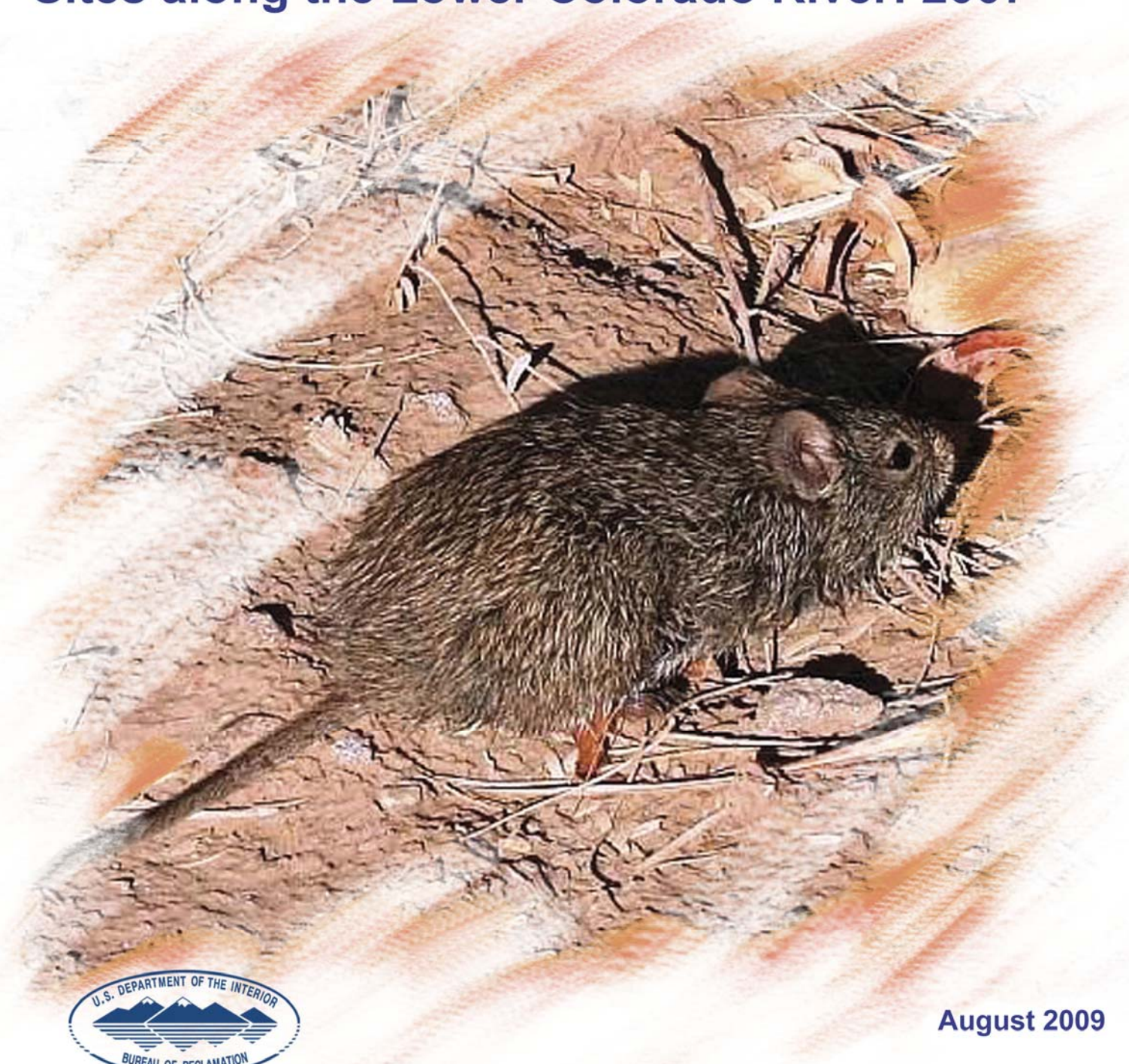




Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Small Mammal Colonization at Habitat Creation Sites along the Lower Colorado River: 2007



August 2009

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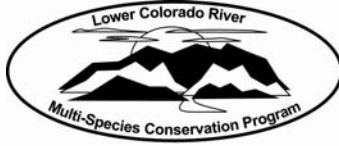
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Lower Colorado River Multi-Species Conservation Program

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Prepared by Allen Calvert, Wildlife Group

Lower Colorado River
Multi-Species Conservation Program
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August 2009

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Abstract

The Bureau of Reclamation is the lead agency for the Lower Colorado River Multi-Species Conservation Program (LCR MSCP). One purpose of the MSCP is to create habitat for species covered under the Habitat Conservation Plan. *Sigmodon arizonae plenus* (Colorado River cotton rat) and *Sigmodon hispidus eremicus* (Yuma hispid cotton rat) are listed as covered species. Monitoring small mammals at current and future habitat creation sites will allow Reclamation to determine whether *Sigmodon* spp. are colonizing these sites. Two sites were surveyed in 2005. In 2006, trapping was increased to include five new sites. In 2007, seven sites were surveyed, six of which had been surveyed in previous years. In 2005, *Sigmodon* spp. were found at both the Pratt site near Yuma, Arizona, and the Cibola Nature Trail site at Cibola National Wildlife Refuge (NWR). One *Sigmodon* spp. was found at only one site at Havasu NWR in 2006. All sites showed an increase in capture rate and species richness in 2007, except for the Pratt site, which only had two species captured. In 2007, *Sigmodon* spp. were found at the Cibola Nature Trail, Imperial NWR, and at a reference site between Laguna Dam and Mittry Lake north of Yuma, Arizona. *Mus musculus* (house mouse) was the most common species at two sites, and *Peromyscus eremicus* (cactus mouse) was the most common species at all other sites except for Cibola NWR, where *Chaetodipus penicillatus* (desert pocket mouse) was the most frequently captured species. After further searching at Havasu NWR, no further *Sigmodon* spp. have been found. The habitat characteristics that appear to be important for the species are not as prevalent at this refuge. The two plant species that have been dominant where *Sigmodon* spp. have been caught are common reed (*Phragmites australis*) and Johnsongrass (*Sorghum halepense*). *Reithrodontomys megalotis* (western harvest mouse) may be a good indicator of *Sigmodon* spp. habitat because it co-exists in the same habitat as *Sigmodon* spp. elsewhere.

Introduction

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

One of the purposes of these efforts is to provide habitat for plant and animal species covered under the Habitat Conservation Plan (HCP), including *Sigmodon hispidus eremicus* (Yuma hispid cotton rat) and *Sigmodon arizonae plenus* (Colorado River cotton rat). Of the acreages of habitat to be created, 125 acres (50.6 ha) of habitat have been designated for *S. a. plenus*, and 76 acres (30.8 ha) of habitat have been designated for *S. h. eremicus*. While other covered species habitat acreages may overlap with these numbers, these amounts will be created with specific habitat characteristics for the two *Sigmodon* species. The range of these two species is assumed to not overlap; however, these two species of *Sigmodon* cannot be distinguished by field characteristics. Genetic work is currently being done by the University of Nevada-Las Vegas (UNLV) where *Sigmodon* spp. have been captured by Reclamation. It is suspected that those captured in the area of Imperial National Wildlife Refuge (NWR) and south to the Yuma, Arizona area are *S. h. eremicus*. Those captured from Cibola NWR north to Havasu NWR are suspected to be *S. a. plenus*. In this report all captures of *Sigmodon* spp. will only be identified to the generic level. Past research has shown that these two species may be versatile in their habitat preference (Hall 1946, Bradley 1966, Zimmerman 1970). Future research will be conducted to better define habitat characteristics of these two species, which will help determine what types of habitat to create.

Reclamation is increasing its understanding of restoration science through an adaptive management approach; therefore, monitoring of current habitat creation/restoration sites is crucial. Preliminary trapping at the Cibola National Wildlife Refuge (NWR) Nature Trail site, and the Pratt Restoration Demonstration site in 2005, found that *Sigmodon* spp. had colonized each site (Dodge 2006). In 2006, a continuation of trapping at the Pratt site, as well as the addition of four habitat creation sites plus one reference site were added. Only one *Sigmodon* spp. was trapped in 2006, and was located on Havasu NWR (Calvert 2007). In 2007, trapping was performed at all previous habitat creation sites as well as a new reference site. This report is a synopsis of all small mammal trapping done by Reclamation for the year 2007, including comparisons to previous years.

Study Areas

Beal Lake Riparian and Marsh Project

The Beal Lake site is adjacent to Beal Lake and Topock Marsh, inside Havasu NWR within the Arizona side of the Colorado River floodplain. It is a two-phase habitat creation project that was initiated in the spring of 2003. The 100-acre (40.5-ha) site is a joint effort between Reclamation and the Havasu NWR with the purpose of evaluating riparian restoration techniques for the improvement of habitat for terrestrial and marsh LCR MSCP covered species (Raulston 2003). When complete, the site will contain Fremont cottonwood, Goodding's willow (*Salix goodingii*), coyote willow (*Salix exigua*), and honey and screwbean mesquite (*Prosopis pubescens*) (Raulston 2003). Currently, the site contains areas of all tree species listed above. Arrowweed (*Pluchea sericea*) has begun to fill in the open areas and edges of most of the plots in the site.

