 7. Means and standard errors of bat minutes for quarterly sampling for all Cibola Valley Conservation Area sites.

Riparian Restoration Sites			Adjacent Habitats		
Month	**Mean Bat Minutes ± SE**	**# Detector Nights**	**Month**	**Mean Bat Minutes ± SE**	**# Detector Nights**
November	8.5 ± 2.6	4	November	10.5 ± 3.5	2
January	3.6 ± 3.6	8	January	0 ± 0	4
April	2.5 ± 0.96	8	April	1.5 ± 0.9	4
July	156.6 ± 27.7	8	July	189.0 ± 26.4	4

Cibola NWR Unit #1 Conservation Area

Eight detector nights were completed for two Cibola NWR Unit #1 Conservation Area sites. A total of 569 call files were obtained, edited, and identified to species or species group. Bat minutes were calculated for each species and species group. Twelve minutes were recorded for the four covered bat species, of which only the California leaf-nosed bat was detected. Tables 7 and 8 in the Appendix show the quarterly summaries of bat minutes recorded in two sites at Cibola NWR Unit #1 Conservation Area.

The data for this restoration area varies from the previous areas because only two sites were monitored: the mass planting site and the Nature Trail site. In 2008, sample sites will be expanded by combining sampling at Cibola NWR #1 with CVCA. Sites to be sampled will include agricultural, mesquite, mature cottonwood, and newly planted cottonwood-willow.

Total Number of Bat Minutes for Covered and Evaluation Species

California leaf-nosed bats were the only covered bat species recorded at the Cibola NWR Conservation Unit #1. Two bat minutes were recorded in the fall and 3 minutes were recorded in the summer at the mass planting site. Four bat minutes were recorded in the fall at the Nature Trail site and 3 minutes were recorded during the summer (Figure 25).

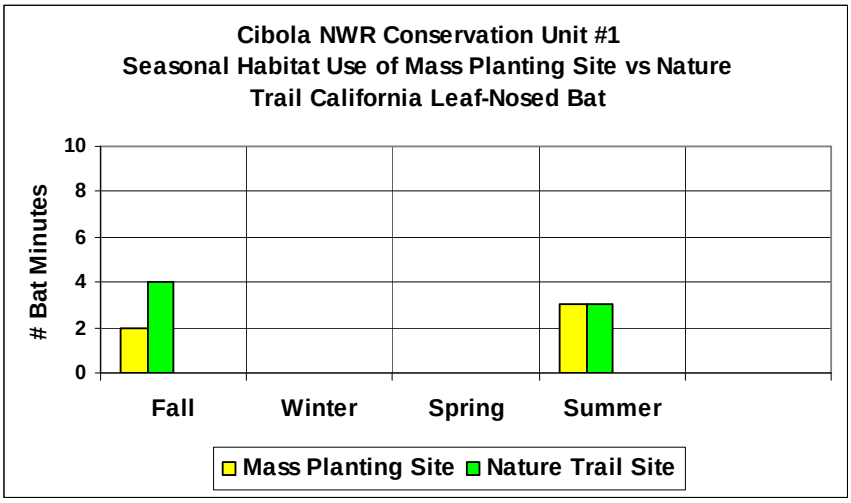


Figure 25. California leaf-nosed bat.

Mean Number of Bat Minutes for Entire Bat Assemblage

The mean number of bat minutes for all the mass planting site was compared with the Nature Trail site (Figure 26). Overall the mass planting site had higher mean number of bat minutes per site compared to the Nature Trail, with the 45-55 Khz species group by far the most abundant, followed by western pipistrelles. The apparent differences between these two sites may be more a function of the difficulty of sampling in the mature cottonwood stands characteristic of the Nature Trail. Additionally, the interior of the mass planting site is extremely dense. The summer period was characterized by large numbers of insects such as cicadas and katydids whose calls made sampling in the interior of either stand nearly impossible. Their calls resulted in near constant static on the bat detectors. Sampling could only be conducted along the outside edges of the stands, which tends to favor edge species such as western pipistrelles.

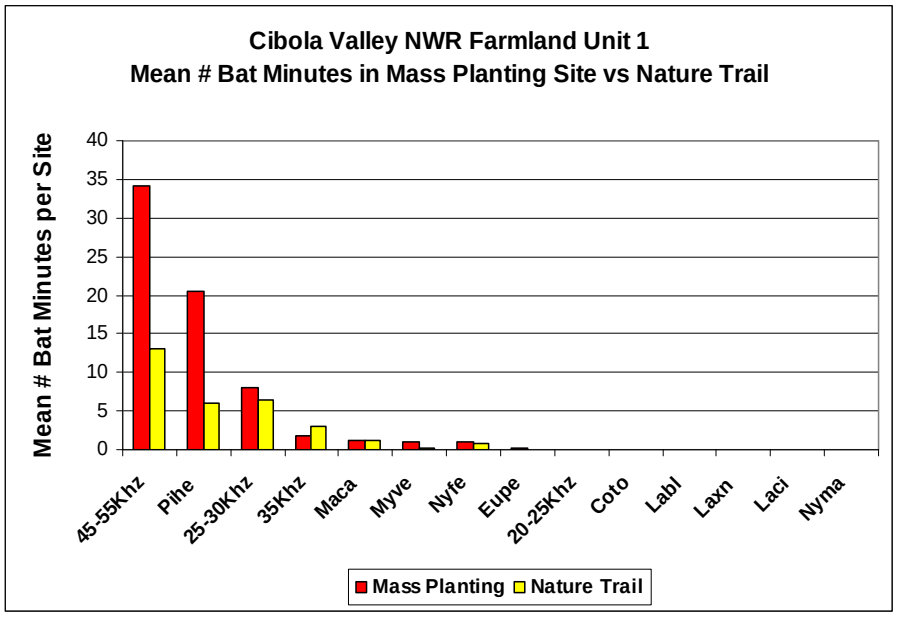


Figure 26. Mean number of bat minutes – Cibola Valley NWR Conservation Unit #1.

Index of Relative Bat Activity

An index of relative bat activity was developed for the mass planting site and for the Nature Trail (Table 8). Overall the bat assemblage is similar for both sites with the 45-55 Khz and 25-30 Khz species groups and western pipistrelle with the highest percentages. The California leaf-nosed bat was the fifth-most abundant species at the Nature Trail at 4% compared to only 1.8% at the mass planting site. There were no other covered or evaluation species at either site.

Table 8. Index of relative bat activity for Mass Planting Site compared with the Nature Trail Site.

Mass Planting		Nature Trail	
Species/Species Groups	**%**	**Species/Species Groups**	**%**
45-55 Khz	50.37	45-55 Khz	42.28
Pihe	30.15	25-30 Khz	21.14
25-30 Khz	11.76	Pihe	19.51
35 Khz	2.57	35 Khz	9.76
Maca	1.84	Maca	4.07
Myve	1.47	Nyfe	2.44
Nyfe	1.47	Myve	0.81
Eupe	0.37	Eupe	0.00
20-25 Khz	0.00	20-25 Khz	0.00
Coto	0.00	Coto	0.00
Labl	0.00	Labl	0.00
Laxn	0.00	Laxn	0.00
Laci	0.00	Laci	0.00

Seasonal Bat Activity for Entire Bat Community

The highest number of mean bat minutes per night was recorded in July at Cibola NWR Conservation Unit #1 for both the mass planting and nature trail sites combined (Table 9). The second-most active period occurred during November with 13.5 mean bat minutes. No samples were taken for April. January, as at other habitat creation areas, had the lowest bat activity at 0.3 mean bat minutes.

Table 9. Means and standard errors of bat minutes for quarterly sampling for all Cibola Valley Conservation Area sites.

