Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Post-Development and System Monitoring of Rodent Populations: 2012–2014

U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

February 2016

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Lower Colorado River Multi-Species Conservation Program

Post-Development and System Monitoring of Rodent Populations: 2012–2014

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ACRONYMS AND ABBREVIATIONS

BBCA	Big Bend Conservation Area
BLCA	Beal Lake Conservation Area
BLM	Bureau of Land Management
Cibola Nature Trail	Cibola National Wildlife Refuge Unit #1 Nature Trail
CRCR	Colorado River cotton rat (*Sigmodon arizonae plenus*)
DPMO	desert pocket mouse (*Chaetodipus penicillatus sobrinus*)
GPS	Global Positioning System
ha	hectare(s)
Havasu NWR	Havasu National Wildlife Refuge
LCR	lower Colorado River
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
MEFF	mobile electronic field form
NAU	Northern Arizona University
PIT	passive integrated transponder
PVER	Palo Verde Ecological Reserve
UTM	Universal Transverse Mercator
YHCR	Yuma hispid cotton rat (*Sigmodon hispidus eremicus*)

Symbols

#	number

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Attachment

1 Example Data Sheet

ABSTRACT

The Bureau of Reclamation is the lead agency for the Lower Colorado River Multi-Species Conservation Program (LCR MSCP). Implementing the LCR MSCP will create at least 8,132 acres of new habitat (5,940 acres of cottonwood-willow (*Populus fremontii*, *Salix gooddingii*), 1,320 acres of honey mesquite (*Prosopis glandulosa*), 512 acres of marsh, and 360 acres of backwater) and produce 660,000 subadult razorback suckers and 620,000 bonytails to augment the existing populations of these fish in the lower Colorado River. Twenty-six Federal or State-listed candidate and sensitive species and their associated habitats, ranging from aquatic and wetland habitats to riparian and upland areas, are covered under the LCR MSCP. This includes the Colorado River cotton rat (*Sigmodon arizonae plenus*) (CRCR) and Yuma hispid cotton rat (*Sigmodon hispidus eremicus*) (YHCR). The desert pocket mouse (*Chaetodipus penicillatus sobrinus*) (DPMO) is being evaluated to determine if it should be added as a covered species. The presence of CRCR, YHCR, and DPMO at existing habitat along the lower Colorado River and at LCR MSCP conservation areas was monitored under LCR MSCP Work Task D10 (System Monitoring of Rodent Populations) and LCR MSCP Work Task F3 (Small Mammal Colonialization of Conservation Areas). Trapping included in this report occurred in eight restoration sites and seven system-wide survey sites from spring 2011 to fall 2014. CRCR were captured at all restoration sites within the species' range (Big Bend Conservation Area [BBCA], Beal Lake Conservation Area [BLCA], Palo Verde Ecological Reserve [PVER], Cibola Valley Conservation Area, and Cibola National Wildlife Refuge Unit #1 Conservation Area). DPMO were captured at the BBCA, BLCA, PVER, and Hunters Hole. YHCR were captured at Yuma East Wetlands.

INTRODUCTION

The Lower Colorado River Multi-Species Conservation Program (LCR MSCP) is a partnership of Federal and non-Federal stakeholders that was created to respond to the need to balance the use of lower Colorado River (LCR) water resources and the conservation of native species and their habitats in compliance with the Endangered Species Act. It is a long-term (50-year) plan to conserve at least 26 species along the LCR from Lake Mead to the Southerly International Boundary with Mexico through implementation of a Habitat Conservation Plan. Implementation of the LCR MSCP began in October 2005. Implementing the LCR MSCP will create at least 8,132 acres of new habitat (5,940 acres of cottonwood-willow (*Populus fremontii*, *Salix gooddingii*) 1,320 acres of honey mesquite (*Prosopis glandulosa*), 512 acres of marsh, and 360 acres of backwater) and produce 660,000 subadult razorback suckers and 620,000 bonytails to augment the existing populations of these fish in the LCR.

Twenty-six Federal or State-listed candidate and sensitive species and their associated habitats, ranging from aquatic and wetland habitats to riparian and upland areas, are covered under the LCR MSCP. This includes the Colorado River cotton rat (*Sigmodon arizonae plenus*) (CRCR) and Yuma hispid cotton rat (*Sigmodon hispidus eremicus*) (YHCR). The desert pocket mouse (*Chaetodipus penicillatus sobrinus*) (DPMO) is being evaluated to determine if it should be added as a covered species. Of the habitat to be created, 125 acres (50.6 hectares [ha]) have been designated for CRCR, and 76 acres (30.8 ha) have been designated for YHCR. It is currently believed that the range of these two species does not overlap. Those captured south of the Trigo and Chocolate Mountains in the area of the Imperial National Wildlife Refuge and south to the Yuma, Arizona, area to date are YHCR. Those captured north of the aforementioned mountain ranges to date are CRCR. The northernmost historic records of CRCR are from an area just south of Laughlin, Nevada (Hall 1946; Bradley 1966). Currently, the Bureau of Reclamation (Reclamation) has not found this species farther north than Havasu National Wildlife Refuge (Havasu NWR) near Needles, California.

DPMO occur in creosote bush and xeric riparian communities of the southwest, from Baja California, Mexico, in the south and southeastern California, southern Nevada, and extreme southwest Utah in the North. The range of the *sobrinus* subspecies is not well documented. Its range along the LCR is assumed to be in Reaches 1–3, from Lake Mead south to Parker Dam.

Reclamation is increasing its understanding of restoration science through an adaptive management approach; therefore, monitoring of habitat creation/ restoration sites is crucial. Species presence at existing habitat along the LCR and at LCR MSCP conservation areas (see figure 2) is being monitored under LCR MSCP Work Task D10 (System Monitoring of Rodent Populations) and Work Task F3 (Small Mammal Colonialization of Conservation Areas). In addition,

LCR MSCP Work Task C27 (Small Mammal Population Studies) is being conducted to identify distribution, genetics, and habitat requirements, and to establish monitoring protocols for the covered small mammal species.

METHODS

Trapping methods were designed to capture cotton rats. Sherman live traps (3 x 3.75 x 12 inches) were placed non-randomly in areas with the highest likelihood of encountering cotton rat species, which generally consist of a dense understory of grasses and/or shrubs alongside or beneath an overhead cover of forbs and low-growing woody species (LCR MSCP Work Task C27) (Goertz 1964). Once the optimal areas were sampled, less than optimal habitat generally consisting of sparse grasses or bare ground underneath mesquite (*Prosopis* spp.) and other overhanging vegetation was sampled. In general, if the overall trapping area is fairly homogenous with appropriately dense vegetation structure, the trapping grid begins on a corner or edge. If a distinctly denser vegetation area is found within an otherwise more open area, the trapping grid will begin in the denser habitat patch. These surveys were focused on determining only the presence of cotton rat species. All other captures were incidental to the main focus, and, therefore, the numbers of individuals of each species (including cotton rats) reported here should be interpreted with caution.

Sherman live traps are triggered by the animal stepping on a pressure plate that then closes a trap door behind the animal. 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. Traps were set 1 to 2 hours before sunset, and pulled within 1 to 2 hours of sunrise during the warmer months to minimize heating of the traps during the trapping period.

When the habitat patch allowed, traps were set out in a grid of at least three transects approximately 50 feet (15 meters) apart. Each transect consisted of at least five trap stations spaced approximately 33 feet (10 meters) apart. Trap spacing may have varied if the more densely vegetated areas were dispersed across the trapping area. For data collected in 2012 and spring 2013, a Universal Transverse Mercator reading (North American Datum 83) was taken with a Global Positioning System (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 (figure 1). This enabled the grid to be replicated and to determine an approximate location of a noteworthy capture in the future.