Palo Verde Ecological Preserve

Palo Verde Ecological Preserve (PVER) is located about 5 miles (8 km) north of Blythe, California, along the California side of the Colorado River. It will encompass up to 1,300 acres (526 ha) when completed. The acreages will be separated into nine different phases, with one phase being planted every year. In the spring of 2006, a 31-acre (12.5-ha) nursery (phase 1) was planted. Phase two was farmed for alfalfa prior to conversion to native riparian habitat. In the spring of 2007 phase 2 was planted with 80 acres (32.4 ha) of cottonwood, willow, and other riparian plants. PVER is being implemented to create habitat for LCR MSCP covered species (Iglitz and Clune in prep.).

Cibola Valley Conservation Area

Cibola Valley Conservation Area (CVCA) is located in Arizona adjacent to the Colorado River, about 15 miles (24 km) south of Blythe, California. It will encompass about 1,019 acres (412 ha) when completed. CVCA is a multi-phase plan in which the first three phases have been identified. All three phases will include Fremont cottonwood, Goodding's willow, coyote willow, and other riparian plant species. Phase 1 was planted in the spring of 2006, and contains a 22-acre (9-ha) nursery and a 64-acre (26-ha) area of cottonwood-willow habitat. Phase 3 was planted in the spring of 2007, and contains more than 80 acres (32 ha) of cottonwood-willow planted in different combinations. Phase 3 also includes 11 acres (4.5 ha) of *Baccharis* spp. mixed with some cottonwood and willow, and almost 8 acres (3 ha) of honey mesquite and quailbush (*Atriplex lentiformis*). In addition to the habitat creation areas, a 194-acre (78.5-ha) area planted in alfalfa (*Medicago sativa*), which will be converted into habitat in the future, is also being monitored to obtain baseline data of a managed agricultural field. CVCA is being implemented to create habitat for LCR MSCP covered species (Singleton and Olson in prep.).

Cibola NWR Unit 1 Conservation Area

The Unit 1 Conservation Area is located on Cibola NWR, which is located along the LCR south of Interstate 10 near Blythe, California, and Cibola, Arizona. The refuge was established in 1964 to provide habitat for wildlife (U.S. Fish and Wildlife Service 2007). The refuge is divided into six management units. Unit 1 is in the northernmost area of the refuge. The conservation area encompasses about 900 acres (364 ha) of Unit 1, and contains undeveloped areas, agricultural fields, and fields being used as research by Reclamation for the LCR MSCP (Garnett and Calvert 2007). One of these fields is the Nature Trail, which is a 34-acre (14-ha) section planted with cottonwood, willow, and mesquite in three distinct areas separated by trails. In the mesquite and willow areas, a dense understory of Johnsongrass (*Sorghum halepense*) and *Baccharis* spp. has become established.

Imperial Ponds Conservation Area

The Imperial Ponds Conservation Area is located on the Imperial NWR, east of the Colorado River, near River Mile 59, just north of Martinez Lake. The project area is within a portion of the refuge known as the Intensive Management Area, which consists of fields and marshes that are managed for waterfowl, marsh birds, native fish, riparian obligate bird species, and other wildlife (Lenon and Dodge in prep.). The entire Intensive Management Area is restricted from public access. Currently the six ponds have been dredged and excavated material from the ponds has been spread across some of the fields. These fields will be planted for waterfowl and an additional 34 acres (14 ha) of cottonwood and willow habitat will be planted adjacent to the nursery as part of the Imperial Ponds Conservation Area (Lenon and Dodge in prep.). Most of the edges of the site are edged in dense riparian vegetation including common reed (*Phragmites australis*), *Baccharis* spp., mesquite (*Prosopis* spp.), and some cottonwood and willow trees.

Pratt Restoration Demonstration Site

The Pratt restoration site is located north of Interstate 8, near Yuma, Arizona, on land administered by the Bureau of Land Management (BLM). The site is north of Laguna Dam, south of Mitty Lake, and is surrounded by farm fields and *Tamarix* spp. In the fall of 2003, one area of *Tamarix* spp. was removed; this area was restored to native vegetation by the BLM in 2007. A leaseholder has farmed the 12-acre (4.9-ha) site since 1949. In 1999, Reclamation established six planting regimes with Fremont cottonwood (*Populus fremontii*), Goodding's willow (*Salix gooddingii*), and coyote willow (*Salix exigua*) using potted plants, seeds, and poles. Reclamation planted potted plants and poles from 3.3 to 10 ft (1-3m) apart. Seeded areas contained cottonwood and willow seeds collected locally and broadcast by hand over wet soils. One cottonwood plot contains a thick 13 to 16.4 ft (4-5 m) high understory of *Baccharis* spp., which was independently established after the initial plantings. *Tamarix* was also established in small numbers in the seeded areas, as well as new individuals of coyote willow in the potted coyote willow area (Raulston 2003). Most of the cottonwood trees range in height from 26 to 46 ft (8-14 m), Goodding's willow from 20 to 33 ft (6-10 m), and coyote willow from 10 to 20 ft (3-6 m).

Laguna Dam/Mittry Lake

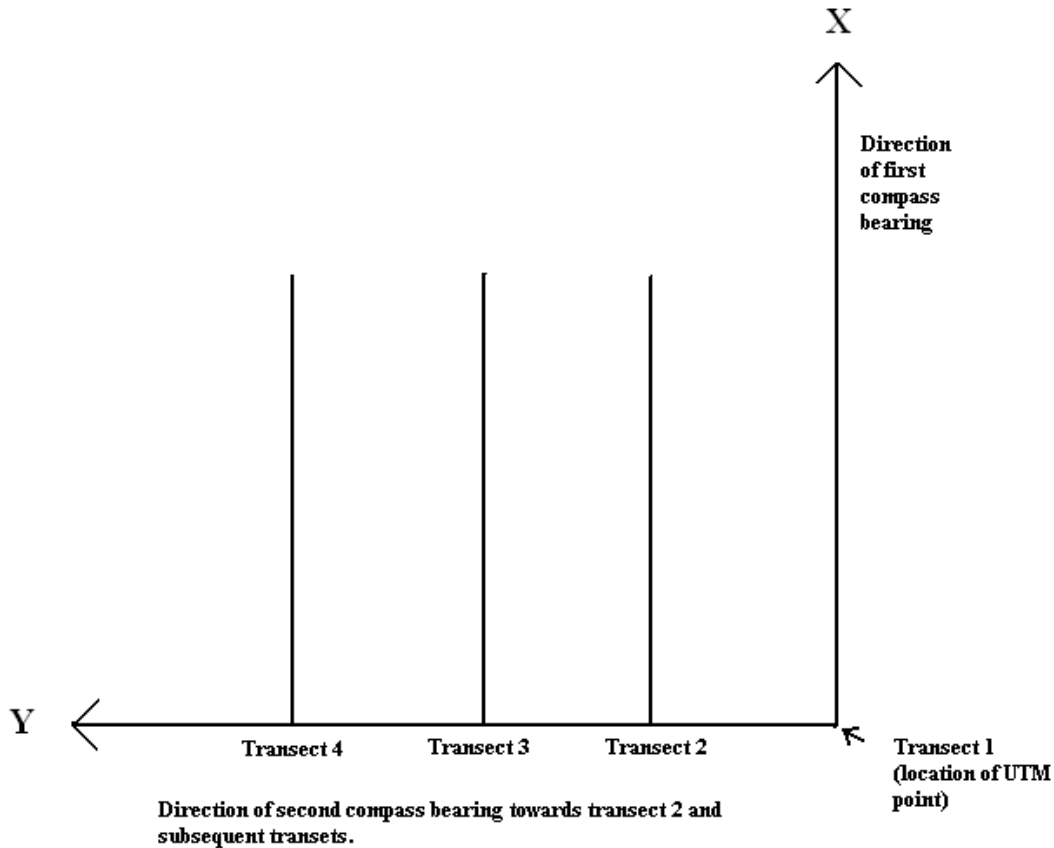
This reference site is north of Yuma, Arizona near the Pratt site along Laguna Dam Road, and fields adjacent to Pratt where BLM began a re-vegetation project this year. The trapping took place northeast of Laguna Dam, and west of Mittry Lake. Vegetation was dominated by mixed dense stands of common reed, arrowweed, *Baccharis* spp., and some *Tamarix* spp. The BLM fields were planted sparsely with cottonwood and willow poles with a mixed understory of saltgrass (*Distichlis spicata*), Johnsongrass, and *Tamarix* spp.

Methods

An ocular examination was made of the habitat types at each site and traps were first placed in areas with the highest density of vegetation at ground level. High vegetation density at ground level has been shown to be positively correlated with higher capture numbers of *Sigmodon* along the LCR (Andersen and Nelson 1999). Once the densest habitats had been sampled, other less densely vegetated habitats were sampled. These surveys are focused on finding *Sigmodon* spp. All other captures are incidental to our main focus. To gain a true representation of small mammal populations in these sites, a more standardized trap array would be needed.