Cibola NWR Conservation Unit #1 – Mass Planting & Nature Trail Sites		
Month	**Mean Bat Minutes ± SE**	**# Detector Nights**
November	13.5 ± 2.5	2
January	0.3 ± 0.3	3
April	0	0
July	122.3 ± 10.3	3

Pratt Restoration Demonstration Site

Twelve detector nights were completed for two Pratt sites. A total of 2,423 call files were obtained, edited, and identified to species or species group. One bat minute was recorded for the western red bat—the only covered bat species detected at Pratt (Figure 8). Tables 9 and 10 in the Appendix show the quarterly summaries of bat minutes recorded in two sites at Pratt Restoration.

The data for this restoration area varies from the previous areas because only two sites were monitored—a site on the edge of the mature cottonwood-willow stand and a site in the interior of the stand. In 2008, sample sites will be greatly expanded by combining sampling at the Pratt Restoration Demonstration area with sampling at Imperial Ponds Conservation Area. Sites to be sampled will include agricultural, saltcedar, and mature cottonwood-willow.

Total Number of Bat Minutes for Covered and Evaluation Species

One bat minute was detected in July for the western red bat in the edge of the stand (Figure 27). Hoary bats were also detected in July in both the interior and edge sites (Figure 28).

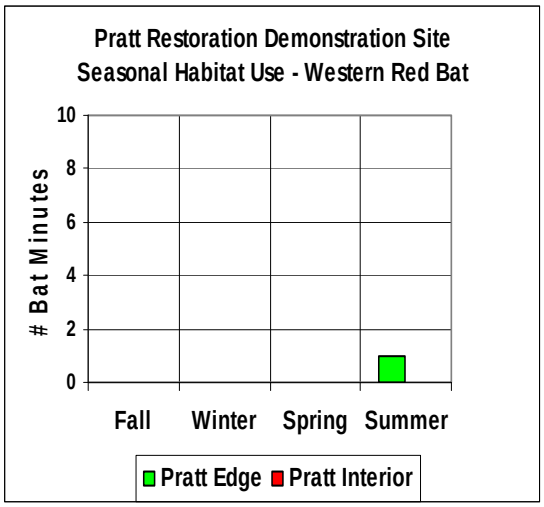


Figure 27. Western red bat.

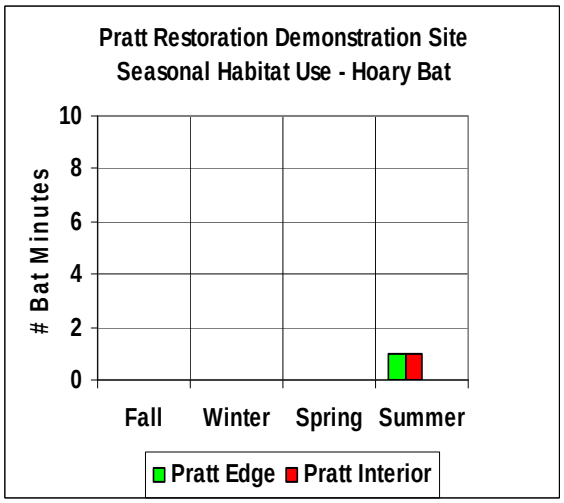


Figure 28. Hoary bat.

Mean Number of Bat Minutes for Entire Bat Assemblage

The mean number of bat minutes for the edge site was compared with the interior sampling site (Figure 29). Overall the edge site had the greatest number of mean bat minutes with 128 minutes for the 25-30 Khz species group compared to 16 minutes in the interior site, 88 minutes for the 45-55 Khz species group compared to 33 minutes in the interior site, and 42 minutes for western pipistrelles compared to 9 minutes in the interior site. As at Cibola NWR Conservation Unit #1, the placement of the detectors greatly influenced the number of bat species detected, particularly in the dense interior of mature cottonwood stands such as the one at Pratt.

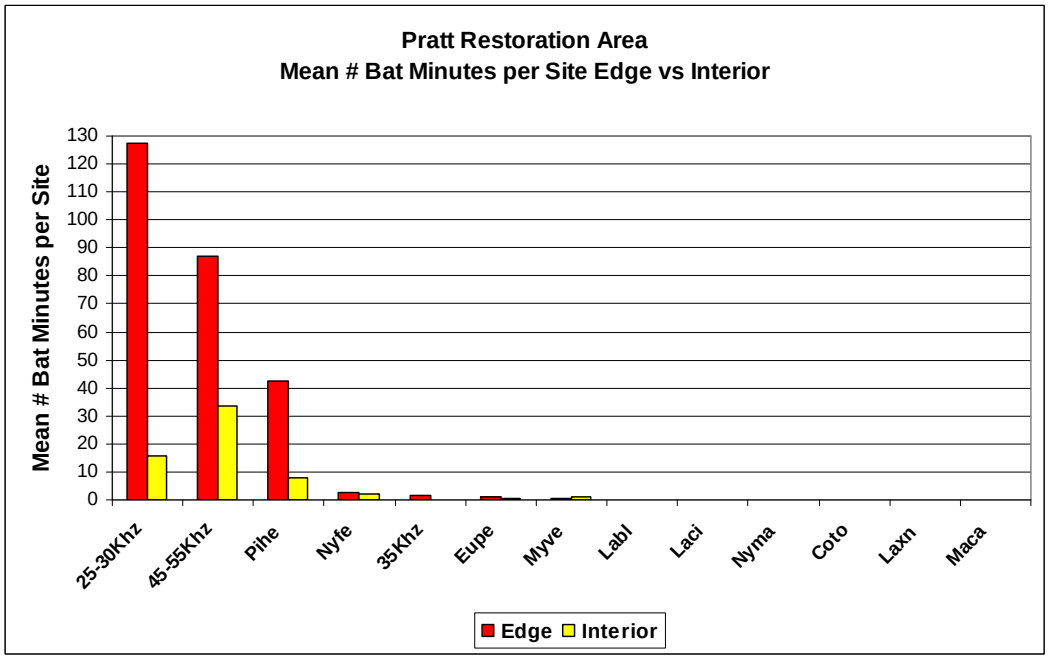


Figure 29. Mean number of bat minutes for the Pratt Restoration Demonstration Area.

Index of Relative Bat Activity

An index of relative bat activity was developed for the edge and interior sampling sites at Pratt combined (Table 10). Overall, the 25-30 Khz species group comprised 44% of the bat minutes detected, followed closely by the 45-55 Khz species group at 37%. Western pipistrelles comprised 15.5% of the detections.

Table 10. Index of relative bat activity for both sites at Pratt.

Species Group or Species	Relative Bat Activity
25-30 Khz	44.16
45-55 Khz	37.29
Pihe	15.52
Nyfe	1.42
35 Khz	0.49
Myve	0.49
Eupe	0.37
Laci	0.12
Labl	0.06
Nyma	0.06
Coto	0.00
Laxn	0.00
Maca	0.00

Seasonal Bat Activity for Entire Bat Community

Table 11 lists the mean number of bat minutes for each quarterly sampling period, with standard errors and number of detector nights. The highest number of mean bat minutes per night was recorded in July at Pratt Restoration Demonstration Site for sample sites combined with 365 mean bat minutes. April activity was significantly lower at only 39 mean bat minutes. No bat activity was detected in January. Acoustic sampling was not conducted during November.

Table 11. Means and standard errors of bat minutes for quarterly sampling for all sites.

Sample Period	Mean Bat Minutes Per Night ± SE	# Detector Nights
November	not implemented	
January	0	4
April	39.25 ± 12.7	4
July	365.0 ± 139.0	4

Imperial Ponds Conservation Area

Forty-eight detector nights were completed for eight sites. A total of 22,853 call files were obtained, edited, and identified to species or species group. Bat minutes were calculated for each

species and species group. A total of 197 bat minutes were recorded for the four covered bat species, consisting mostly of California leaf-nosed bats and yellow bats, with smaller numbers of red bats and Townsend's big-eared bats (Figure 8). Tables 11 and 12 in the Appendix show the quarterly summaries of bat minutes recorded for eight sites at Imperial Ponds Conservation Area.