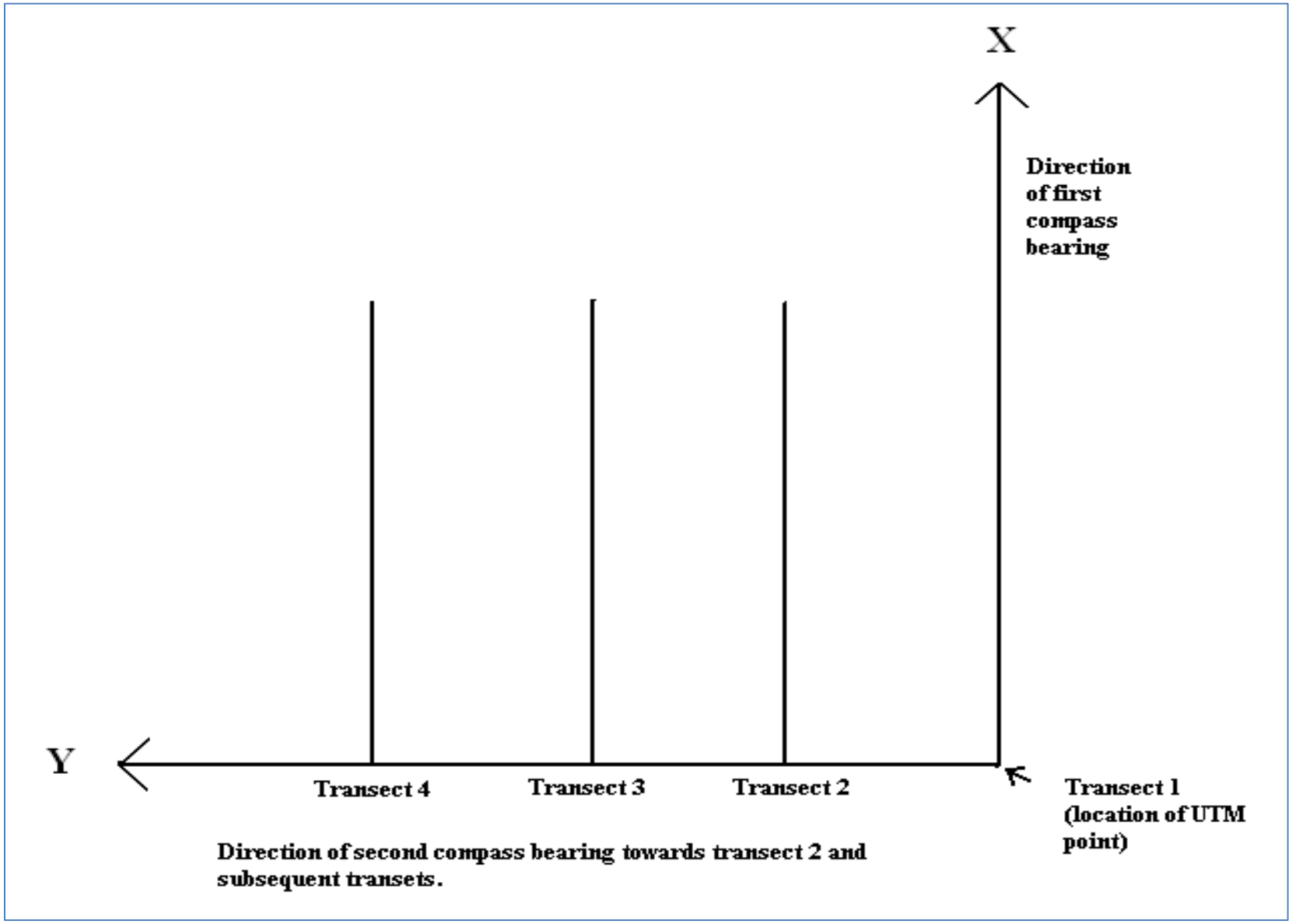


Figure 1.—Diagram of a transect grid.

Study Areas

Habitat Conservation Areas

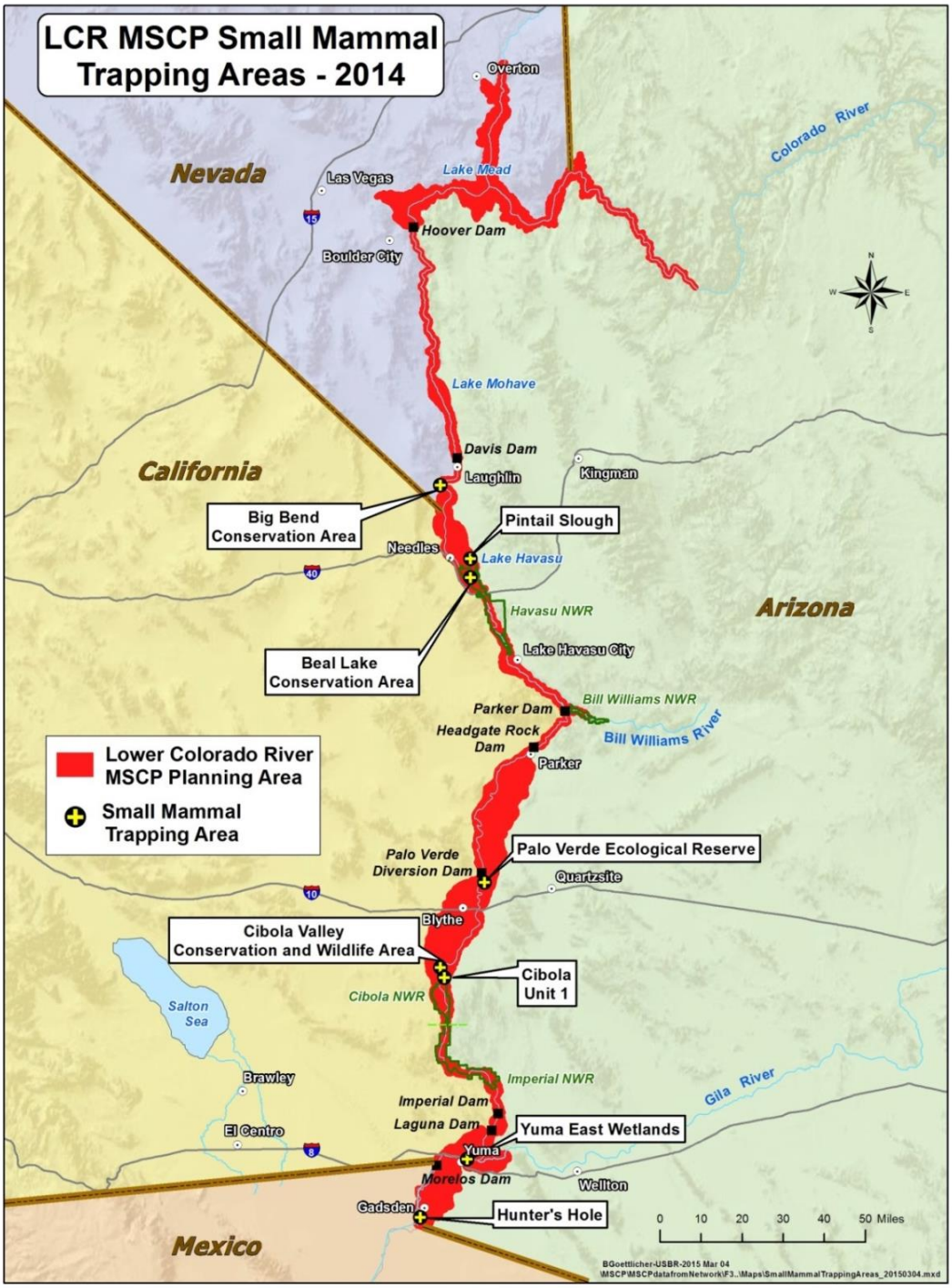


Figure 2.—LCR small mammal trapping areas.

When the habitat patch with the highest density vegetation was more linear, transects were not set in a grid system. If only a single linear stretch of habitat was trapped, a single transect was set along the edge of the habitat patch – this usually meant that the transect was much longer than in the typical grid system (15 or more trap stations).

In 2012 and 2013, the number of traps per station was changed from a single trap to two traps within 1 meter of each other at each trap station within a transect. This was done to better align the trapping method for these presence surveys with the trapping method of a mark-recapture study that was concurrently being conducted at some of the same trapping areas. For consistency, it was decided that all transects should have two trap stations. This was implemented fully in 2014.

Beginning in the fall of 2013, the approximate location of each trap was recorded using a Trimble Juno GPS unit running a mobile electronic field form (MEFF) using the software Terrasync while traps were collected the following morning. Each transect was labeled by a letter, and each trap was numbered. For example, the first trap station of the first transect of a grid would be labeled A-1, and if there were two traps at that location, they were designated as trap A-1-a and A-1-b on the data sheet. Data are entered by hand on paper data sheets and electronically using MEFFs.

Captured animals were either viewed from inside the trap or transferred into a clear plastic bag and identified to species. Animals were identified using the Mammals of California field guide (Jameson and Peeters 2004) and the Kays and Wilson field guide (Kays and Wilson 2002) as well as the expertise of LCR MSCP personnel that had more than 3 years of experience conducting surveys. Cotton rats were given an age class based on three general size classes (adult, subadult, and juvenile). The age classes were based on the general size of the individual using the experience of LCR MSCP personnel present during the survey. Gender was also determined for cotton rats. All other species were only given an age class of either adult or juvenile, and gender was not determined. Measurements were taken if needed for identification. When the *Sigmodon* sp. was captured for LCR MSCP Work Task C27 (Small Mammal Population Studies), a passive integrated transponder (PIT) tag was placed subcutaneously. This mark-recapture method allows for estimation of survival rates and demographic parameters. A standardized data sheet was used to list all animals captured, whether they were PIT tagged or marked, where in the grid they were captured, the location of the grid, and what the dominant ground cover vegetation was in the trapping area. All of the exact same data were also recorded within the MEFF file on the Trimble GPS unit. 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.

Big Bend Conservation Area

The Big Bend Conservation Area (BBCA) is located in Nevada 5 miles south of Laughlin, Nevada, along the Needles Highway (figure 3). The site is within Reach 3. The site includes 15 acres of backwater, as well as 15 acres of habitat, comprised of a marshy strip of cattails (*Typha* spp.) leading into a drier strip of arrowweed (*Pluchea sericea*) and baccharis (*Baccharis salicifolia*). The majority of the small mammal captures were located at the interface of a grassy area comprised of dallis grass (*Paspalum dilatum*) and bushy bluestem (*Andropogon glomeratus*) with the upland shrubs.

Figure 3.—Big Bend Conservation Area.