Traps were baited with a mixture of oats, peanut butter, and vanilla. A small handful of cotton was also added to each trap to provide insulating cover for any animal trapped overnight. Sherman live traps were used, which are triggered by the animal stepping on a pressure plate that then closes a trap door behind the animal. Traps were set out in transects of 15 traps per transect whenever possible. Transects were then set out in a grid to cover as great an area as possible. Traps in each transect were 33 ft (10 m) apart, and transects were 50 ft (15 m) apart. A UTM reading (NAD 83) was taken with a GPS unit at the location of the first trap of the first transect in the grid. At this point, a compass bearing (X) was taken in the direction of the first transect. A second bearing (Y) was also taken from this point perpendicular to the X bearing. In the Y direction, each subsequent transect in the grid was started at this bearing (see Figure 1). This enables the grid to be replicated and to determine an approximate location of a noteworthy capture in the future. Each transect is labeled by a letter, and each trap is numbered. For example, the first trap of the first transect of a grid would be labeled A-1 on the data sheet. Aerial maps of each site are also brought and trapping areas are marked for future reference.

Figure 1. Diagram of a transect grid



Starting in the fall, trapping was modified to focus on areas of each site where small mammal colonization was likely. The 15-trap transect grid method does not always work for the new focus. Transects are now placed in such a manner that the entire focus area is saturated with traps. Distance between traps varied, but the average was 25 ft (7.6 m). This enables fewer traps to be used while increasing the capture rate. Because the focus of this effort is to find *Sigmodon* spp., areas where it would be highly unlikely to find them were not trapped. This still allows ample captures of non-target species that are more general in their habitat preferences. This method was recommended by researchers at UNLV with whom we have a cooperative agreement to study population genetics of the two cotton rat species. Also, in areas where planting has not yet occurred and bare ground and agriculture are the pre-treatment conditions, trapping will occur in adjacent areas when potential *Sigmodon* spp. habitat is present.

Traps were set out in the afternoon and collected the following morning after sunrise. Captured animals were transferred into a clear plastic bag and identified to species. Animals were identified using a key to local small mammal species provided by UNLV, a key included in the Mammals of California field guide (Jameson and Peeters 2004), the Kays and Wilson field guide (2002), as well as the expertise of UNLV researchers. Measurements were taken if needed for identification. A standardized data sheet was used to list all animals captured, where in the grid they were captured, the location of the grid, and what ground cover/macrohabitat was found in

the trapping area. All animals were released back into the trapping area once identification was made. Traps in which an animal had been captured were washed in a bleach water solution and then rinsed in plain water and set out to dry after each trapping day.

Results

A list of scientific and common names for all species captured during this project can be found in Table 1.

Table 1. Scientific and common names of all species captured during project

Scientific Name	Common Name
<i>Sigmodon hispidus eremicus</i>	Yuma hispid cotton rat
<i>Sigmodon arizonae plenus</i>	Colorado River cotton rat
<i>Peromyscus eremicus</i>	Cactus mouse
<i>Peromyscus maniculatus</i>	Deer mouse
<i>Chaetodipus penicillatus</i>	Desert pocket mouse
<i>Dipodomys merriami</i>	Merriam's kangaroo rat
<i>Neotoma albigula</i>	White-throated woodrat
<i>Reithrodontomys megalotis</i>	Western harvest mouse
<i>Sylvilagus audubonii</i>	Desert cottontail
<i>Mus musculus</i>	House mouse

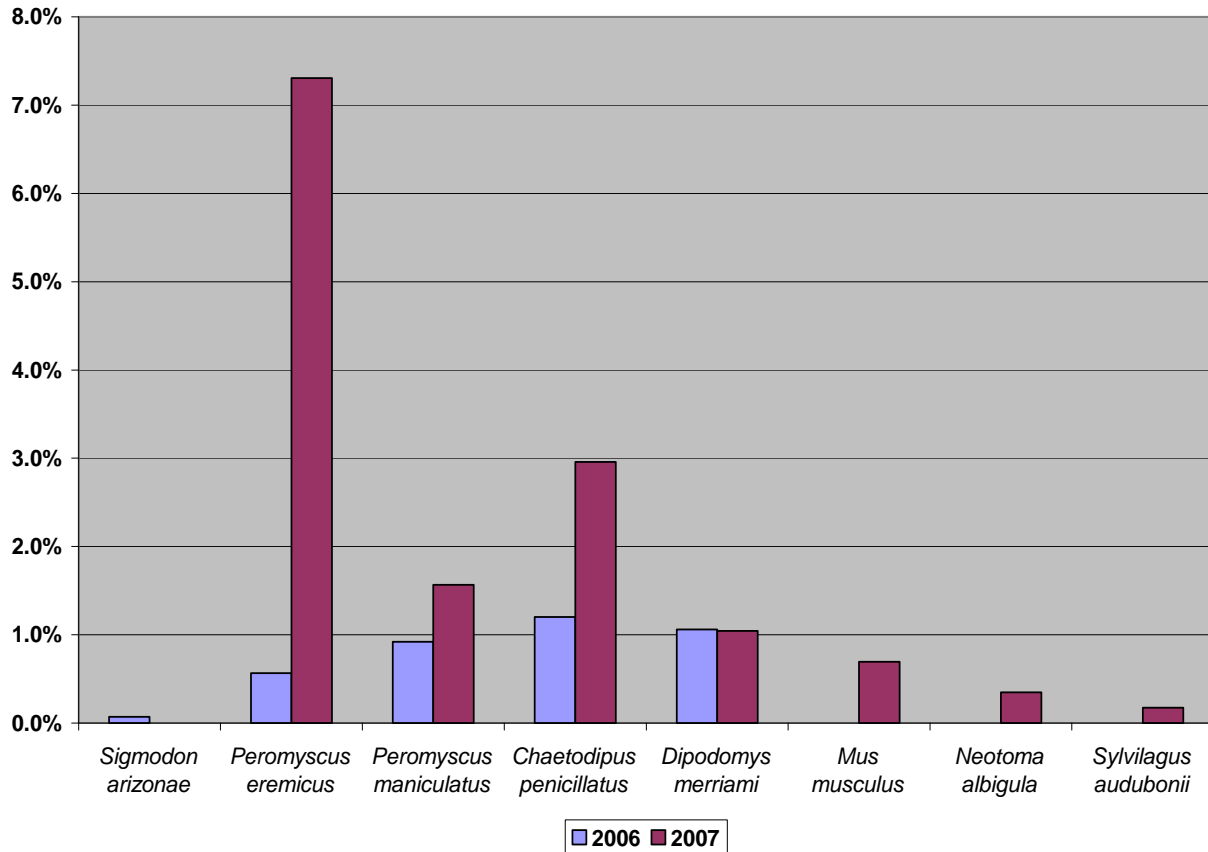
Beal Lake Riparian and Marsh Project

In 2006, 1,415 traps were set out with a total of 55 small mammals captured. In 2007, 575 traps were set out (255 in March, 200 in October, & 120 in November) with a total of 81 small mammals captured (Table 2). No *Sigmodon* spp. were captured in 2007. Arrowweed was the dominant cover where most captures occurred. Seven species were captured in 2007, bringing the total species captured at Beal to eight. Capture rates were higher in 2007 for all but two species. *Dipodomys merriami* (Merriam's kangaroo rat) had almost the same capture rate both years (Figure 2). One new species, *Sylvilagus audubonii* (desert cottontail), was captured in 2007. A total of eight species have now been captured at Beal, with *Peromyscus eremicus* (cactus mouse) being the most commonly captured species.