Total Number of Bat Minutes for Covered and Evaluation Species

A total of 12 red bat minutes were recorded for both sample periods combined (Figure 30). Bat minutes were recorded only during April and July. Nine bat minutes were recorded at Pond 1 during April and 1 minute was recorded in the mature cottonwood nursery. During July, 1 bat minute was recorded at Pond 5 and 1 minute was recorded at Field 18.

A total of 70 bat minutes were recorded for both sample periods for western yellow bats in the Imperial Ponds Conservation Area (Figure 31). Most of the minutes of bat activity were recorded at Pond 1 (62) and 7 minutes were recorded that same night in Pond 2 nearby.

Four minutes of bat activity were recorded for the pale Townsend's big-eared bat in the mature cottonwood nursery (Nursery Edge) during April (2 minutes) and July (2 minutes) (Figure 32).

A total of 111 minutes were recorded for the California leaf-nosed bat (Figure 33). The lowest number of bat minutes was recorded in January for a total of 5 minutes. Ponds 1 and 2 and Butler Lake each had 1 minute of activity, and McAllister Lake had 2 minutes. April had the highest number of bat minutes with most of the minutes being recorded in the mature cottonwood nursery (Nursery Edge; 17 minutes) and at the exploratory site in untreated saltcedar (Control; 16 minutes). The mature cottonwood nursery also had the highest number of bat minutes in November at 15. Athough only one night was sampled in July, the nursery had 4 minutes in the interior and 5 minutes in an exploratory site in a flooded channel (Nursery Channel). Of the pond habitats, Pond 5 had the highest amount of bat minutes at 8.

A total of 14 minutes of bat activity were recorded for the hoary bat, most of which occurred in July (Figure 34). Six minutes were recorded in the mature cottonwood/willow nursery in July. Field 18 had one minute of activity, and McAllister Lake and Pond 1 each had 2 bat minutes in July. In April 1 minute of activity was recorded at Pond 2 and 2 minutes were recorded in the exploratory site (Control) in untreated saltcedar.

Mean Number of Bat Minutes for Entire Bat Assemblage

One of the most remarkable findings is the tremendous use of the newly reconstructed ponds by not only the flagship bat species but by other species as well such as western yellow bats, mastiff bat, and California leaf-nosed bats when compared to the untreated ponds (Butler and McAllister are natural backwaters that have not been physically altered, although some freshening has occurred) (Figure 35). A very close second is the cottonwood nursery, which attracted use by the three covered species and other species groups, but also attracted California leaf-nosed bats and cave myotis.

The 45-55 Khz species group had the highest number of bat minutes with a total of 7,037, the bulk of which were concentrated on ponds 1 and 2 and the Nursery Edge during April. Butler Lake and McAllister Lake also received good levels of bat activity for this species group. The western pipistrelle was the second most active species with 2,512 minutes recorded, followed by

the 25-30 Khz species group with 2,361 minutes, again mostly utilizing ponds 1 and 2 and the nursery during April. The greater mastiff bat had 283 minutes of activity recorded at the LCR shoreline site in April (Table 23). One of the only occasions that a silver-haired bat (Lano) was recorded during monitoring (or at least identified to species because of very unique characteristic call features and not lumped in with the 25-30 Khz species group) occurred at Pond 1 in July.

Seasonal habitat use of riparian and adjacent habitats by the four covered and evaluation bat species and one indicator bat species for Imperial Ponds Conservation Area are shown in figures in 30-33.

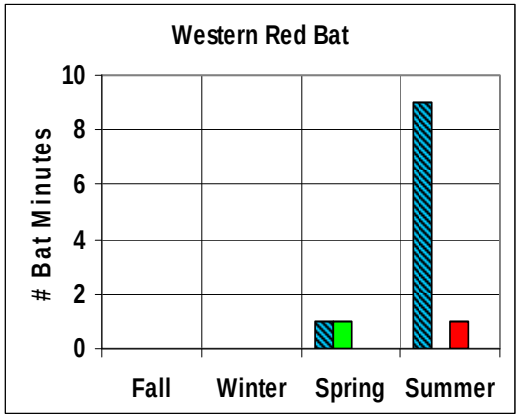


Figure 30. Western red bat.

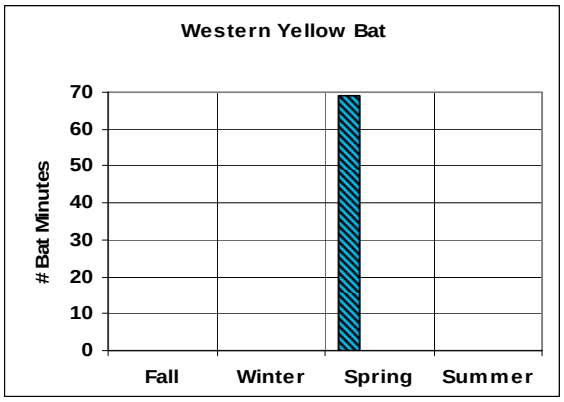


Figure 31. Western yellow bat.

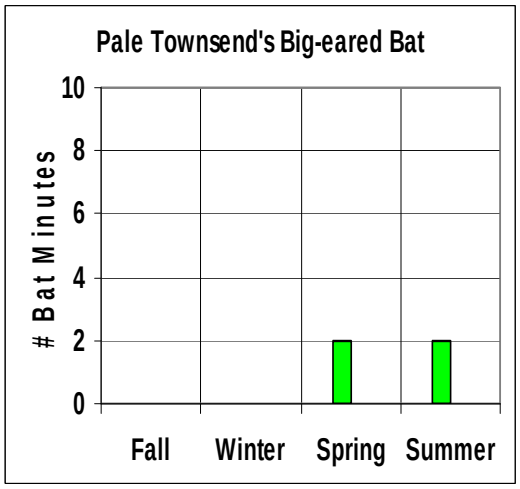


Figure 32. Pale Townsend's big-eared bat.

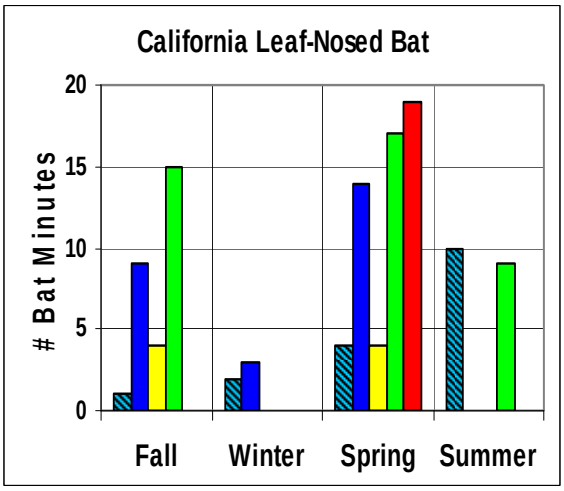


Figure 33. California leaf-nosed bat.

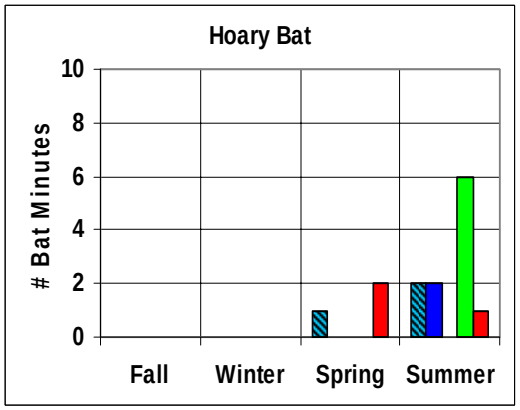
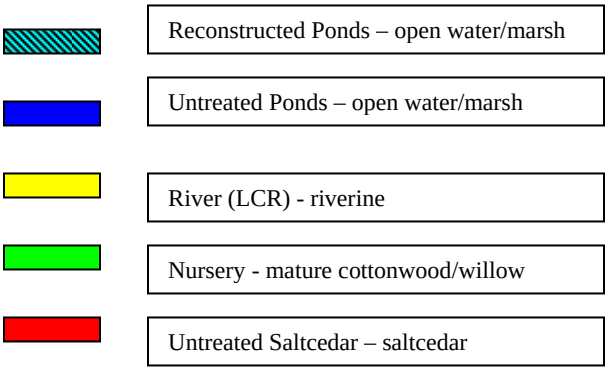


Figure 34. Hoary bat (indicator).