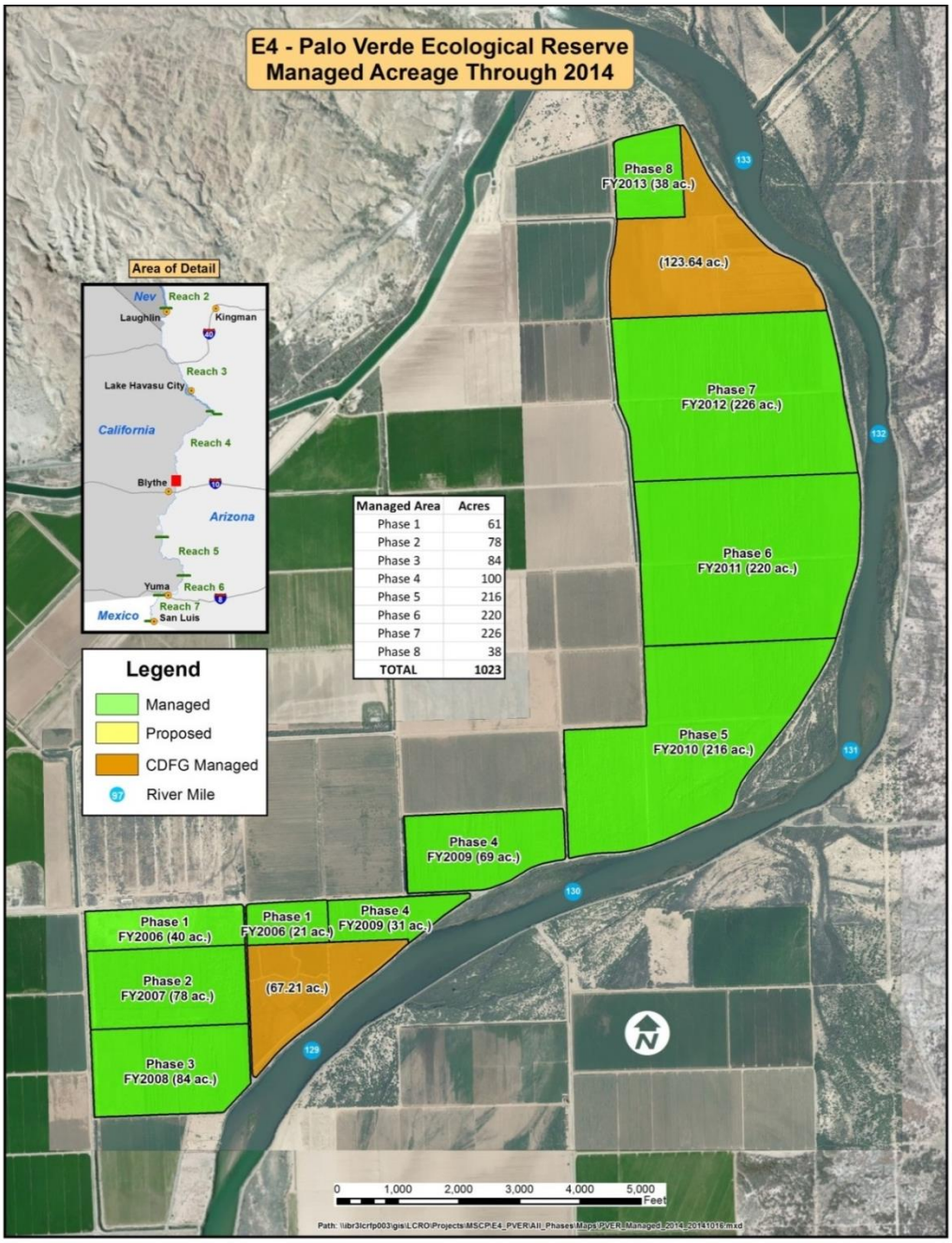
Beal Lake Conservation Area

The Beal Lake Conservation Area (BLCA) is 100 acres adjacent to Beal Lake and Topock Marsh, inside the Havasu NWR on the Arizona side of the Colorado River (figure 4). The site is within Reach 3. It is a two-phase habitat creation project that was initiated in spring 2003. The site was planted with cottonwoods, Goodding's willows, coyote willows (*Salix exigua*), honey mesquite, and screwbean mesquite (*Prosopis pubescens*). Currently, the site contains areas of all tree species listed above. Arrowweed and some baccharis have begun to fill in the open areas and edges of most of the plots in the site.

Figure 4.—Beal Lake Conservation Area.

Palo Verde Ecological Preserve

The Palo Verde Ecological Preserve (PVER) is located about 5 miles (8 kilometers) north of Blythe, California, along the California side of the Colorado River (figure 5). The site is within Reach 4. It encompasses 1,300 acres (526 ha). The acreages are separated into nine different phases, with one phase planted every year through 2014 (see figure 4). In the spring of 2006, a 31-acre (12.5-ha) nursery (phase 1) was planted. In the spring of 2007, phase 2 was planted with 80 acres (32.4 ha) of cottonwood, willow, and other riparian plants. Phase 3 was planted in the spring of 2008 and is also planted with cottonwood-willow habitat types. Phase 4 was planted in 2009 and contains mostly cottonwood-willow with one plot of mesquite and a mix of native grasses. Phases 5, 6, and 7 were planted in 2010, 2011, and 2012 with cottonwood-willow habitat. Phase 8 was planted in 2013 with 38 acres (15.4 ha) of mesquite and quailbush (*Atriplex lentiformis*) habitat.



Managed Area	Acres
Phase 1	61
Phase 2	78
Phase 3	84
Phase 4	100
Phase 5	216
Phase 6	220
Phase 7	226
Phase 8	38
TOTAL	1023

Figure 5.—Palo Verde Ecological Reserve.

Cibola Valley Conservation Area

The Cibola Valley Conservation Area is located in Arizona adjacent to the Colorado River, about 15 miles (24 kilometers) south of Blythe, California (figure 6). The site is within Reach 4. It will encompass about 1,235 acres (500 ha) when completed. Three phases include cottonwoods, Goodding's willows, coyote willows, 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 over 80 acres (32 ha) of cottonwood-willow planted in different combinations (see figure 5). Phase 3 also includes 11 acres (4.5 ha) of baccharis mixed with some cottonwood and willow. Phase 2 was planted in the spring of 2008. Most of phase 2 is planted with cottonwood-willow habitat, with one small area of honey mesquite and quailbush. Phase 4 was planted in 2009 with mesquite and quailbush. Phase 5 was planted in 2010 with 71 acres (28.7 ha) of mesquite-quailbush. Phase 6 was planted in 2011 with 89 acres (36 ha) of mesquite-quailbush.

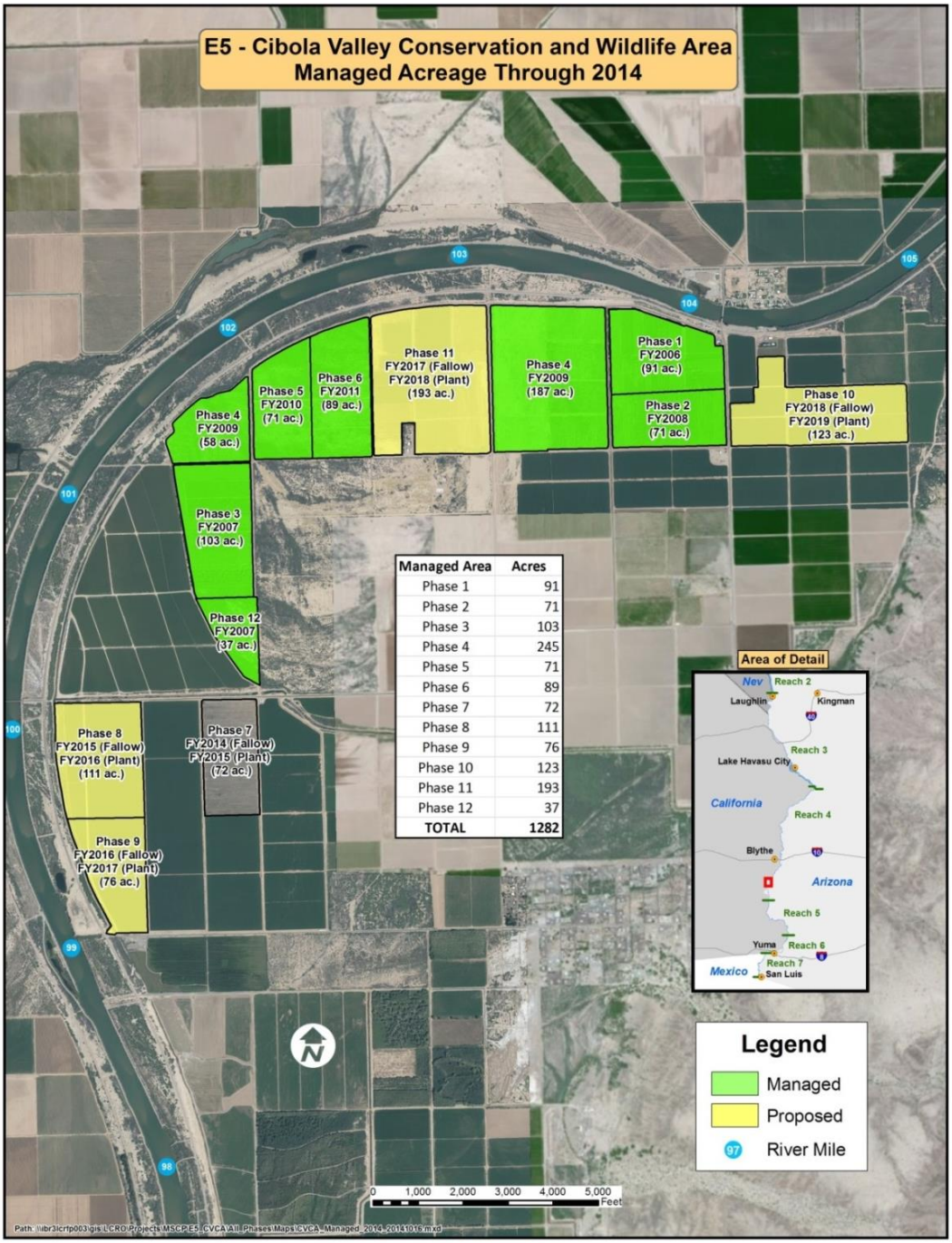


Figure 6.—Cibola Valley Conservation Area.