Table 2. Summary of all captures at Beal

Species	2006	2007	Totals
<i>Sigmodon arizonae</i>	1	0	1
<i>Peromyscus eremicus</i>	8	42	50
<i>Peromyscus maniculatus</i>	13	9	22
<i>Chaetodipus penicillatus</i>	17	17	34
<i>Dipodomys merriami</i>	15	6	21
<i>Mus musculus</i>	0	4	4
<i>Neotoma albigula</i>	0	2	2
<i>Sylvilagus audubonii</i>	0	1	1
unknown species	1	0	1
Totals	55	81	136

Figure 2. Capture rate of all species captured from 2006-2007 at Beal



Palo Verde Ecological Preserve

No *Sigmodon* spp. have been captured at PVER. In 2006, Phase 2 was trapped (195 trap nights) while it was still being farmed for alfalfa with no captures. In the spring of 2007, Phase 2 was

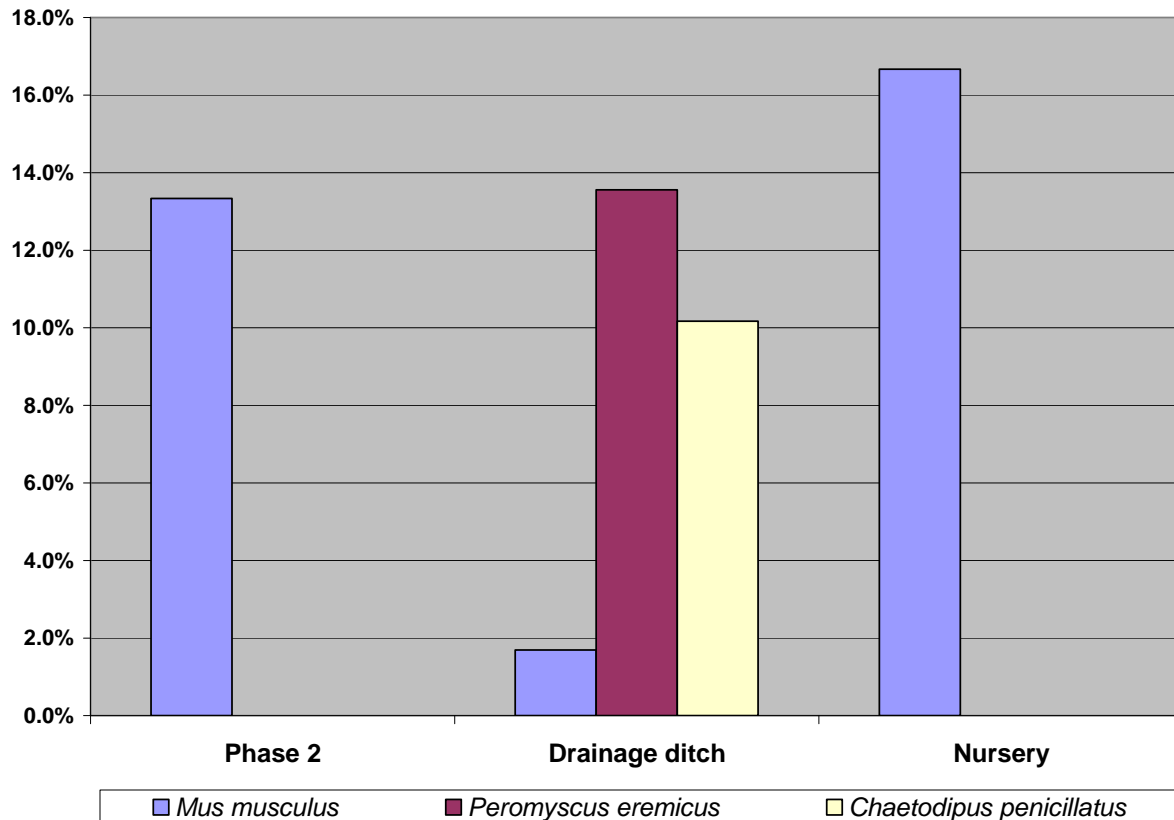
trapped again (255 trap nights) when it was a barren field prior to tree planting, and two *Peromyscus maniculatus* (deer mouse) were captured (Table 2). In the fall of 2007, Phase 2 was trapped (120 trap nights), as well as two additional areas. The edge of a drainage ditch along the west side of Phase 2 was trapped (59 trap nights), and the nursery was also trapped (60 trap nights). A summary of captures in these three areas can be found in Table 3. Of the three areas trapped in the fall, the drainage ditch edge had the most species, and the highest capture rate (Figure 3). The exotic *Mus musculus* (house mouse) was the only species captured in the habitat creation fields. Phase 2 was planted with cottonwood and willow trees with a groundcover of mainly alfalfa. The drainage ditch edge contained dense arrowweed. The nursery area contained two different groundcovers. Three transects (45 traps) were placed in very dense Bermuda grass (*Cynodon dactylon*) where some *Atriplex* spp. had been planted. The other transect (15 traps) was placed where cottonwood and willow trees had been planted with alfalfa as a groundcover. Eight of the ten *M. musculus* captured in the nursery were captured in the single alfalfa transect.

A total of four species have been captured at PVER, with *M. musculus* having the highest number of captures.

Table 3. Summary of all captures at PVER

Species	Phase 2 spring	Phase 2 fall	Drainage ditch	Nursery	Totals
<i>Mus musculus</i>	0	16	1	10	27
<i>Peromyscus maniculatus</i>	2	0	0	0	2
<i>Peromyscus eremicus</i>	0	0	8	0	8
<i>Chaetodipus penicillatus</i>	0	0	6	0	6
Totals	2	16	15	10	43

Figure 3. Comparison of capture rates at three areas in PVER for the fall of 2007



Cibola Valley Conservation Area

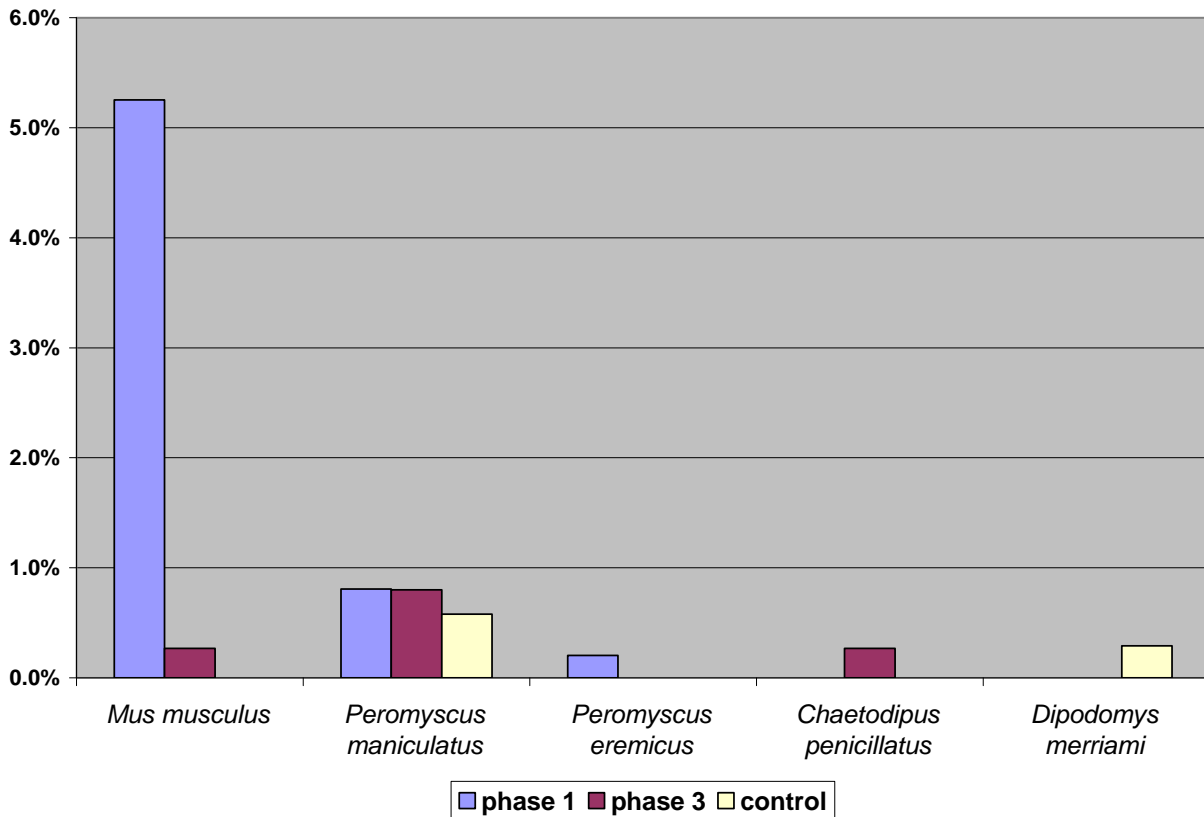
In 2006, trapping was performed in the spring (484 trap nights), right before planting occurred on Phase 1, and then again after the first growing season in the fall (255 trap nights). No *Sigmodon* spp. have been captured at CVCA. Five *P. maniculatus* were captured prior to planting, and only one was captured in the fall. The control alfalfa area was also trapped in 2006 (195 trap nights) with no captures. In the spring of 2007, there were no captures in Phase 1 (300 trap nights), three captures in the control area (300 trap nights), and one capture in Phase 3 pre-planting (150 trap nights). One of the control area captures was a *D. merriami*; all other captures were *P. maniculatus*. In the fall of 2007, there were 31 captures in Phase 1 (195 trap nights), no captures in the control area (45 trap nights), and four captures in Phase 3 (225 trap nights). Three species were captured in Phase 1 (*M. musculus*, *P. maniculatus*, and *P. eremicus*), with *M. musculus* having the most captures (n=26), followed by *P. maniculatus* (n=4), and then *P. eremicus* (n=1). In Phase 3, *M. musculus*, *P. maniculatus*, and *Chaetodipus penicillatus* (desert pocket mouse) were captured, with *P. maniculatus* having the most captures (n=2), while there was one capture each of the other two species. There have now been five confirmed species at CVCA, with *M. musculus* being the most prevalent (Table 4). Capture rates varied between the three areas, with *M. musculus* having the highest capture rate in Phase 1 (Figure 4). The only species to be captured at all three sites was *P. maniculatus*. In Phase 1, seven transects (105

traps) were located in an area where coyote willow had been planted with a groundcover mixture of alfalfa, grasses, and ivyleaf morning-glory (*Ipomoea hederacea*). Six transects (90 traps) were placed in a field where cottonwood had been planted with a groundcover of alfalfa and some grasses. Phase 3 was planted with cottonwood, willow, and *Baccharis* spp. with no cover crop. When trapping took place in the fall, a groundcover containing a variety of grasses and sedges had come in. A total of five species have been captured at CVCA, with *M. musculus* being the most commonly captured species.