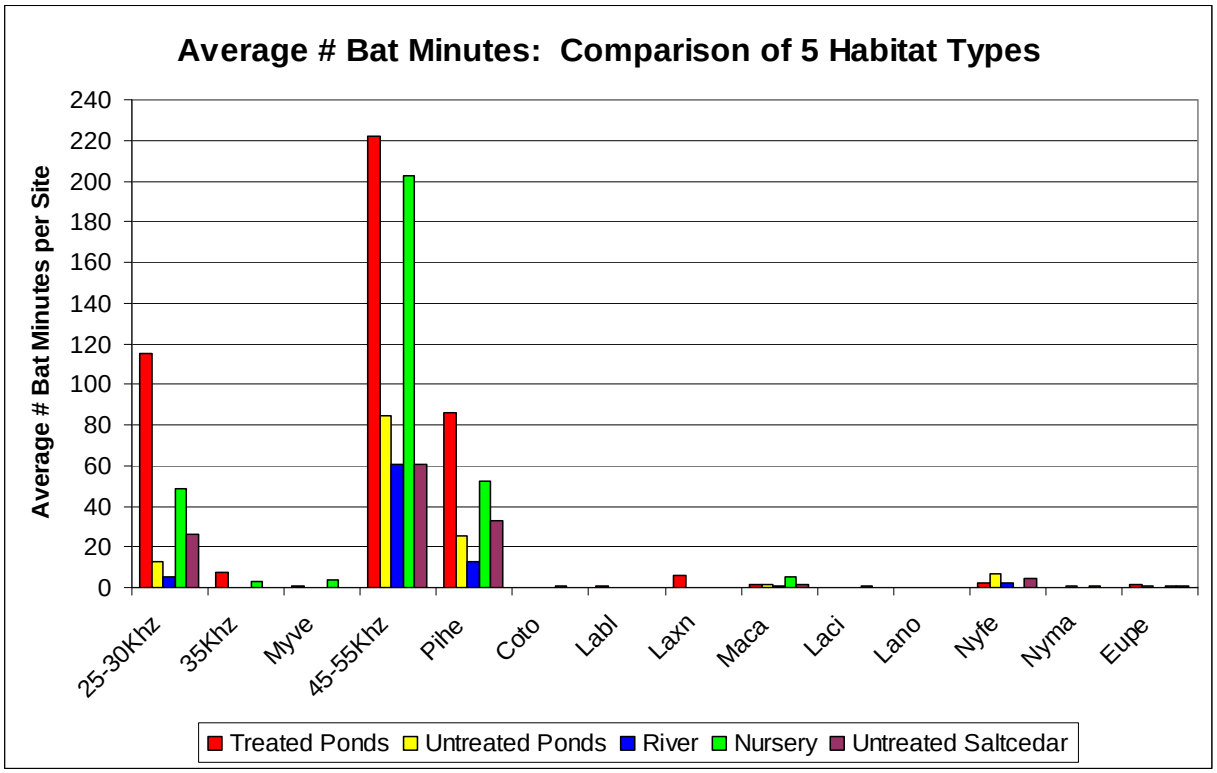


Figure 35. Mean number bat minutes in five habitats in the Imperial Ponds Conservation Area.

Index of Relative Bat Activity

An index of relative bat activity was developed for five categories of sites at the Imperial Ponds Conservation Area: reconstructed ponds, untreated ponds, river, nursery, and untreated saltcedar (Table 12). The 45-55 Khz species group (which consists primarily of Yuma myotis and California myotis) was the predominant species group in all categories. This species group was particularly abundant in the river site at 74%, in the nursery at 64%, and in the untreated ponds (Butler and McAllister) at 62%. The 25-30 Khz species group, which consists mostly of Mexican free-tailed bats, big brown bats, and pallid bats was second in species composition only at the reconstructed ponds at 26%, otherwise it was the third most abundant species group at the other site categories. Western pipistrelles, with the exception of the reconstructed ponds, were second in abundance, ranging from a high of 26% in the untreated saltcedar sites to 15.8% on the river. The pocketed free-tailed bat formed a significant part of the relative bat activity at the untreated ponds (6%), the river (2.6%), and the untreated saltcedar sites (3.5%). California leaf-nosed bat activity was fairly consistent among treatment and habitat types, ranging from 1.6% at the nursery to 1.2% at the river and untreated saltcedar sites. It was scarce, however, in the reconstructed ponds at 0.3%. Western red bats, hoary bats, pale Townsend's big-eared bats, and the big free-tailed bats form very small components of the overall bat activity for all treatments and habitats.

Table 12. Index of relative bat activity for treatment and habitat types in the Imperial Ponds Conservation Area.

Reconstructed Ponds		Untreated Ponds		River	
Species/ Species Groups	%	Species/ Species Groups	%	Species/ Species Groups	%
45-55 Khz	50.00	45-55 Khz	62.17	45-55 Khz	74.23
25-30 Khz	26.01	Pihe	20.02	Pihe	15.80
Pihe	19.32	25-30 Khz	9.70	25-30 Khz	5.98
35 Khz	1.71	Nyfe	5.95	Nyfe	2.61
Laxn	1.32	Maca	1.29	Maca	1.23
Nyfe	0.45	Nyma	0.37	Myve	0.15
Eupe	0.36	Eupe	0.25	35 Khz	0.00
Maca	0.32	35 Khz	0.15	Coto	0.00
Myve	0.21	Laci	0.06	Labl	0.00
Labl	0.19	Myve	0.03	Laxn	0.00
Laci	0.06	Coto	0.00	Laci	0.00
Nyma	0.06	Labl	0.00	Lano	0.00
Lano	0.02	Laxn	0.00	Nyma	0.00
Coto	0.00	Lano	0.00	Eupe	0.00
Nursery		**Untreated Saltcedar**			
45-55 Khz	63.85	45-55 Khz	47.75		
Pihe	16.46	Pihe	26.13		
25-30 Khz	15.35	25-30 Khz	20.33		
Maca	1.62	Nyfe	3.51		
Myve	1.10	Maca	1.22		
35 Khz	0.83	Eupe	0.36		
Laci	0.24	Myve	0.29		
Nyma	0.20	35 Khz	0.21		
Coto	0.16	Labl	0.07		
Eupe	0.12	Laci	0.07		
Labl	0.04	Nyma	0.07		
Nyfe	0.04	Coto	0.00		
Laxn	0.00	Laxn	0.00		
Lano	0.00	Lano	0.00		

Seasonal Bat Activity for Entire Bat Community

April had the highest mean bat minutes per night at 499 minutes and July had the second highest mean at 470 minutes per night (Table 13). This is in contrast to all other habitat creation areas monitored, which had July with the most minutes of bat activity recorded, followed by April. Of the eight sites monitored, ponds 1 and 2 and the mature cottonwood-willow nursery had the highest number of bat minutes recorded for April.

Table 13. Mean number of bat minutes with standard errors for treatment and habitat types at Imperial Ponds Conservation Area.