Cibola National Wildlife Refuge Unit #1 Conservation Area

The Cibola National Wildlife Refuge is located approximately 30 miles south of Blythe, California, along 12 miles of the LCR in Arizona and California (see figure 2). The site is within Reach 4. The refuge is divided into six management units, of which Unit #1 comprises approximately 949 acres (figure 7).

The Cornfield Nature Trail was planted in 1999 with 34 acres (13.8 ha) of cottonwood-willow and mesquite habitat. The central portion of the site is a mix of dense Johnsongrass (*Sorghum halapense*) and baccharis. The Cottonwood Genetics study field was planted in 2007 with cottonwoods as part of a Northern Arizona University (NAU) study. The field has a sparse canopy structure, and in the open areas, dense patches of Johnsongrass have come in.

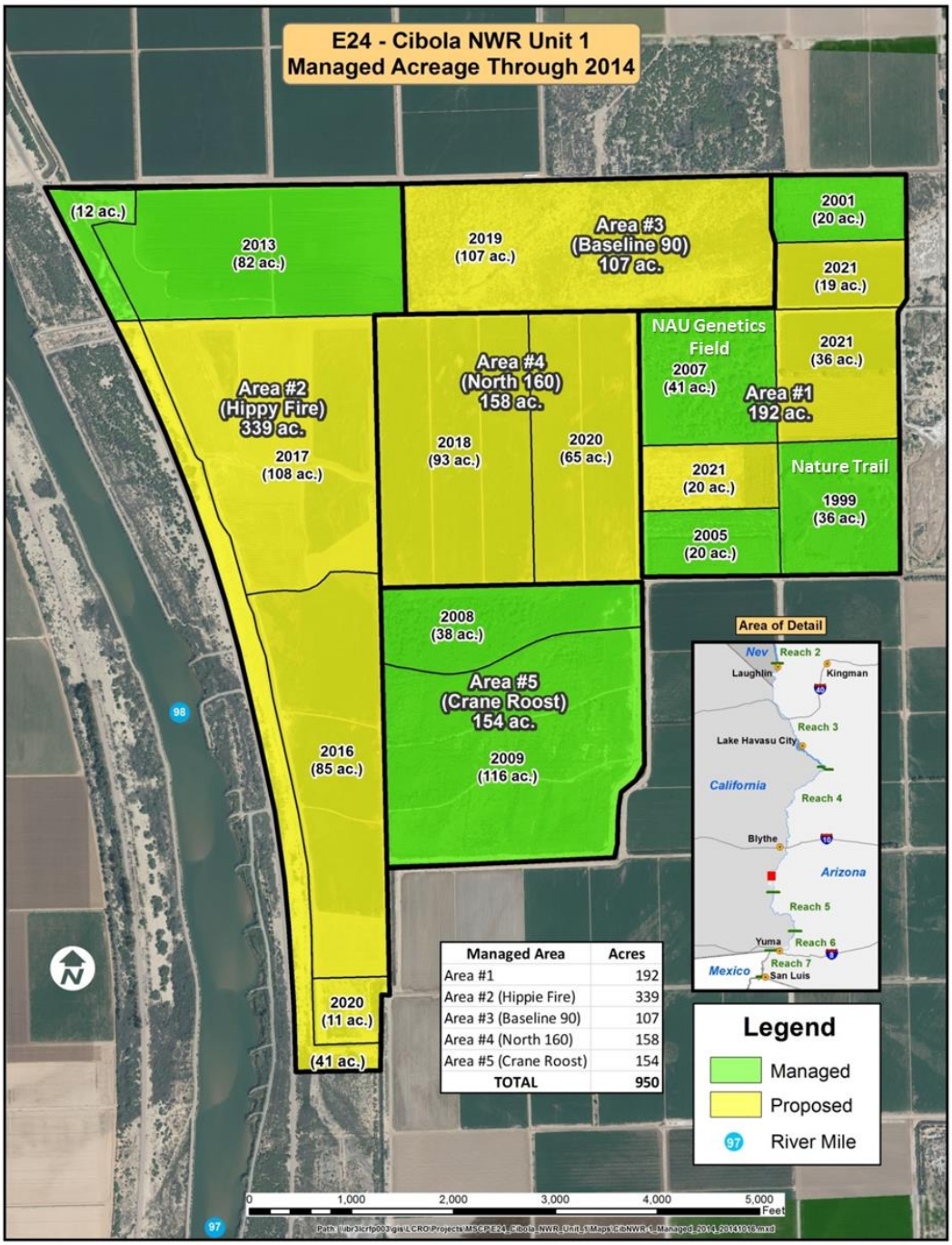


Figure 7.—Cibola National Wildlife Refuge Unit #1 Conservation Area.

Yuma East Wetlands

Yuma East Wetlands is a 392-acre site owned by the Quechan Indian Tribe, the city of Yuma, and the Arizona Game and Fish Department. The site is within Reach 6. The site is located within the city of Yuma, Arizona (see figure 2). Habitat restoration activities began in Yuma East Wetlands in 2004. The majority of the planting took place in 2009, including 115 acres (46.5 ha) of cottonwood-willow habitat, 102 acres (41.3 ha) of marsh habitat, and 175 acres (158.6 ha) of mesquite habitat (figure 8). In 2013, the LCR MSCP entered into partnership with the Quechan Indian Tribe, city of Yuma, Arizona Game and Fish Commission, and Yuma Crossing National Heritage Area to support the long-term management of the site. In 2014, the bankline portion of the site was cleared of invasive vegetation and replanted with native vegetation. The site contains many open canopy areas that allow for a healthy variety of shrub and grass species necessary for YHCR colonization.

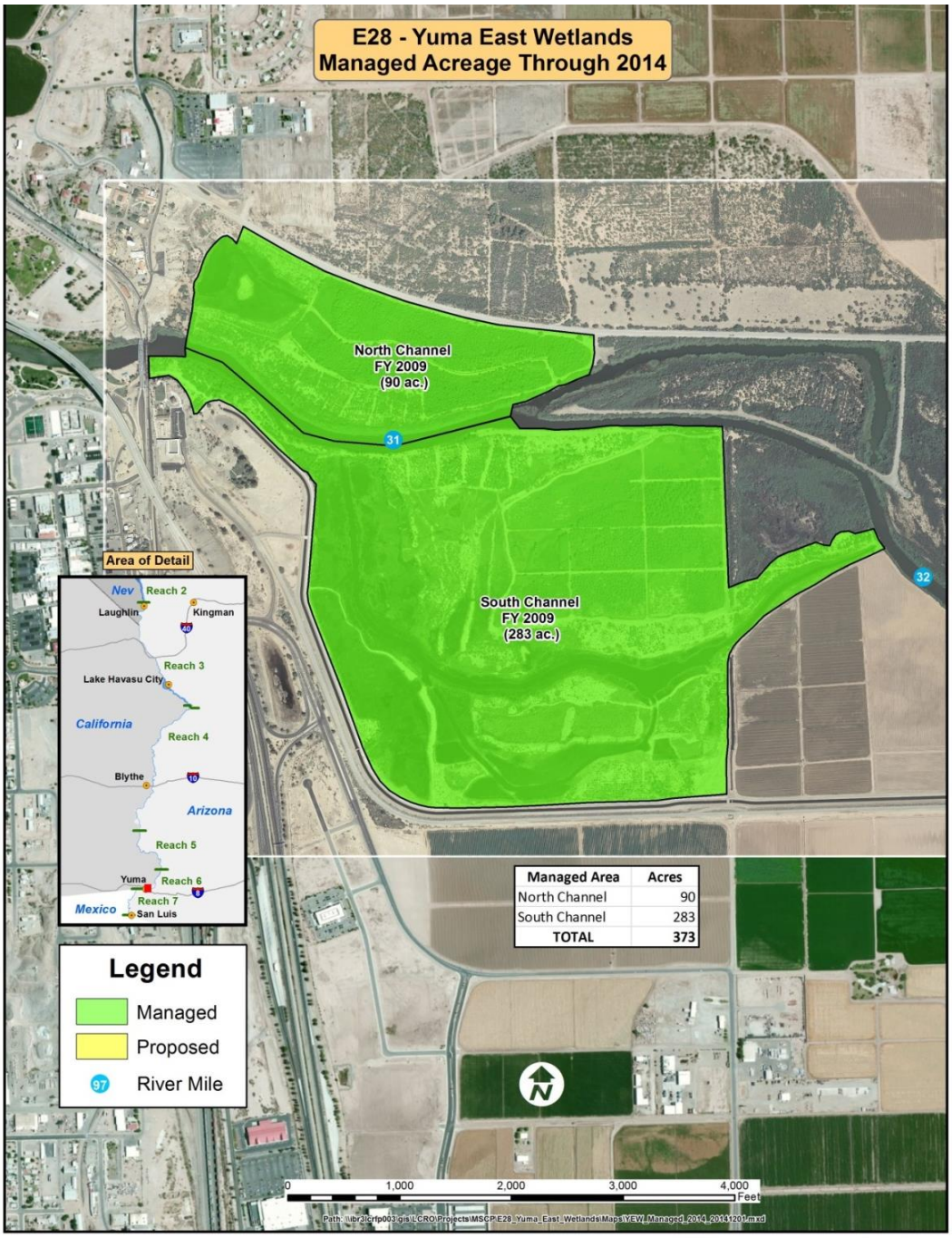


Figure 8.—Yuma East Wetlands.