Table 4. Summary of all captures at CVCA

Species	2006	2007	Totals
<i>Mus musculus</i>	0	27	27
<i>Peromyscus maniculatus</i>	6	9	15
<i>Peromyscus eremicus</i>	0	1	1
<i>Chaetodipus penicillatus</i>	0	1	1
<i>Dipodomys merriami</i>	0	1	1
Totals	6	39	45

Figure 4. A comparison of capture rates between trapping areas at CVCA for 2007



Cibola NWR Unit 1 Conservation Area

Until this year, only the Nature Trail at Cibola NWR had been trapped for small mammals. The Nature Trail was trapped in 2005, and two species were captured, one of which was *Sigmodon* spp. In 2007, the Nature Trail was trapped again (300 traps), and four additional species were captured (Table 5). Capture rates were highest both years for *Sigmodon* spp. (Figure 5). All trapping at the Nature Trail took place where Johnsongrass and *Baccharis* spp. had created a tall dense groundcover in a mesquite planted area, and a willow planted area. All but one of the *Sigmodon* spp. captures were in the mesquite planted area. Four *Sigmodon* spp. captured in 2007 were taken as voucher specimens, and genetic samples were taken of the other nine for the UNLV study. In the fall, additional trapping took place in three adjacent areas (180 traps) to the Nature Trail. A total of 28 individuals of four species were found in these three areas (Table 6). *Dipodomys merriami* was the only species that had not also been captured at the Nature Trail. Two transects (60 traps) were at a cottonwood-willow mass planting demonstration where mostly Bermuda grass had been established with small patches of Johnsongrass. The second area of trap placement was at the Arnett drainage ditch next to the mass planting area. Two transects (60 traps) were placed on the edges (one on each side) of the ditch where arrowweed and quailbush dominated. The third trapping area was one long transect (60 traps) on the edge of a field known as the Crane Roost, where mesquite, cottonwood and willow had been planted, and an understory of *Baccharis* spp. and quailbush had become established. Only two captures occurred in the mass planting area, all other captures occurred in the other two areas (Table 6). When capture rates between the Nature Trail and the other three locations are compared, the three species that are found in both areas have higher capture rates in the other three locations (Figure 6). These areas however, lack three species found at the Nature Trail, including *Sigmodon* spp. A total of seven species have been captured at Cibola NWR Unit 1, with *C. penicillatus* being the most captured species (Table 7).

Table 5. Summary of all captures at the Cibola NWR Nature Trail

Species	2005	2007	Totals
<i>Sigmodon</i> spp.	7	13	20
<i>Peromyscus maniculatus</i>	5	1	6
<i>Peromyscus eremicus</i>	0	4	4
<i>Chaetodipus penicillatus</i>	0	7	7
<i>Neotoma albigula</i>	0	1	1
<i>Reithrodontomys megalotis</i>	0	1	1
Totals	12	27	39

Figure 5. A comparison of capture rates between years for all species at the Cibola NWR Nature Trail

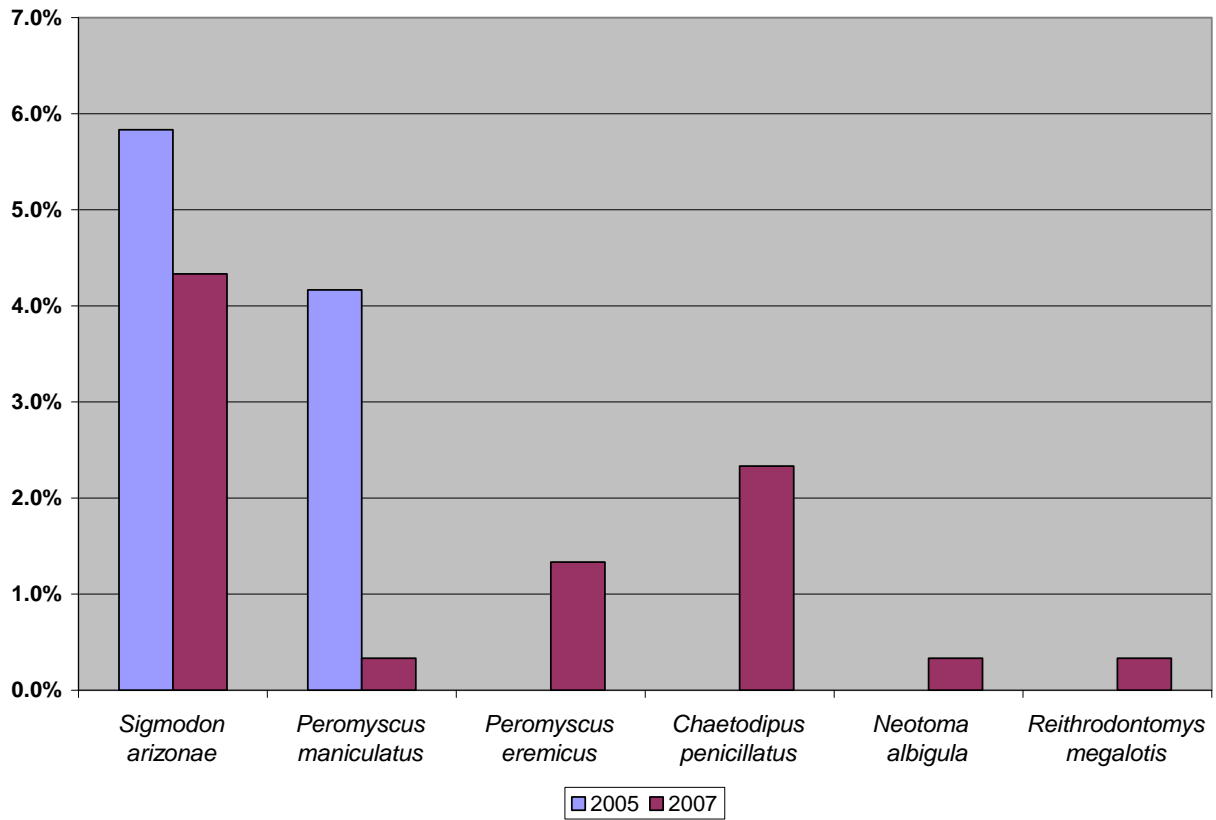


Table 6. Summary of all captures in the three areas adjacent to the Nature Trail

Species	Mass planting	Arnett ditch	Crane Roost	totals
<i>Peromyscus eremicus</i>	1	2	1	4
<i>Peromyscus maniculatus</i>	1	7	3	11
<i>Chaetodipus penicillatus</i>	0	3	9	12
<i>Dipodomys merriami</i>	0	0	1	1
totals	2	12	14	28

Figure 6. A comparison of capture rates between the Nature Trail and other trapping areas at Cibola NWR: 2007