Sample Period	Mean Bat Minutes Per Night ± SE	# Detector Nights
Treated Ponds		
November	34.5 ± 7.5	2
January	11.0 ± 5.8	4
April	961.8 ± 202.4	4
July	681.0 ± 83.0	2
Untreated Ponds		
November	52.0 ± 7.1	3
January	13.3 ± 5.6	6
April	274.2 ± 45.2	6
July	641.1 ± 0	1
River		
November	63.0 ± 0	1
January	4.0 ± 2.0	2
April	290.5 ± 45.5	2
July	no samples	
Nursery		
November	116.0 ± 0	1
January	6.0 ± 6	2
April	682.0 ± 100.0	2
July	347.3 ± 36.8	3
Untreated Saltcedar		
November	21.0 ± 0	1
January	0.3 ± 0.3	3
April	267.7 ± 102.1	3
July	517.0 ± 0	1
All Sites		
November	53.1 ± 10.5	8
January	9.6 ± 2.8	15
April	499.1 ± 86.8	17
July	470.6 ± 68.0	8

The treated ponds and nursery were the sites of exceptional bat activity compared with the other sample sites at the Imperial Ponds Conservation Area. They received their highest use during April sample period in contrast to the untreated ponds (Butler and McAllister) and the untreated ponds where July was the highest use period. The overall number of mean bat minutes was far higher at the treated ponds (ponds 1 and 2) and the nursery for both April and July than at the other sites.

Discussion

Western red bats were detected at five of the six habitat creation areas, with 35 bat activity minutes recorded. A little over half (54%) of the bat minutes were recorded in recently planted fields at Beal Lake, PVER, and CVCA. Only 6% of the bat minutes were recorded in mature cottonwood stands at Pratt and Imperial Ponds. Interestingly, 40% of the bat minutes occurred at ponds 1 and 5 at Imperial Ponds Conservation Area and at lake habitats at Beal Lake Habitat

Restoration Project. This preliminary data indicates that lake habitat appears to be important for western red bats as does the younger aged cottonwood-willow plantations. The relatively low numbers of calls recorded at the mature cottonwood sites (low number of calls recorded at the cottonwood nursery at Imperial Ponds and Pratt Restoration and no calls recorded at the mature cottonwood stand at the MAPS banding station at Beal Lake) may be a function of the relatively small size of these stands, the difficulty of sampling within these stands, and the overall low population levels of this species along the Lower Colorado River. While these cottonwood stands were established several years earlier than the most recent plantings, these stands still have not achieved the complexity of habitats available in truly old growth cottonwood, with areas of dead limbs, loose dead bark, and large complex canopies.

Western yellow bats were detected at three of the six habitat creation areas, with a total of 83 bat minutes recorded. Most of the bat minutes were recorded during a single pulse at ponds 1 and 2 in the Imperial Ponds Conservation Area during April. Eight minutes of bat activity were recorded at Beal Lake; 6 minutes were in lake habitats and 5 minutes were in newly planted mesquite and cottonwood-willow fields. One minute was recorded in saltcedar habitat as well. At PVER, 1 minute was recorded along the river during April. Ninety-six percent of the yellow bat activity minutes were recorded during the April survey period, which likely indicates that western yellow bats were traveling through the areas during the spring migration period.

No bat minutes were recorded for this species during 12 detector nights at the Pratt Restoration Demonstration Area. However, a yellow bat was captured during mist netting in July and was also recorded acoustically when we set out additional Anabat detectors during capture activities. This is a good example of the value of multiple monitoring methods. It is also an indicator of the importance of detector location. In the case of supplemental acoustic monitoring during mist netting, we found bats using a slightly wider corridor in the center of the stand. Future sampling will consider relocating the interior monitoring site to a slightly wider corridor.

Pale Townsend's big-eared bats were detected in extremely low numbers at three of six habitat creation areas, with a total of 4 bat minutes recorded. One minute was recorded in a newly planted cottonwood-willow field at Beal Lake in July; 1 minute was recorded at CVCA also in a newly planted cottonwood-willow field, and 4 minutes were recorded at the cottonwood nursery at the Imperial Ponds Conservation Area during April and July. These extremely low numbers are not unexpected as this species produces vocalizations of low intensity and are difficult to detect at distances greater than a few meters. These are also known as whispering bats. Additionally, these species have good eyesight and do not always echolocate (Brown 2006). More significantly, there is only one known maternity colony on the Lower Colorado River and none of the habitat creation areas are within 20 miles of it.

California leaf-nosed bats had the highest number of minutes recorded of the 4 covered bat species at 353 minutes. They were detected at 5 of the 6 habitat creation areas. They also were widely scattered throughout the habitats from newly planted fields, to ponds, to the LCR to mature cottonwood stands. They were also present in good numbers during all the quarterly surveys, except during the cold period in January. At Beal Lake 18% of the bat minutes were recorded in newly planted fields while 73% were recorded in lake habitats. 7% of the bat minutes were recorded in saltcedar and only 2% was recorded in mature cottonwoods. Nearly all of the

calls recorded at PVER were collected in November. Similarly most of the calls recorded at CVCA occurred in January. In this case 29 minutes of bat activity were recorded, and consisted of social calls. In both PVER and CVCA, most of the minutes of activity were recorded in newly planted cottonwood/willow fields. At the Imperial Ponds Conservation Area, 39% of the bat minutes were recorded in lake habitats and 37% were recorded in mature cottonwood habitat at the nursery. River habitat was also used (7%); untreated fields (3%) and saltcedar (14%).

It was hoped that the hoary bats would serve as a good indicator for tree bats until the red bats and yellow bats begin to rebuild their populations. However, with one notable exception, this did not prove to be the case. While hoary bats were detected at five of the six habitat creation areas, the number of bat minutes was as low or lower than those of the red or yellow bats. The exception occurred at PVER in July when 67 bat activity minutes were recorded along the river during a single night's sampling. It is not possible to determine if this represented a group of bats passing through the area along the river, or whether a small number of bats were responding to an aquatic insect hatch or other factor. Except for the large pulse of activity at PVER in July, most of the activity throughout the habitat creation areas was spread out between newly planted cottonwood/willow fields, untreated agricultural sites, mature cottonwood and saltcedar. The low numbers of hoary bats is not surprising probably because of the lack of roosting habitat – the same problem that red and yellow bats must cope with.

A total of 13 minutes of bat activity were recorded for the hoary bat at Beal Lake Restoration Project. Over half of these were recorded in newly planted cottonwood/willow/mesquite fields and the rest over lake habitats. Other than the large pulse of activity at PVER in July on the river, eight minutes were recorded at newly planted cottonwood/willow fields and six minutes was recorded along the river. Only three minutes of bat activity were recorded at CVCA in an agricultural field (control) and none were recorded for the Cibola NWR Conservation #1 site. Pratt had two minutes recorded in July. A total of 14 minutes of bat activity for the hoary bat were recorded at Imperial Ponds, five of which were recorded in lake habitats and six in mature cottonwood. Overall most of the calls for the five habitat creation areas were recorded in July with a few recorded in April.

In 2008, permanent bat monitoring stations will be installed at the Beal Lake Restoration Project (probably in the middle of the newly planted cottonwood/willow/mesquite fields); and at the Imperial Ponds Conservation Area (probably near the mature cottonwood nursery). These stations will provide a much more detailed look at how and when migrants move through the habitat creation areas. We got some tantalizing glimpses of these events, but these continuously recording stations will fill in the gaps in information.

Additionally, the capture program that was begun in the summer of 2007 will accompany April and July acoustic surveys plus additional netting will be done once in May, August and September. The Ahakhav Preserve will be added to the restoration sites for both capture and acoustic surveys. This will greatly increase information on the use of the habitat creation areas. One of the most important pieces information to come out of the capture program is an increased understanding of how bats utilize habitats, particularly mature cottonwood/willow stands. We found that it is critically important for bats to have clear access to the interior of cottonwood/willow stands. Dead branches and overhanging live branches that block access and

create clutter can prevent bats from utilizing mature cottonwood habitat that otherwise would be suitable.