Hunters Hole

Hunters Hole is located near the community of San Luis, 18 miles south of Yuma, Arizona (see figure 2). The site is within Reach 6. The LCR MSCP added the site to the program in 2011. The site was planted in spring 2012 with approximately 44 acres (17.8 ha) of habitat (figure 9), in three cover types: cottonwood-willow, honey mesquite, and marsh.

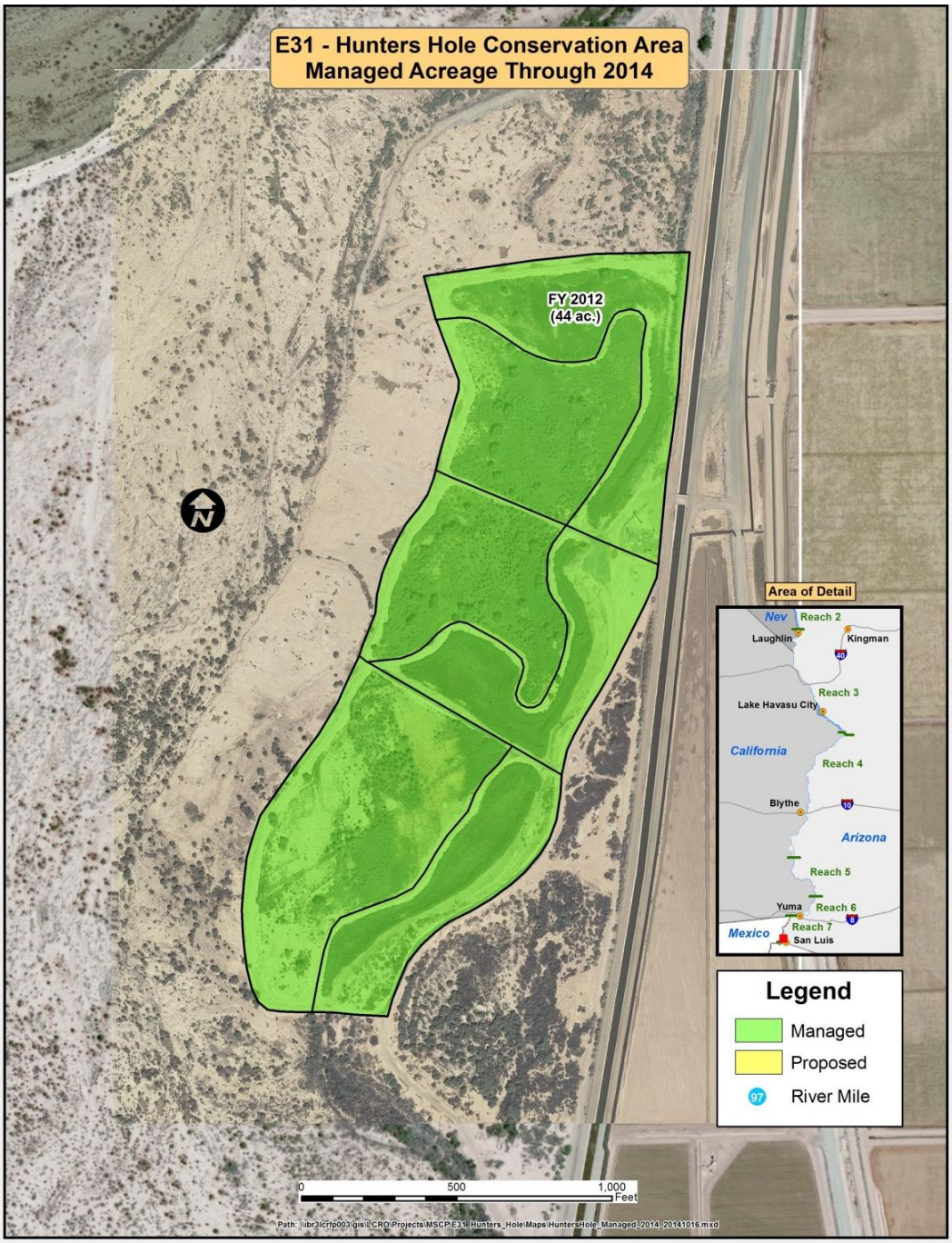


Figure 9.—Hunters Hole

System Monitoring Areas

Pintail Slough

Pintail Slough is located in the southeastern portion of the Havasu NWR. The site is within Reach 3. When the Pintail Slough trapping area was first established, the vegetation consisted of a dense area of Mexican devil weed (*Chlorocantha spinosa)* intermixed with Johnsongrass and Bermuda grass (*Cynodon dactylon*). Over time, the grass areas died back, and little to no new growth of either grass was apparent. During this time, the Mexican devil weed area became much drier, but the shrubs appeared to still be alive. This area is not currently being irrigated by the U.S. Fish and Wildlife Service and only receives water during rainfall events.

Kohen Ranch

Kohen Ranch is located on the Bill Williams River National Wildlife Refuge. The site is within Reach 4. This area had been planted with mesquite by the U.S. Fish and Wildlife Service and now primarily has Bermuda grass as an understory within most of the site. However, there is a small patch of Mexican devil weed in one area.

Ehrenberg Southwestern Willow Flycatcher Site

This site is within an area a few miles south of Ehrenberg, Arizona. The site is within Reach 4. It contains dense areas of baccharis interspersed with cottonwood and willow trees. It is located directly east of the levee road that runs along the edge of the Colorado River.

Mittry Lake – Betty's Kitchen Restoration Area

This area contains two areas that were revegetated with native species on Bureau of Land Management (BLM) land adjacent to Betty's Kitchen Recreation Area. The site is within Reach 6. One area, known as the Pratt Agricultural Lease Restoration Area, was originally planted by Reclamation. A fire had burned part of the site, and BLM has conducted some revegetation efforts in the burned area. Next to this area, BLM has an additional revegetation project that is primarily cottonwood and willow, but it has larger, more open areas of shrubs and grasses that have established due to irrigation of the site.

Gila Valley – Laguna Dam

This area immediately downstream from Laguna Dam is dominated by common reed (*Phragmites*) with some baccharis shrubs interspersed. The site is within Reach 6. This area is just south of Betty's Kitchen Recreation Area and is accessed by walking along Laguna Dam.

Gila River

This area is located just east of where Highway 95 crosses the Gila River along a side channel of the river. The site is within Reach 6. The area consists of some baccharis shrubs with a dense ground cover of bulrush (*Scirpus* spp).

West Highline Canal

The West Highline Canal is located on the western edge of the Imperial Valley in California. The site is within Reach 5. Adjacent to the canal are areas of dense common reed interspersed with the occasional baccharis shrub.

Limitrophe Area in the Yuma Valley

The Limitrophe Area is the section of the Colorado River south of Morelos Dam and north of the Mexico border. The site is within Reach 6. Within this section, an area approximately 2.5 miles (4 kilometers) north of Hunters Hole was surveyed. The site was dominated by common reed with some arrowweed and/or baccharis shrubs occasionally interspersed.

RESULTS

Habitat Conservation Areas

Big Bend Conservation Area

The majority of the small mammal captures occurred at the interface of a grassy area comprised of blue grass (*Poa* sp.) and bushy bluestem (*Andropogon glomeratus*) with baccharis shrubs (see figures 10–12). The area was first trapped in 2012, which produced the first CRCR captured in Nevada since 1966 (Bradley 1966). Nine species have been captured at the site (table 1). CRCR have been captured every season surveyed. High numbers of DPMO were caught during the 2012 and 2013 fall survey sessions.