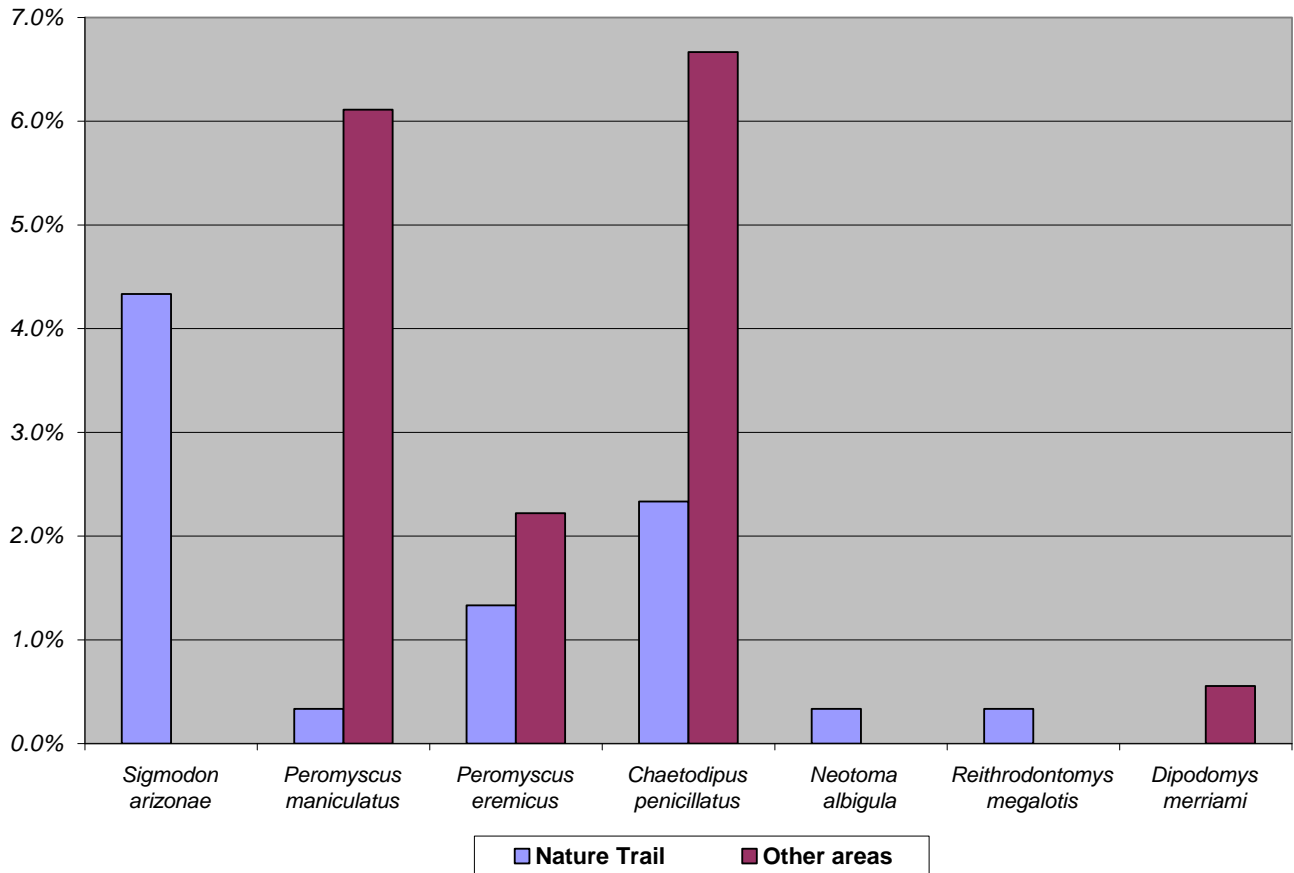


Table 7. Summary of all captures and capture rates at Cibola NWR Unit 1 for 2007

Species	Total captures	capture rate
<i>Sigmodon arizonae</i>	13	2.7%
<i>Chaetodipus penicillatus</i>	19	4.0%
<i>Peromyscus eremicus</i>	8	1.7%
<i>Peromyscus maniculatus</i>	12	2.5%
<i>Neotoma albigula</i>	1	0.2%
<i>Reithrodontomys megalotis</i>	1	0.2%
<i>Dipodomys merriami</i>	1	0.2%
Totals	55	11.5%

Imperial Ponds Conservation Area

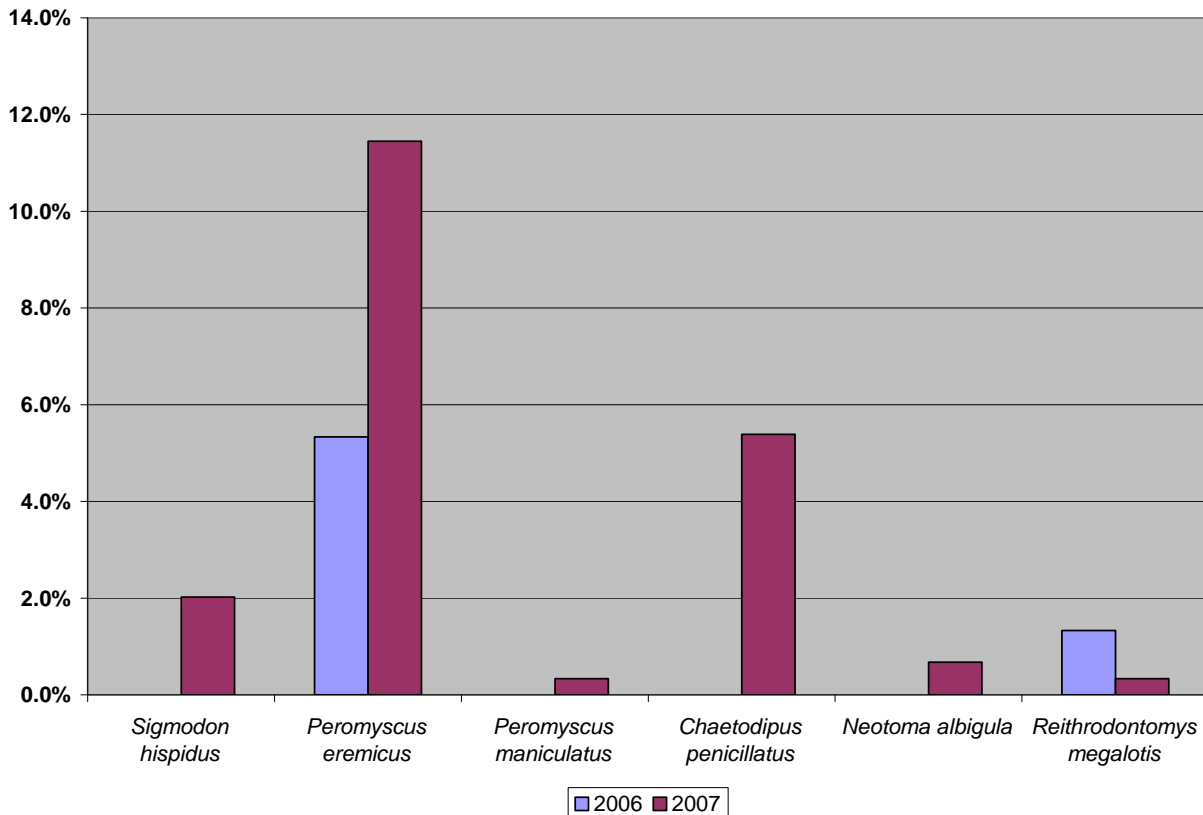
In 2006, 75 total traps were set out at the cottonwood-willow nursery, and an area across the road from the nursery with a total of five small mammals captured. In 2007, a total of 297 traps (149 in March and 148 in October) were set out around the perimeter of most of the conservation area,

and 60 rodents were captured. A total of six species have been captured at this site. A summary of all species captured can be found on Table 8. Capture rates were highest in both years for *P. eremicus* (Figure 7). No *Sigmodon* spp. were captured in 2006, but 6 were captured in 2007. Four adults were captured in the spring and one juvenile was captured in the fall, across the road from the nursery in a dense stand of vegetation dominated by common reed. One additional juvenile *Sigmodon* spp. was captured in the spring across the road from the bare fields in a sparse mixture of common reed, arrowweed, and *Baccharis* spp. Five of the six *Sigmodon* spp. captured had genetic samples taken before being released for the UNLV study. A total of six species have been captured at Imperial, with *P. eremicus* having the most captures.

Table 8. Summary of all captures at Imperial

Species	2006	2007	Totals
<i>Sigmodon hispidus</i>	0	6	6
<i>Peromyscus eremicus</i>	4	34	38
<i>Peromyscus maniculatus</i>	0	1	1
<i>Chaetodipus penicillatus</i>	0	16	16
<i>Neotoma albigula</i>	0	2	2
<i>Reithrodontomys megalotis</i>	1	1	2
Totals	5	60	65