At Pratt we found that multiple species of bats including the yellow bat could use a narrow opening in the canopy created by the relatively infrequent use of a small two-track road that kept the canopy open. Adjacent areas blocked by dead branches and other clutter were not used at all or were used infrequently. The MAPS banding station near Beal Lake consists of a small stand of mature cottonwood. Inside the stand is an open gallery beneath the cottonwood canopy, but access to bats is limited by dead branches, overhanging live branches and other clutter. No bat activity was detected inside this stand during exploratory sampling conducted in July. However activity occurred along the edges of the stand. In yet another example, acoustic sampling within the cottonwood stand at the nursery at Imperial Ponds Conservation Area showed good use by a wide variety of bat species during April and July. Bats can access the interior of this stand through fairly clear openings in the canopy. Very minor trimming of small areas of clutter cold provide access to red bats and yellow bats to these mature cottonwood stands. The capture program is also assisting us in determining optimum Anabat detector locations for acoustic sampling.

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Appendix I – Data Tables

Table 1. Quarterly summary of bat minutes recorded in 9 sites at Beal Lake Habitat Restoration simultaneously, first night.

Beal Lake Habitat Restoration Post Development Bat Monitoring FY 2007 Sample 1																
Location	**20-25Khz**	**25-30Khz**	**35Khz**	**Myve**	**45-55Khz**	**Pihe**	**Coto**	**Labl**	**Laxn**	**Maca**	**Laci**	**Nyfe**	**Nyma**	**Eupe**	**Site Total**	**Status**
November 2006																
Field K		4													4	b
Field BB		4			1										5	b
Field C		1			3							1			5	b
Field FF		4													4	b
MAPS Bnd. Sta.		28			45	6						4			83	
Sacramento Wash		19	3		171	4				9					206	
Beal Pump Sta.		9			123					7		1			140	
Beal Lake		46	1	1	54				1					13	116	
Topock Marsh		101			48	3				23					175	
Species Subtotal	0	216	4	1	445	13	0	0	1	39	0	6	0	13	738	
January 2007																
Field K		4													4	b
Field BB															0	b
Field C															0	b
Field FF		2													2	b
MAPS Bnd. Sta.		1			1							11			13	b
Sacramento Wash					2										2	b
Beal Pump Sta.															0	b
Beal Lake												1			1	b
Topock Marsh		13			3							23			39	b
Species Subtotal	0	20	0	0	6	0	0	0	0	0	0	35	0	0	61	
April 2007																
Field K		75		3	17	4									99	
Field BB		102	2	6	22	6									138	
Field C		118	2	9	37	57			1	1		1			226	
Field FF		59	2	2	5	1				1		2			72	
MAPS Bnd. Sta.		50	2	1	69	56				1		1			180	
Sacramento Wash		15		1	47	33				1		2			99	
Beal Pump Sta.		150	4	28	276	37				7					502	
Beal Lake	6	242	72	65	516	60			4	35	1	3			1004	
Topock Marsh		61	1	4	70	72			1	1	1	1			212	
Species Subtotal	6	872	85	119	1059	326	0	0	6	47	2	10	0	0	2532	
July 2007																
Field K		15	1	13	82	126									237	
Field BB	8														8	d*
Field C		33	1	20	146	90					4			1	295	
Field FF		61	2	16	58	197	1	3							338	
MAPS Bnd. Sta.		62		4	106	189				1					362	
Sacramento Wash		29	2	2	134	58			1						226	
Beal Pump Sta.		53	4	15	178	176		1							427	
BealLk		307	7	5	200	207				2					728	
BealTopoc		233	6	29	185	346		1		2					802	
Species Subtotal	8	793	23	104	1089	1389	1	5	1	5	4	0	0	1	3423	
Grand Total	14	1901	112	224	2599	1728	1	5	8	91	6	51	0	14	6746	

Status Codes:
a = Detector not deployed
b = No calls or few calls - detector functioning properly
c = Detector malfunction
d = Partial night
No code = detector functioning properly

* partial night sample excluded from totals

Table 2. Quarterly summary of bat minutes recorded in 9 sites at Beal Lake Habitat Restoration simultaneously, second night.

Beal Lake Habitat Restoration Post Development Bat Monitoring FY 2007 Sample 2																
	20-25Khz	25-30Khz	35Khz	Myve	45-55Khz	Pihe	Coto	Labl	Laxn	Maca	Laci	Nyfe	Nyma	Eupe	Site Total	Status
November 2006																
Field K																a
Field BB																a
Field C				Detectors not deployed for the second night's sampling in November												a
Field FF																a
MAPS Bnd. Sta.																a
Sacramento Wash																a
Beal Pump Sta.																a
Beal Lake																a
Topock Marsh																a
January2007																
Field K																b
Field BB																b
Field C																b
Field FF																b
MAPS Bnd. Sta.																c
Sacramento Wash										1					1	b
Beal Pump Sta.																b
Beal Lake																b
Topock Marsh					9										9	b
Species Subtotal	0	0	0	0	9	0	0	0	0	1	0	0	0	0	10	
April2007																
Field K		64	1	8	14	5									92	
Field BB		104	5	6	14	11			4		1				145	
Field C		103	17	21	359	5				26	1				532	
Field FF		82		3	4	2									91	
MAPS Bnd. Sta.															0	c
Sacramento Wash		27		2	57					1		14			101	
Beal Pump Sta.		103	3	10	406	3				14					539	
Beal Lake		225	23	53	443	16				20	3				783	
Topock Marsh															0	c
Species Subtotal	0	708	49	103	1297	42	0	0	4	61	5	14	0	0	2283	
July2007																
Field K		30		10	63	93				1				2	199	
Field BB		164									2	17	6	1	190	
Field C		86	3	7	85	146		6		1				6	340	
Field FF															0	c
MAPS Bnd. Sta.															0	c
SacramentoWash		28			28	8							0		64	
Beal Pump Sta.		35	1	5	113	132		1					0	2	289	
Beal Lake		196	5	16	80	103		1		4			0		405	
Topock Marsh		75	0	28	135	225				7			0	1	471	
Species Subtotal	0	614	9	66	504	707	0	8	0	13	2	17	6	12	1958	
SpeciesTotal	0	1322	58	169	1810	749	0	8	4	75	7	31	6	12	4251	

Status Codes:
a = Detector not deployed
b = No calls or few calls - detector functioning properly
c = Detector malfunction
d = Partial night

Table 3. Quarterly summary of bat minutes recorded in 4 sites at Palo Verde Ecological Reserve simultaneously, first night.

Palo Verde Ecological Reserve Post Development Bat Monitoring Sample Period 1																
November 2006	**25-30Khz**	**35Khz**	**Myve**	**45-55Khz**	**Pihe**	**Coto**	**Labl**	**Laxn**	**Maca**	**Laci**	**Lano**	**Nyfe**	**Nyma**	**Eupe**	**Site Total**	**Status**
Phase II NW				3	3							6			12	b
Phase II SE				26	4				8			2			40	b
Phase I Nursery				2	1				14						17	b
LCR Shoreline	2			13	7				1			26			49	b
Species Subtotals	2	0	0	44	15	0	0	0	23	0	0	34	0	0	118	
January 2007																
Phase II NW															0	b
Phase II SE												2			2	b
Phase I Nursery															0	b
LCR Shoreline															0	b
Species Subtotals	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	
April 2007																
Phase II NW	2			4								3		1	10	b
Phase II SE				9								3			12	b
Phase I Nursery				1	1							2			4	b
LCR Shoreline	3		1	5								5		1	15	b
Species Subtotals	5	0	1	19	1	0	0	0	0	0	0	13	0	2	41	
July 2007																
Phase II NW	66		1	28	279					4		13			391	
Phase II SE	20	1	7	41	294		4					2			369	
Phase I Nursery															0	c
LCR Shoreline	138	10	135	139	219		1	1	1	67	1	85			797	
Species Subtotals	224	11	143	208	792	0	5	1	1	71	1	100	0	0	1557	
Species Totals	231	11	144	271	808	0	5	1	24	71	1	149	0	2	1718	

Status Codes:
a = Detector not deployed
b = No calls or few calls - detector functioning properly
c = Detector malfunction
d = Partial night
No code = detector functioning properly

Table 4. Quarterly summary of bat minutes recorded in 4 sites at Palo Verde Ecological Reserve simultaneously, second night.