Table 1.—Summary of small mammal surveys at the Big Bend Conservation Area

Species	Spring 2012	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Colorado River cotton rat	4	3	2	3	1	1
Desert pocket mouse	0	48	4	58	5	14
Brown rat	0	0	0	1	0	0
Cactus mouse	6	14	8	46	7	16
Deer mouse	2	0	0	0	0	0
Grasshopper mouse	0	0	1	0	0	0
Harvest mouse	0	0	0	0	0	1
Spotted skunk	0	0	0	3	0	1
White-throated wood rat	3	2	3	1	0	0
Total captures	**15**	**67**	**18**	**112**	**13**	**33**
Traps/nights	30/1	110/2	29/2	120/2	80/1	120/1

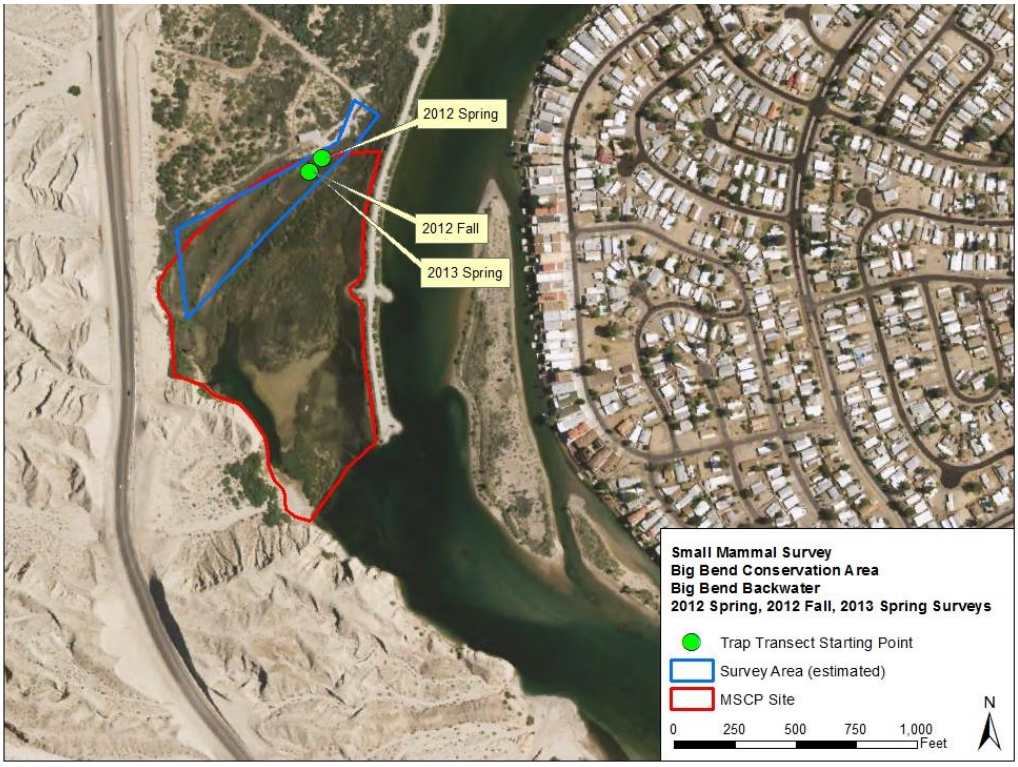


Figure 10.—Survey areas at the Big Bend Conservation Area, spring 2012 through spring 2013.

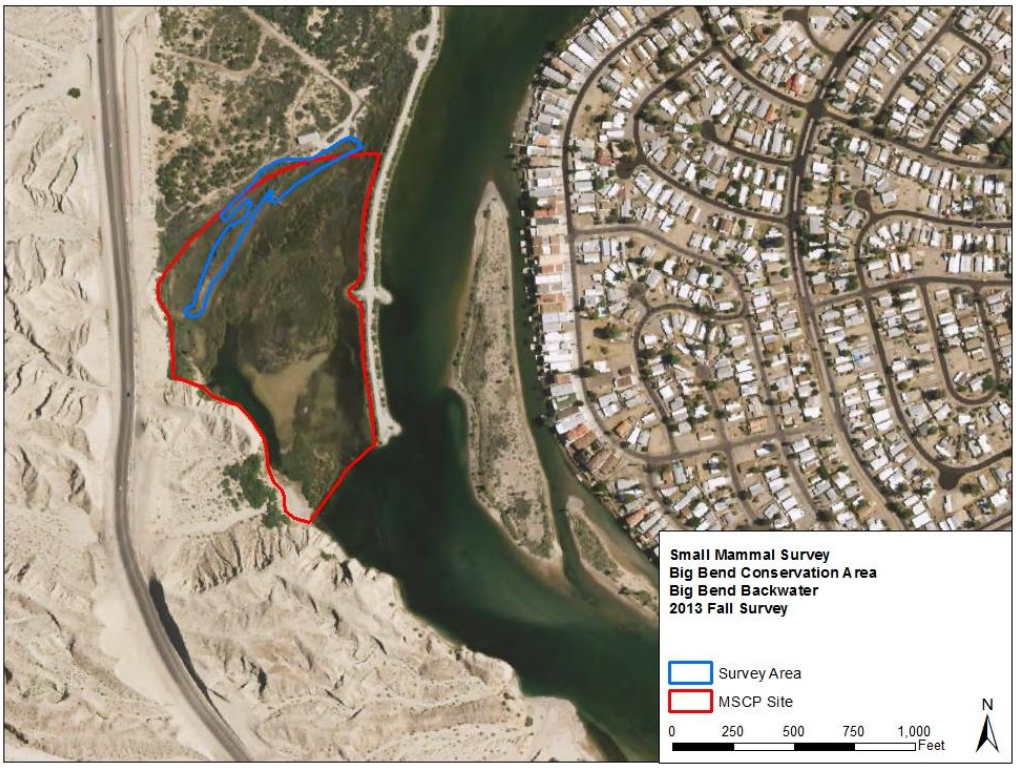


Figure 11.—Survey areas at the Big Bend Conservation Area, fall 2013.

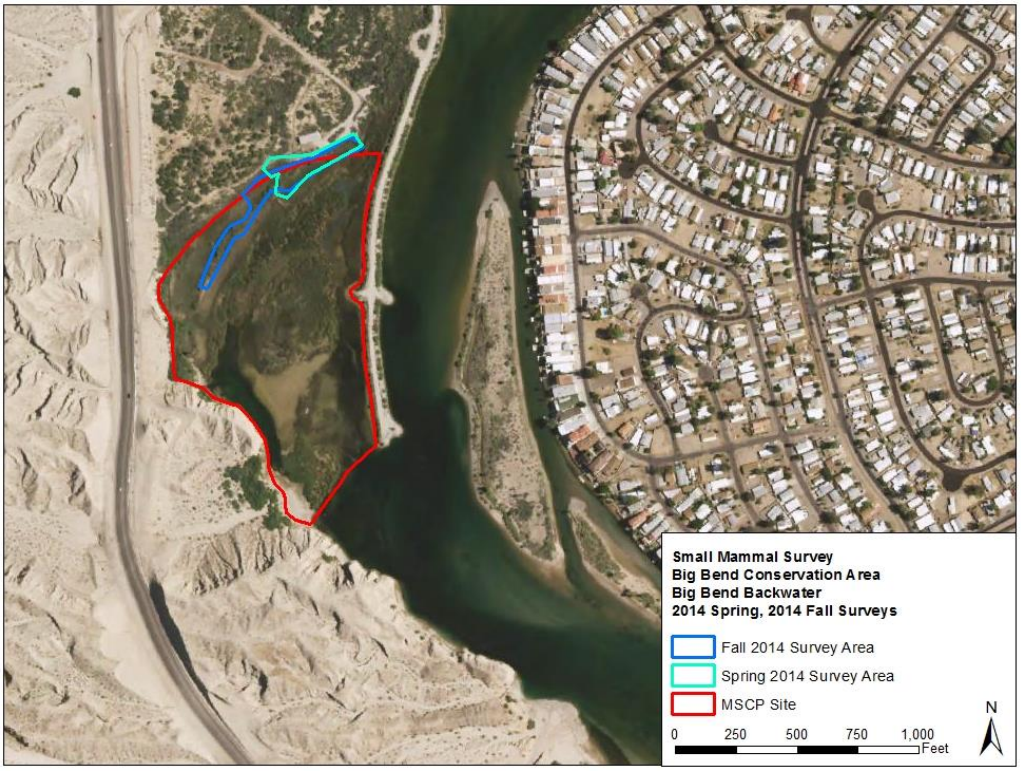


Figure 12.—Survey areas at the Big Bend Conservation Area, spring and fall 2014.

Beal Lake Conservation Area

Beal Cell F contains a small patch of grass that has produced CRCR in prior years of trapping (see figures 13–15). Six species have been captured at the site (table 2). The patch is small and increasingly dominated by arrowweed, and it has produced no CRCR captures in recent years. DPMO have been captured in all years except spring 2013.