Figure 7. Capture rate of all species captured from 2006-2007 at Imperial



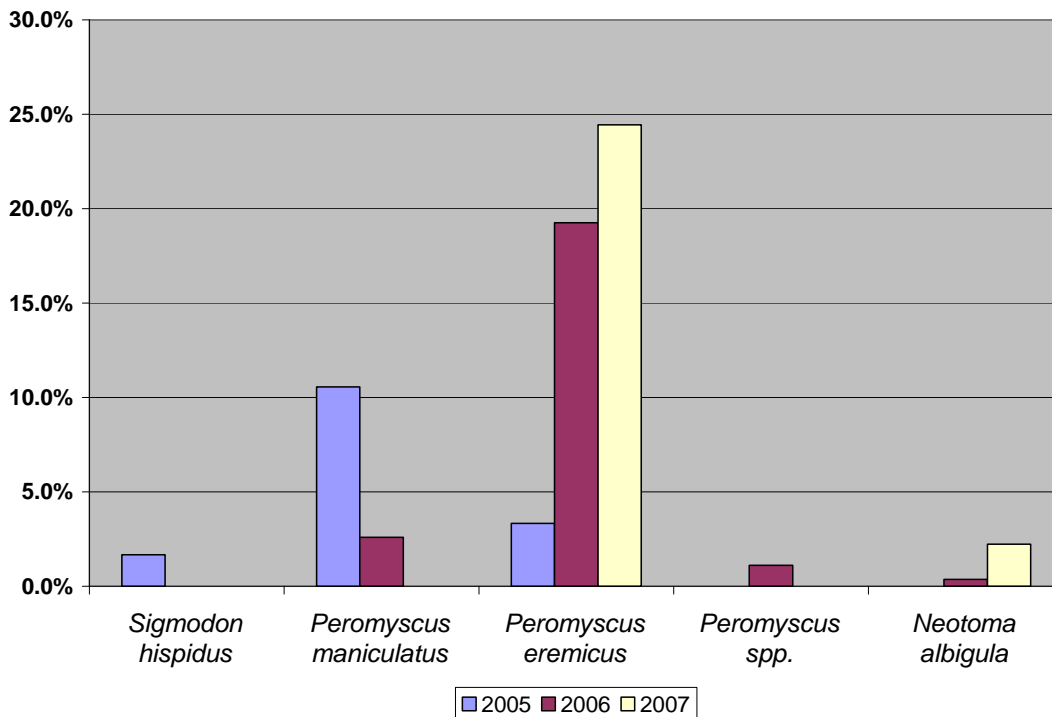
Pratt Restoration Demonstration Site

Pratt was trapped in 2005, 2006, and 2007. A total of 180 traps were set out in 2005, and 270 traps were set out in 2006. In 2007, 45 traps were set out in March. A total of 28 small mammals were captured in 2005, 63 were captured in 2006, and 12 were captured in 2007 (Table 9). A total of 4 species have been captured at this site. Three *Sigmodon* spp. were captured in 2005 and none were captured in 2006, or 2007. *Peromyscus maniculatus* had the highest capture rate in 2005, and *P. eremicus* had the highest capture rate in 2006 and 2007. In 2005, all captures were in a dense stand of *Baccharis* spp. In 2006, captures took place in this same *Baccharis* stand as well as a dense stand of coyote willow. In 2007 all captures were in the *Baccharis* stand. Capture rates were highest for *P. maniculatus* in 2005, and for *P. eremicus* in 2006 and 2007 (Figure 8). A total of four species have been captured at Pratt, with *P. eremicus* being the most commonly captured species. *Sigmodon* spp. has not been captured since 2005.

Table 9. Summary of all captures at Pratt

Species	2005	2006	2007	Totals
<i>Sigmodon hispidus</i>	3	0	0	3
<i>Peromyscus maniculatus</i>	19	7	0	26
<i>Peromyscus eremicus</i>	6	52	11	69
<i>Peromyscus</i> spp.	0	3	0	3
<i>Neotoma albigula</i>	0	1	1	2
Totals	28	63	12	103

Figure 8. Capture rates of all species captured from 2005-2007 at Pratt



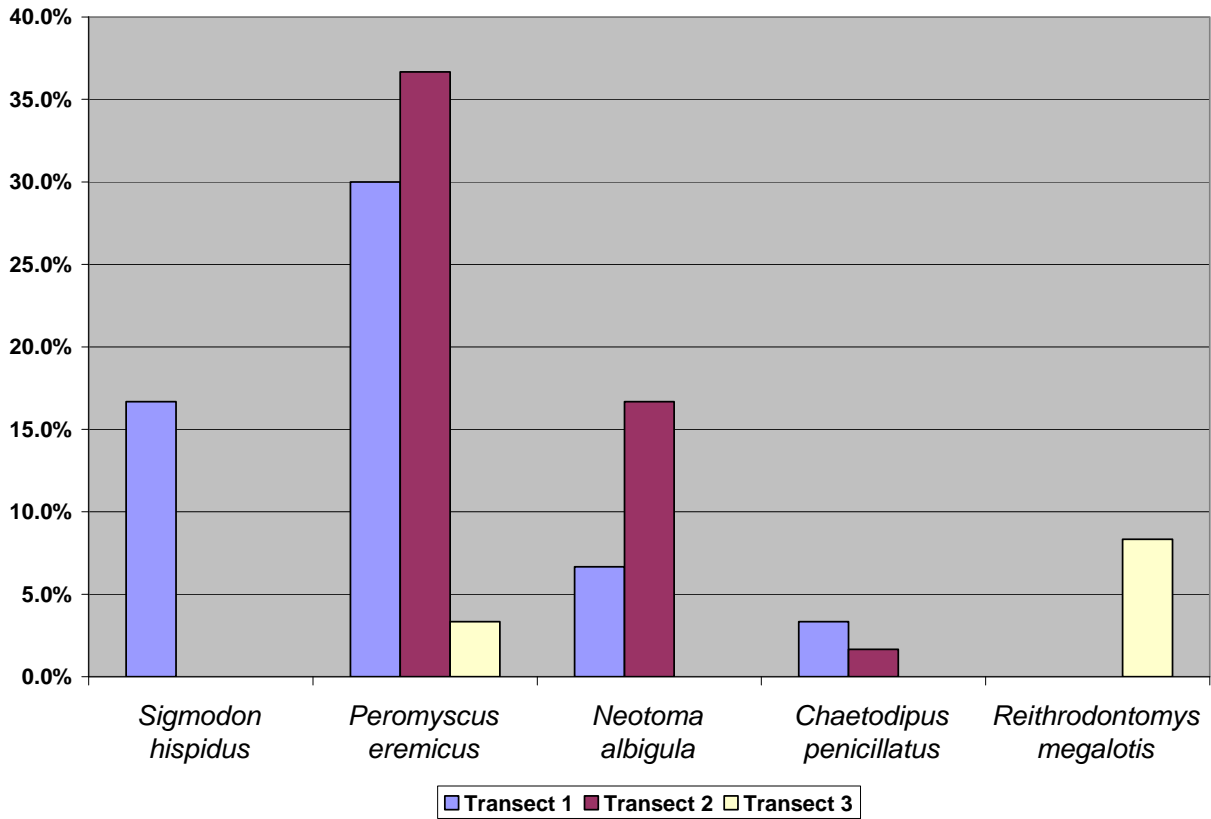
Laguna Dam/Mittry Lake

This was the first time this area has been trapped for small mammals. Because *Sigmodon* spp. had been found at the Pratt site previously, this trapping was done to determine if they still occurred in the area, and if so, to obtain genetic samples from this locale. Transect 1 (30 traps) was the only transect where *Sigmodon* spp. was captured (Table 10). Transect 1 also had the highest species richness of the three transects. Transect 2 (60 traps) had the most captures, with *P. eremicus* being the most commonly captured species. Transect 3 (60 traps) had the least number of captures, however it was the only transect where *Reithrodontomys megalotis* (western harvest mouse) was captured. The highest capture rates for Transects 1 and 2 were for *P. eremicus*, while *R. megalotis* had a higher capture rate in Transect 3 (Figure 9). Transect 1 was placed on the edge of a dense stand of common reed with some *Tamarix* spp. and *Baccharis* spp. mixed in at the very western end of Mittry Lake. Transect 2 was placed on the edge of a dense mixed stand of arrowweed and common reed. Transect 3 was placed in the BLM re-vegetated fields where salt grass, *Tamarix* spp. and Johnsongrass created an understory around the sparse cottonwood-willow pole plantings. A total of five species were captured at this site, with *P. eremicus* having the most captures. Two of the *Sigmodon* spp. were taken as voucher specimens, and the other three had genetic samples taken before being released.

Table 10. Summary of all captures at Laguna Dam/Mittry Lake area

Species	Transect 1	Transect 2	Transect 3	Totals
<i>Sigmodon hispidus</i>	5	0	0	5
<i>Peromyscus eremicus</i>	9	22	2	33
<i>Neotoma albigula</i>	2	10	0	12
<i>Chaetodipus penicillatus</i>	1	1	0	2
<i>Reithrodontomys megalotis</i>	0	0	5	5
Totals	17	33	7	57

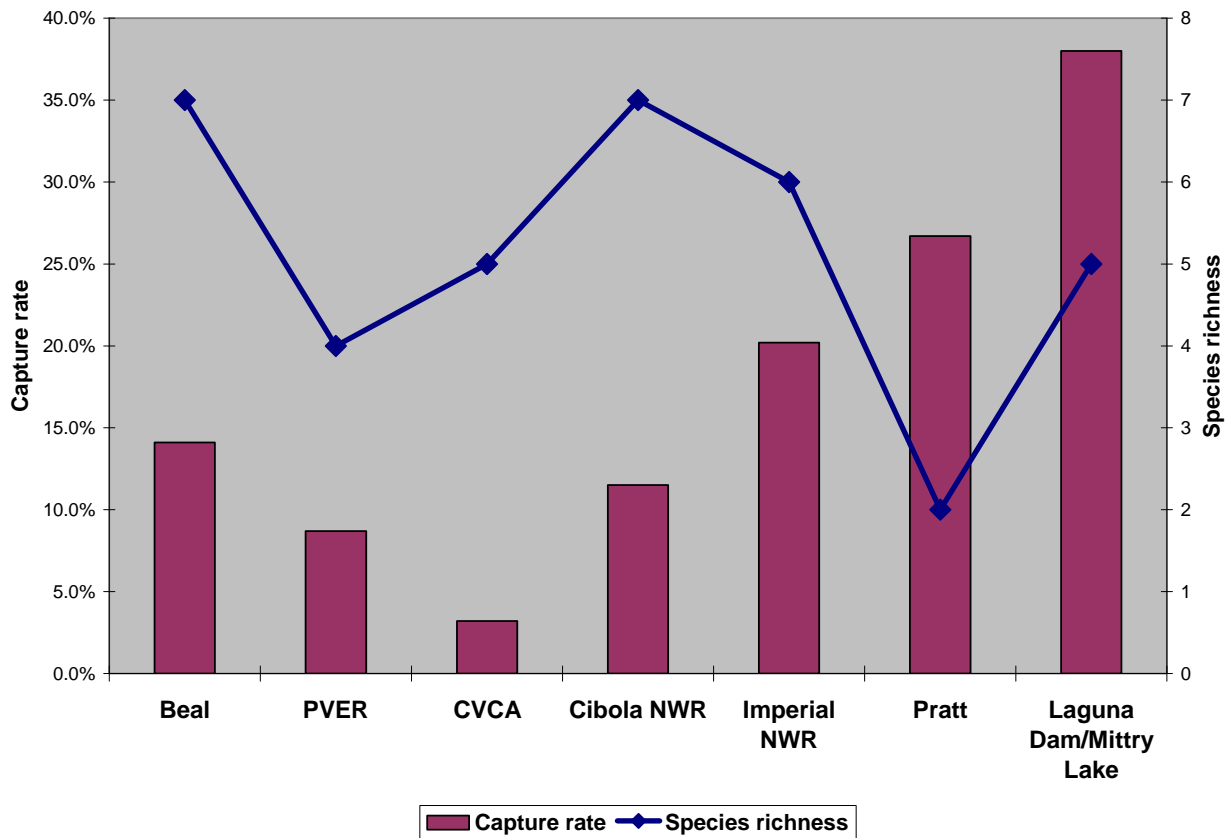
Figure 9. Comparison of capture rates between three areas at Laguna Dam/Mittry Lake