Palo Verde Ecological Reserve Post Development Bat Monitoring Sample Period 2															
	25-30Khz	35Khz	Myve	45-55Khz	Pihe	Coto	Labl	Laxn	Maca	Laci	Nyfe	Nyma	Eupe	Total	Status
November 2006															
Phase II NW				Detectors not deployed in April 2nd night											a
Phase II SE															a
Phase I Nursery															a
LCR Shoreline															a
January 2007															
Phase II NW														0	b
Phase II SE														0	b
Phase I Nursery														0	c
LCR Shoreline														0	b
Species Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
April 2007															
Phase II NW	1			2	15						1			19	b
Phase II SE				34	14					1				49	b
Phase I Nursery				2	16					1				19	b
LCR Shoreline	8	2		9	41					6				66	b
Species Subtotal	9	2	0	47	86	0	0	0	0	8	1	0	0	153	
July 2007															
Phase II NW	36	2	2	8	99					1	4			152	
Phase II SE	28	2	7	38	182		2			1	22		2	284	
Phase I Nursery														0	c
LCR Shoreline														0	a
Species Subtotal	64	4	9	46	281	0	2	0	0	2	26	0	2	436	
Species Total	73	6	9	93	367	0	2	0	0	10	27	0	2	589	

Status Codes:

a = Detector not deployed

b = No calls or few calls - detector functioning properly

c = Detector malfunction

d = Partial night

No code = detector functioning properly

Table 5. Quarterly summary of bat minutes recorded in 6 sites at Cibola Valley Conservation Area simultaneously, first night.

Cibola Valley Conservation Area Post Development Bat Monitoring FY 2007 Sample 1																
	20-25Khz	25-30Khz	35Khz	Myve	45-55Khz	Pihe	Coto	Labl	Laxn	Maca	Laci	Nyfe	Nyma	Eupe	Site Total	Status
November 2006																
Field A		2			11							2	1		16	b
Field B	1	2								1		1		1	6	b
Field C		1			2	1							4		8	b
Field D					1							1	2		4	b
Phase III PreTreat.	2	1			8							2	1		14	b
Control					3					1		2		1	7	b
Species Subtotal	3	6	0	0	25	1	0	0	0	2	0	8	8	2	55	
January 2007																
Field A															0	b
Field B															0	b
Field C															0	b
Field D										29					29	b
Phase III PreTreat.															0	b
Control															0	b
Species Subtotal	0	0	0	0	0	0	0	0	0	29	0	0	0	0	29	
April 2007																
Field A					2										2	b
Field B															0	b
Field C					2										2	b
Field D															0	b
Phase III PreTreat.															0	b
Control					2										2	b
Species Subtotal	0	0	0	0	6	0	0	0	0	0	0	0	0	0	6	
July 2007																
Field A		13	1		61	90		1							166	
Field B		2			36	56									94	
Field C		6	2		34	47				1		1			91	
Field D		11	2		50	79		1		1					144	
CVCA2		7			123	91				1			1		223	
CVCAWat		37	3	1	40	64				2	1				148	
Species Subtotal	0	76	8	1	344	427	0	2	0	5	1	1	1	0	866	
Species Total	3	82	8	1	375	428	0	2	0	36	1	9	9	2	956	

Status Codes:
a = Detector not deployed
b = No calls or few calls - detector functioning properly
c = Detector malfunction
d = Partial night
No code = detector functioning properly

Table 6. Quarterly summary of bat minutes recorded in 6 sites at Cibola Valley Conservation Area simultaneously, second night.

Cibola Valley Conservation Area Post Development Bat Monitoring FY 2007 Sample 2																
	20-25Khz	25-30Khz	35Khz	Myve	45-55Khz	Pihe	Coto	Labl	Laxn	Maca	Laci	Nyfe	Nyma	Eupe	Site Total	Status
November 2006																
Field A																a
Field B																a
Field C																a
Field D				Detectors not deployed in November second night												a
Phase III PreTreat																a
Control																a
January 2007																
Field A															0	b
Field B															0	b
Field C															0	b
Field D															0	b
Phase III PreTreat															0	b
Control															0	b
Species Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
April2007																
Field A		6			2										8	b
Field B		1			3		1								5	b
Field C			1		1										2	b
Field D		1													1	b
Phase III PreTreat															0	b
Control		2			1							1			4	b
Species Subtotal	0	10	1	0	7	0	1	0	0	0	0	1	0	0	20	
July 2007																
Field A		161	11	3	75	72				2					324	
Field B		60	12	4	24	45									145	
Field C		16	1		28	44									89	
Field D		108	3	3	19	64		2		1					200	
Phase III PreTreat		13			56	71									140	
Control		86	1	3	57	95				1	2				245	
Species Subtotal	0	444	28	13	259	391	0	2	0	4	2	0	0	0	1143	
Species Total	0	454	29	13	266	391	1	2	0	4	2	1	0	0	1163	

Status Codes:
a = Detector not deployed
b = No calls or few calls - detector functioning properly
c = Detector malfunction
d = Partial night
No code = detector functioning properly

Table 7. Quarterly summary of bat minutes recorded in 2 sites at Cibola NWR Conservation Unit #1 simultaneously, first night.

Cibola NWR Conservation Unit #1 Post Development Bat Monitoring FY 2007 Sample 1																
	20-25Khz	25-30Khz	35Khz	Myve	45-55Khz	Pihe	Coto	Labl	Laxn	Maca	Laci	Nyfe	Nyma	Eupe	Site Total	Status
November 2006																
Mass Planting	0	0	0	0	9	0	0	0	0	2	0	4	0	1	16	b
Nature Trail	0	0	0	0	5	0	0	0	0	4	0	2	0	0	11	b
Species Subtotal	0	0	0	0	14	0	0	0	0	6	0	6	0	1	27	
January 2007																
Mass Planting			Detector not deployed at Cmass, first night													a
Nature Trail	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	b
Species Subtotal	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	
April 2007																
Mass Planting			Detectors not deployed in April, first night													a
Nature Trail																a
July 2007																
Mass Planting	0	8	3	1	65	35	0	0	0	1	0	0	0	0	113	
Nature Trail	0	4	1		4	27	0	0	0	2	0	0	0	0	38	d*
Species Subtotal	0	12	4	1	69	62	0	0	0	3	0	0	0	0	151	
Species Totals	0	24	8	2	84	62	0	0	0	9	0	6	0	1	141	

Status Codes:

a = Detector not deployed

b = No calls or few calls - detector functioning properly

c = Detector malfunction

d = Partial night

No code = detector functioning properly

* partial night sample excluded from totals

Table 8. Quarterly summary of bat minutes recorded in 2 sites at Cibola NWR Conservation Unit #1 simultaneously, second night.

		Cibola NWR Conservation Unit #1Post Development Bat Monitoring FY 2007 Sample 2														
	20-25Khz	25-30Khz	35Khz	Myve	45-55Khz	Pihe	Coto	Labl	Laxn	Maca	Laci	Nyfe	Nyma	Eupe	Site Total	Status
November 2006																
Mass Planting			Detectors not deployed in November, second night.													a
Nature Trail																a
January 2007																
Mass Planting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	b
Nature Trail	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	b
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
April2007																
Mass Planting			Detectors not deployed in April, second night.													a
Nature Trail																a
July 2007																
Mass Planting	0	24	4	3	63	47	0	0	0	2	0	0	0	0	143	
Nature Trail	0	26	12	1	46	24	0	0	0	1	0	1	0	0	111	
Species Subtotal	0	50	16	4	109	71	0	0	0	3	0	1	0	0	254	
Species Totals	0	50	16	4	109	71	0	0	0	3	0	1	0	0	254	
Status Codes:																
a = Detector not deployed																
b = No calls or few calls - detector functioning properly																
c = Detector malfunction																
d = Partial night																
No code = detector functioning properly																

Table 9. Quarterly summary of bat minutes recorded in 2 sites at Pratt Restoration simultaneously, first night.