Table 2.—Summary of small mammal surveys at Beal Lake Conservation Area

Species	Spring 2012	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Colorado River cotton rat	1	1	0	0	0	0
Desert pocket mouse	3	1	0	1	1	0
Cactus mouse	1	1	0	4	2	3
Harvest mouse	3	0	0	1	0	0
House mouse	0	1	0	0	0	0
Merriam's kangaroo rat	0	0	0	1	0	0
Total captures	**8**	**4**	**0**	**7**	**3**	**0**
Traps/nights	55/1	40/1	60/1	60/1	60/1	60/1

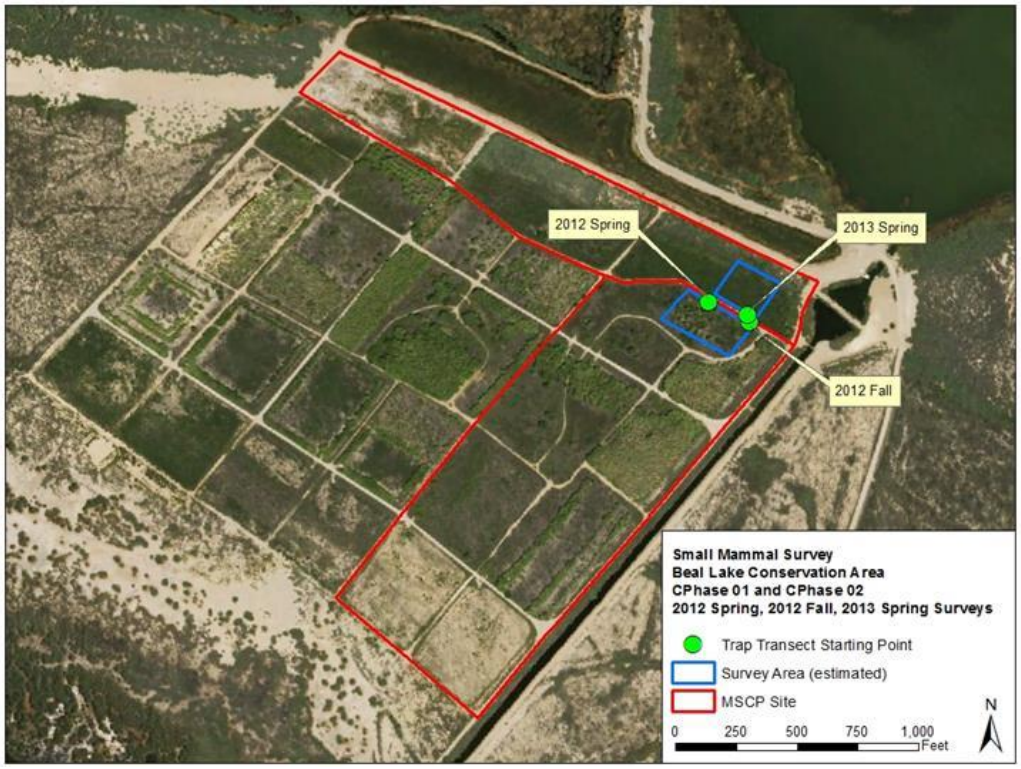


Figure 13.—Survey areas at the Beal Lake Conservation Area, spring 2012 through spring 2013.

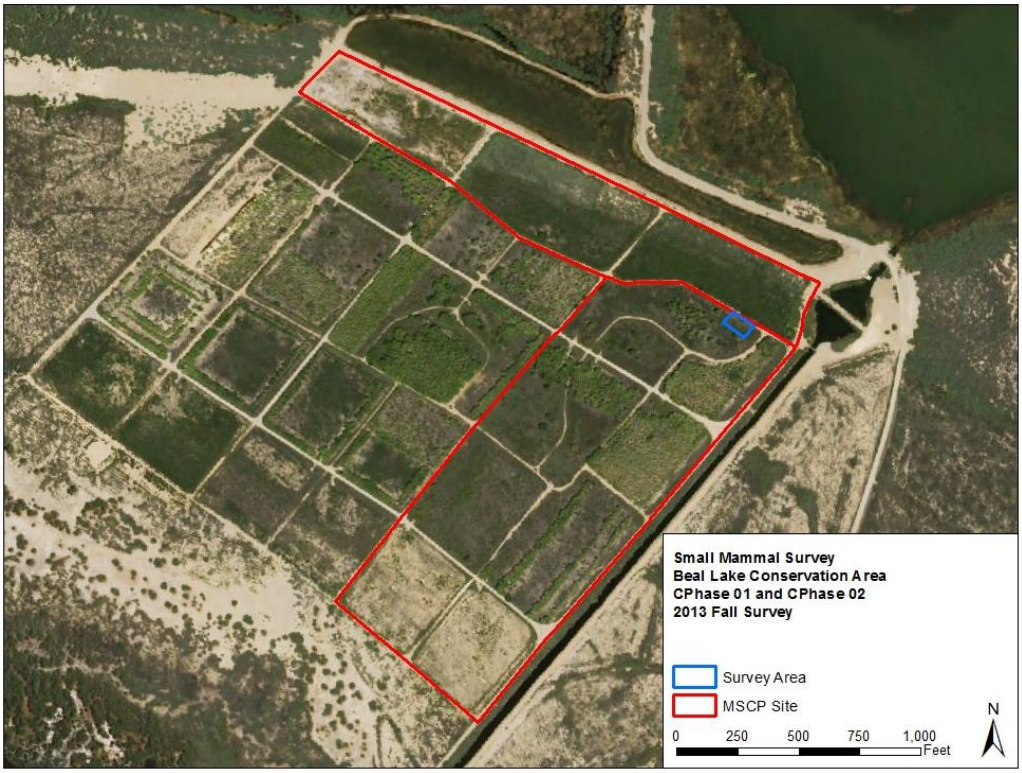


Figure 14.—Survey areas at the Beal Lake Conservation Area, fall 2013.

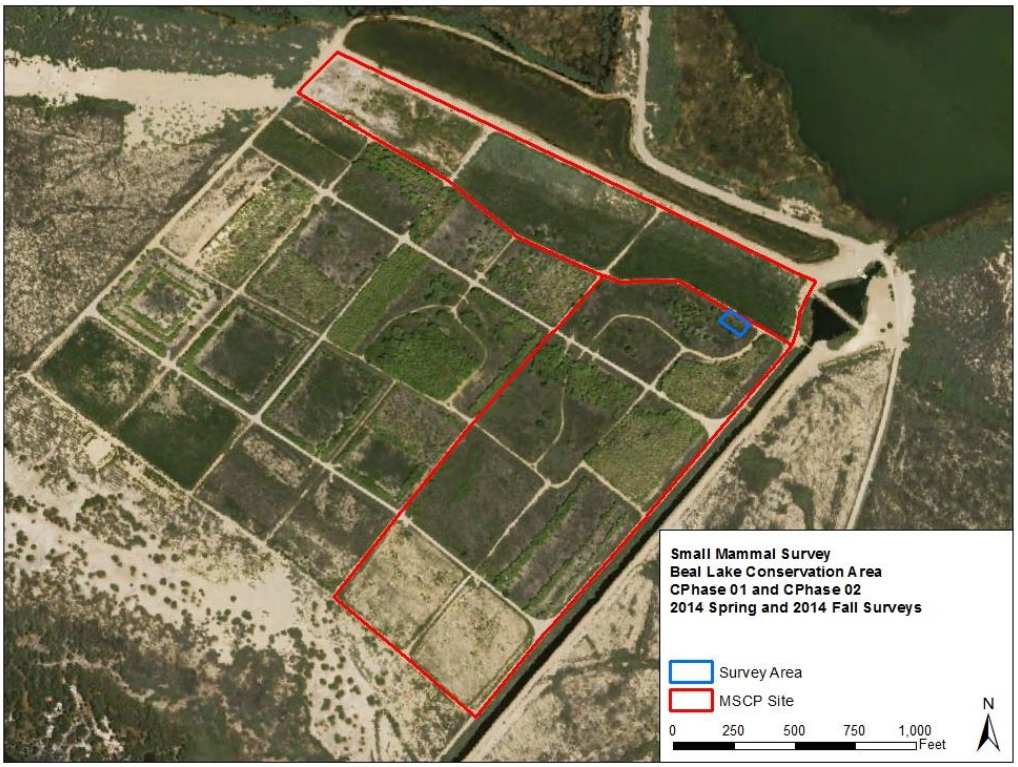


Figure 15.—Survey areas at the Beal Lake Conservation Area, spring and fall 2014.

Palo Verde Ecological Reserve

The PVER has been trapped since 2007. The site consists of multiple planting phases with a variety of habitat types (see figures 16–25). All areas trapped contained a grass and/or shrub component. Six species have been captured at the site (tables 3–10). Cotton rats have been captured in Phases 2, 4, 5, 6, and 8. DPMO have been captured in phases 2, 4, and 5.

The accretion bench area that is within the current river flood plain is adjacent to Phase 4 and was trapped multiple times, some of which were for the demographic study previously mentioned in LCR MSCP Work Task C27 (Small Mammal Population Studies). CRCR were captured during every trapping session (table 10).