Between-Site Comparison

Cibola NWR and Beal had the highest species richness, while Laguna/Mittry Lake had the highest capture rate of any of the sites (Figure 10). The CVCA had the lowest capture rate, and Pratt had the lowest species richness.

Figure 10. A comparison of species richness and capture rates at all sites trapped in 2007



Discussion

This was the third year of small mammal trapping for Reclamation at habitat creation sites as part of the LCR MSCP (Dodge 2006 and Calvert 2007). Trapping effort has increased each year since the preliminary trapping of 2005. As effort has increased, so has the number of captures, capture rate, and for most sites, the number of species as well. In 2007, the search for *Sigmodon* spp. in and around habitat creation sites became a focus. Since one *Sigmodon* spp. was captured at Beal in 2006, most of the trapping in 2007 at Beal occurred either in the general area, or in similar habitat (dense arrowweed) as where the capture was. This included the edge of the Beal ditch which connects Beal Lake with Topock Marsh. This ditch is across a dirt road from where the capture was, and is thought to be the corridor that the *Sigmodon* spp. was using when it ventured over into the Beal fields. Another area searched away from the fields, was the edge of Beal Lake where cattails occurred, and the water had receded so moist ground was the substrate. Since no further captures were made, it is unknown where the source population of this individual is located. Populations of *Sigmodon* spp. farther south have been found in patches of common reed or Johnsongrass. Common reed has only been seen on Havasu NWR in very thin strips which are not wide enough to be used by *Sigmodon* spp. Johnsongrass has not been found on Havasu NWR. As part of the UNLV study, a thorough survey of the area will be made to find

the population and to obtain genetic samples. One interesting capture at Beal was of a juvenile *S. audubonii*. This species is not normally captured in Sherman traps because of its size, so the capture rate is not a reliable way to predict abundance or proportions of this species in the small mammal assemblage. All other species abundance, excluding *Sigmodon* spp. may also not be correctly represented in these surveys. Reclamation's focus during these surveys has been on the presence or absence of *Sigmodon* spp. Traps were not set out equally among habitat types, and the number of traps varied with the size of available habitat in which *Sigmodon* spp. might be found. Because of this, true comparisons between sites cannot be made in regards to total small mammal assemblages.

At PVER, the nursery and Phase 2 areas do not seem to have the habitat characteristics where we have captured *Sigmodon* spp. as of yet. Because of this, in addition to trapping in the actual habitat creation areas, trapping was conducted at a drainage ditch adjacent to Phase 2, which would be the most likely location where *S. arizonae* would colonize from if they occur in the area. Because of the steepness of the ditch bank, traps were only able to be placed on the top edge. Since there was no *Sigmodon* captures, it is unknown whether there is a population in the area. The presence of *M. musculus* is not surprising, since most of the land in the area is agricultural fields. It is interesting to note that only one *M. musculus* was found along the drainage ditch, and no native small mammals were found in the nursery or Phase 2. While the ditch is manmade, the vegetation is much closer to natural conditions in the area. As time goes on at the habitat creation sites, it is hoped that they will gradually become more inviting to native small mammals, especially for *Sigmodon* spp.

At CVCA, findings were similar to PVER. Phase 1 at CVCA has one more growing season than Phase 2 at PVER, which may be why there were some *P. maniculatus* as well as *M. musculus* in the fields. Phase 3 at CVCA was planted the same time as Phase 2 at PVER, but found a small difference in species composition. Three different species were found at Phase 3, though numbers were low for all species. The main difference between these two sites is that at PVER, a cover crop of alfalfa was planted when the trees were put in the ground, and at Phase 3 at CVCA, no cover crop was planted but a dense groundcover of various grasses and sedges became established. This probably more closely matches what would happen if a stand of cottonwood-willow came in naturally in an area. This may aid the colonization of small mammals, especially that of *Sigmodon* spp.

At Cibola NWR, the Nature Trail has been monitored both in 2005 and 2007. Presence of *Sigmodon* spp. was found in 2005. In 2007, the large numbers of captures confirmed that a population continues to use the site. This was also the highest number of captures of *Sigmodon* spp. at any of the sites. After trapping this year in adjacent areas, it is still unknown where they colonized from. The trapping effort at the Arnett ditch was similar to the ditch at PVER, with trapping being confined to the upper edges of the steep bank. This ditch may be the colonizing source for the Nature Trail, but they may stay lower down near the waters edge. This same ditch travels south through the Island Unit of the refuge where Anderson and Nelson (1999) trapped *Sigmodon* spp. previously on a re-vegetation area. The three areas that were trapped adjacent to the Nature trail are also part of the Unit 1 Conservation Area, where habitat creation will be conducted in the coming years as part of the LCR MSCP. Trapping effort at these three areas is a

baseline for what small mammals to expect in the area and to determine whether *Sigmodon* spp. occur elsewhere in the conservation area.

At Imperial NWR, trapping is similar to the new areas trapped at Cibola NWR in that they are baseline surveys of habitat adjacent to where habitat creation will occur. The fact that *Sigmodon* spp. is present in these areas is important to note, because once planting has taken place, we will know when/if colonization happens in the habitat creation areas. The only habitat that *Sigmodon* spp. seems to be found in the conservation area is where large dense stands of common reed occur. Usually some other vegetation like *Baccharis* spp. can be found in these stands as well. In 2008, trapping effort will continue to increase and focus on areas where *Sigmodon* spp. may be found.

At Pratt this year, effort was reduced because of the change in habitat where *Sigmodon* spp. was once found. The dense *Baccharis* spp. stand where they were found in 2005 had grown large enough that rather than having a dense understory, there was a sparse understory below the dense mature *Baccharis* spp. Also this site has had problems with getting a consistent irrigation schedule. After a few years of possibly no water on the site, some areas of the site including the *Baccharis* spp. stand had begun to turn brown and dieback was occurring. It is assumed that *Sigmodon* spp. no longer occupies this site and trapping will no longer be performed unless habitat characteristics change enough to suggest re-colonization. This effort will now be moved to the new re-vegetation areas that BLM planted this year which was trapped along with the Laguna Dam/Mittry Lake trapping.

Sigmodon hispidus was trapped utilizing transects at the Laguna Dam/Mittry Lake area. Like Imperial, the habitat where they were found was dominated by common reed with some other species mixed in. Because they were found here, and previously at the Pratt site, it is assumed that *Sigmodon* spp. occupies any appropriate habitat in the vicinity of Laguna Dam, and Mittry Lake. The vegetation in the new BLM re-vegetated areas may have been too recent for colonization to occur this year. This area had patches of Johnsongrass and salt grass which had become established and irrigation appeared adequate for ground cover species to continue to grow. Since the cottonwood and willow poles were planted fairly sparsely, this may end up aiding the type of herbaceous understory which *Sigmodon* spp. prefers. Trapping will be conducted here again in 2008 to determine if *Sigmodon* spp. will colonize from the surrounding areas. While captures were low in this re-vegetated area, it was interesting that more *R. megalotis* were found than *P. eremicus*. *Reithrodontomys megalotis* is known to prefer grassland habitats in other areas, and is often found to co-exist with *Sigmodon* spp., even using their runways (Webster and Jones 1982). Single captures have occurred at the Cibola NWR Nature Trail and at Imperial NWR. While *R. megalotis* is not usually found in abundant numbers, it may still prove to be an indicator that the habitat is becoming more like what *Sigmodon* spp. may prefer.

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