Pratt Restoration Post Development Bat Monitoring FY 2007 Sample 1															
	25-30Khz	35Khz	Myve	45-55Khz	Pihe	Coto	Labl	Laxn	Maca	Laci	Nyfe	Nyma	Eupe	Site Total	Status
November 2006															
Pratt Edge		Monitoring not established at Pratt in November 2006													a
Pratt Interior															a
January 2007															
Pratt Edge														0	b
Pratt Interior														0	b
Species Subtotal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
April 2007															
Pratt Edge	12	1		35	21									69	b
Pratt Interior				6	1									7	b
Species Subtotal	12	1	0	41	22	0	0	0	0	0	0	0	0	76	
July 2007															
Pratt Edge	311		2	158	78					1	3		1	554	
Pratt Interior	24		1	54	7						4		2	92	
Species Subtotal	335	0	3	212	85	0	0	0	0	1	7	0	3	646	
Species Totals	347	1	3	253	107	0	0	0	0	1	7	0	3	722	

Status Codes:
a = Detector not deployed
b = No calls or few calls - detector functioning properly
c = Detector malfunction
d = Partial night
No code = detector functioning properly

Table 10. Quarterly summary of bat minutes recorded in 2 sites at Pratt Restoration simultaneously, second night.

		Pratt Restoration Post Development Bat Monitoring FY 2007 Sample 2													
	25-30Khz	35Khz	Myve	45-55Khz	Pihe	Coto	Labl	Laxn	Maca	Laci	Nyfe	Nyma	Eupe		Status
November 2006															
Pratt Edge		Monitoring not established at Pratt in November 2006													a
Pratt Interior															a
January 2007															
Pratt Edge														0	b
Pratt Interior														0	b
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
April 2007															
Pratt Edge	12			16	13									41	b
Pratt Interior	12			23	5									40	b
	24	0	0	39	18	0	0	0	0	0	0	0	0	81	
July 2007															
Pratt Edge	301	7	1	227	99		1				10	1	3	650	
Pratt Interior	42		4	84	27					1	6			164	
	343	7	5	311	126	0	1	0	0	1	16	1	3	814	
	367	7	5	350	144	0	1	0	0	1	16	1	3	895	
Status Codes:															
a = Detector not deployed															
b = No calls or few calls - detector functioning properly															
c = Detector malfunction															
d = Partial night															
No code = detector functioning properly															

Table 11. Quarterly summary of bat minutes recorded in Imperial Ponds Conservation Area simultaneously, first night.

Imperial Ponds Conservation Area Post Development Bat Monitoring Sample 1															
	25-30Khz	**35Khz**	**Myve**	**45-55Khz**	**Pihe**	**Coto**	**Labl**	**Laxn**	**Maca**	**Laci**	**Nyfe**	**Nyma**	**Eupe**	**Site Totals**	**Status**
November 2006															
Butler Lake N	4			38	7				2		10			61	
Butler Lake S				10	10				6		12			38	
Field 18	4			14	1						2			21	
Nursery Edge				96	4				15		1			116	
Pond 1				39	1				1		1			42	
Pond 2				24	1						2			27	
McAllister Lake	3			40	4				1		8			57	
LCR Shoreline				57					4		2			63	
	11	0	0	318	28	0	0	0	29	0	38	0	0	425	
January 2007															
Butler Lake N	1			15					1					17	b
Butler Lake S				2							2			4	b
Field 18											1			1	b
Nursery Edge	3			9										12	b
Pond 1	7			15										22	b
Pond 2	2			17					1					20	b
McAllister Lake	3			31							1			35	b
LCR Shoreline	2			3							1			6	b
Species Subtotal	18	0	0	92	0	0	0	0	2	0	5	0	0	117	
April 2007															
Butler Lake N	17			200	90						36		1	344	
Butler Lake S	11			92	51				4		27			185	
Field 18	47			237	68				3	1				356	
Nursery Edge	162	1	2	470	126	2	1		17	1				782	
Pond 1	505	84	8	563	209		9	62	1		7		2	1450	
Pond 2	422	5		459	240			7	1		1			1135	
McAllister Lake	22			305	44				7		32			410	
LCR Shoreline	36		1	196	87				2		14			336	
Exploratory Samples:															
Control	31			218	74				14		46			383	
Species Subtotal	1253	90	11	2740	989	2	10	69	49	2	163	0	3	5381	
July 2007															
Field 18															a
Nursery Interior															a
Nursery Edge			Detectors not deployed in July for first night												a
Nursery Channel															a
Pond 1															a
POND5															a
Marsh Channel															a
McAllister Lake															a
LCR Shoreline															a
Species Totals	1282	90	11	3150	1017	2	10	69	80	2	206	0	3	5923	

Status Codes:
a = Detector not deployed
b = No calls or few calls - detector functioning properly
c = Detector malfunction
d = Partial night
No code = detector functioning properly

Table 12. Quarterly summary of bat minutes recorded at Imperial Ponds Conservation Area simultaneously, second night.

Imperial Ponds Conservation Area Post Development Bat Monitoring FY2007 Sample 2																
	25-30Khz	35Khz	Myve	45-55Khz	Pihe	Coto	Labl	Laxn	Maca	Laci	Lano	Nyfe	Nyma	Eupe	Site Total	Status
November 2006																a
McAllister Lake																a
Butler Lake N																a
Butler Lake S			Detectors not deployed in November for 2nd night													a
Pond 1																a
Pond 2																a
LCR Shoreline																a
Field 18																a
Nursery Edge																a
Control																a
January 2007																
McAllister Lake	2			18					2						22	b
Butler Lake N				2											2	b
Butler Lake S															0	b
Pond 1				1					1						2	b
Pond 2															0	c
LCR Shoreline					2										2	b
Field 18															0	c
Nursery Edge															0	b
Exploratory Sample:																
Control															0	b
Species Subtotal	2	0	0	21	2	0	0	0	3	0	0	0	0	0	28	
April 2007																
McAllister Lake	64			259	42										365	
Butler Lake N	2			168	6							2		1	179	
Butler Lake S	21			113	23				3			2			162	
POND1	13			545	25										583	
POND2	184	1	2	453	34			1	2	1		1			679	
LCR Shoreline	1			228	14				2					245	490	
Field 118	7			93	19										119	d*
Nursery Edge	27			518	37										582	
Exploratory Sample:																
Control	1			51	8				2	2					64	b
Species Subtotal	320	1	2	2428	208	0	0	1	9	3	0	5	0	246	3104	
July 2007																
McAllister Lake	96	5		308	212					2			12	6	641	
Pond 1	192	1		134	241				2	2	1	9	3	13	598	
Pond 5	59		1	411	277		1		8			3		4	764	
LCR Shoreline															0	a
Field 18	195	3	4	105	203		1						1	5	517	
Exploratory Sampling:																
Marsh Channel	25	4	1	48	121							1		3	203	
Nursery Interior	97	11	1	158	61	2			4					2	336	
Nursery Edge	84	3	1	146	171					5			5	1	416	
Nursery Channel	16	6	24	221	18				5						290	
Discontinued Sampling:																
Butler Lake N		Eliminated from sampling														
Butler Lake S		Eliminated from sampling														
Pond 2		Replaced with sampling at Pond 5														
Species Subtotal	764	33	32	1531	1304	2	2	0	19	9	1	13	21	34	3765	
Species Totals	1086	34	34	3980	1514	2	2	1	31	12	1	18	21	280	6897	

Status Codes:
a = Detector not deployed
b = No calls or few calls - detector functioning properly
c = Detector malfunction
d = Partial night
No code = detector functioning properly

* partial sample excluded from totals