Table 3.—Summary of all small mammal surveys, 2011–14, at the Palo Verde Ecological Reserve

Species	Spring 2012	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Colorado River cotton rat	11	6	4	33	7	5
Desert pocket mouse	1	2	1	1	0	4
Cactus mouse	1	3	1	42	9	2
Deer mouse	0	0	0	3	0	5
Harvest mouse	2	17	0	28	5	11
House mouse	7	19	15	12	20	9
Total captures	**22**	**47**	**21**	**119**	**41**	**36**
Traps/nights	90/1	120/1 30/2	150/1	180/1 120/4	180/1	180/1 120/4

Table 4.—Summary of small mammal surveys at Palo Verde Ecological Reserve Phase 2

Species	Fall 2012	Fall 2014
Colorado River cotton rat	0	2
Desert pocket mouse	1	0
Harvest mouse	11	3
House mouse	3	0
Total captures	**15**	**5**
Traps/nights	60/1	40/1

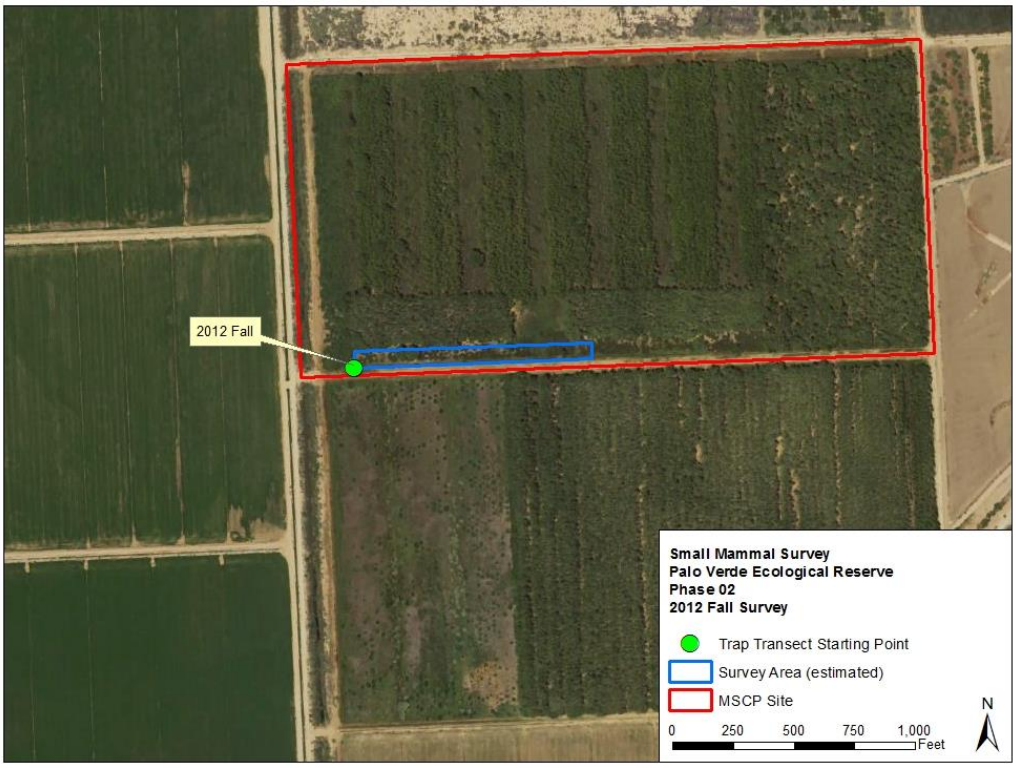


Figure 16.—Survey areas at Palo Verde Ecological Reserve Phase 2, fall 2012.

Table 5.—Summary of small mammal surveys at Palo Verde Ecological Reserve Phase 3

Species	Fall 2014
Cactus mouse	2
Deer mouse	1
House mouse	2
Total captures	**5**
Traps/nights	40/1

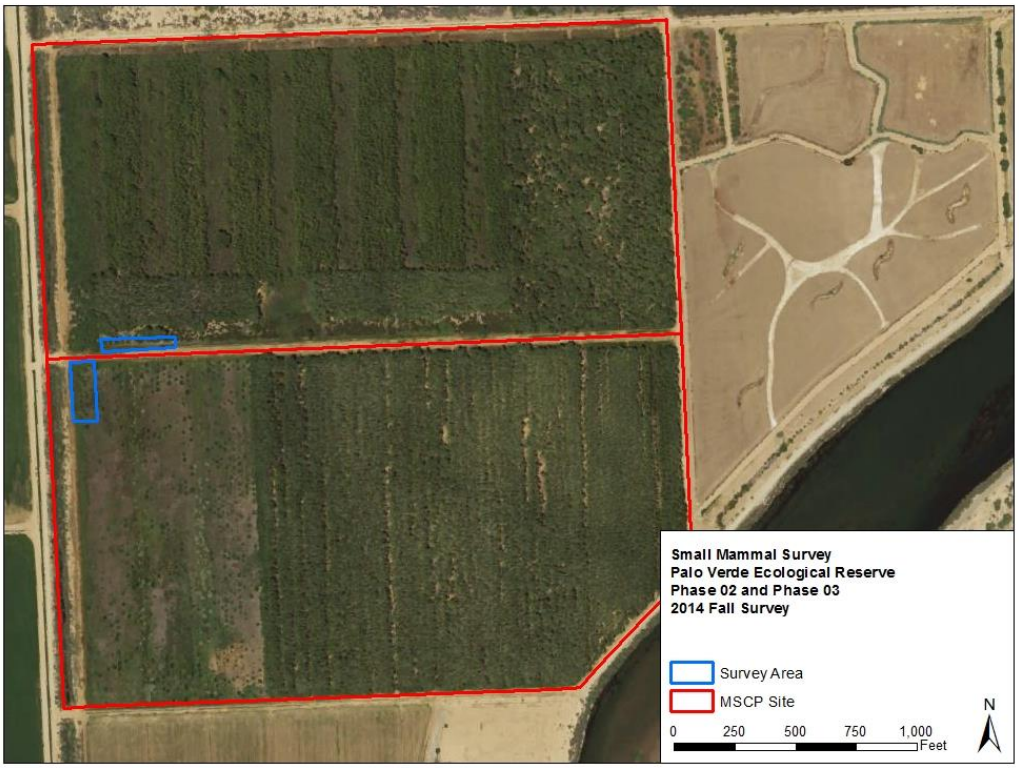


Figure 17.—Survey areas at Palo Verde Ecological Reserve Phases 2 and 3, fall 2014.

Table 6.—Summary of small mammal surveys at Palo Verde Ecological Reserve Phase 4

Species	Spring 2012	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Colorado River cotton rat	10	2	2	0	7	0
Desert pocket mouse	0	1	1	1	0	2
Cactus mouse	0	2	1	11	9	0
Deer mouse	0	0	0	0	0	4
Harvest mouse	2	3	0	5	4	0
House mouse	3	10	4	7	5	0
Total captures	**15**	**18**	**8**	**24**	**25**	**6**
Traps/nights	45/1	30/1	60/1	60/1	60/1	60/1

Table 7.—Summary of small mammal surveys at Palo Verde Ecological Reserve Phase 5

Species	Spring 2012	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Colorado River cotton rat	1	1	2	0	0	1
Desert pocket mouse	1	0	0	0	0	1
Cactus mouse	1	1	0	0	0	0
Harvest mouse	0	3	0	0	1	0
House mouse	4	6	2	0	0	1
Total captures	**7**	**11**	**4**	**0**	**1**	**3**
Traps/nights	45/1	30/2	50/1	60/1	60/1	120/1

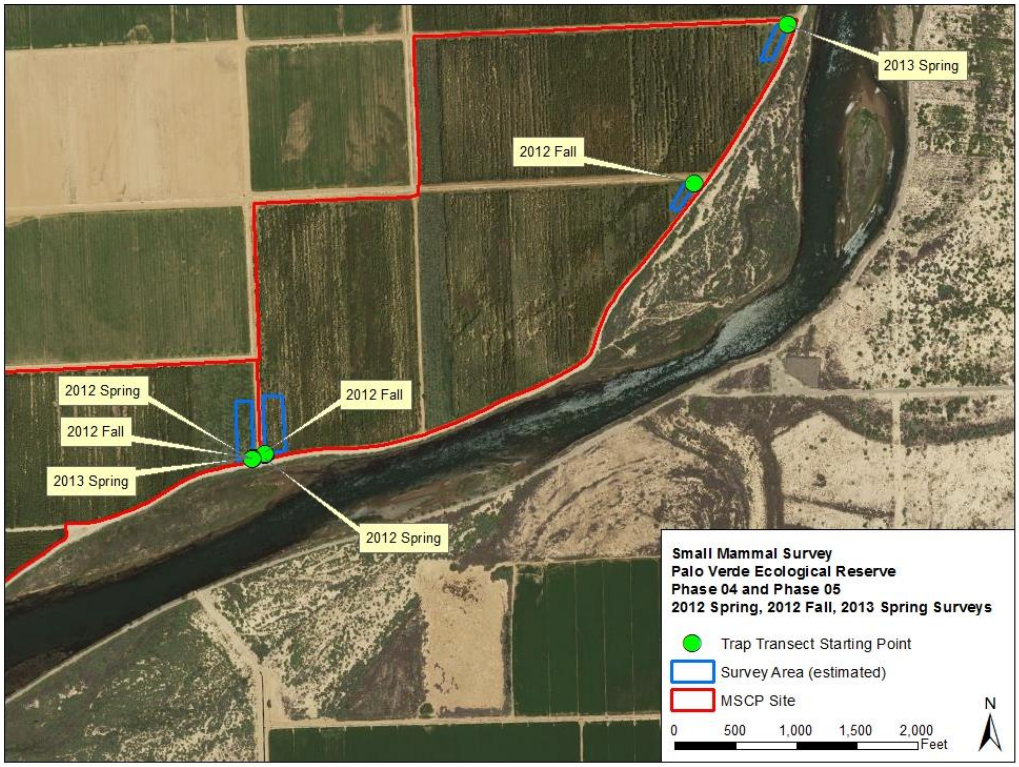


Figure 18.—Survey areas at Palo Verde Ecological Reserve Phases 4 and 5, spring 2012 through spring 2013.

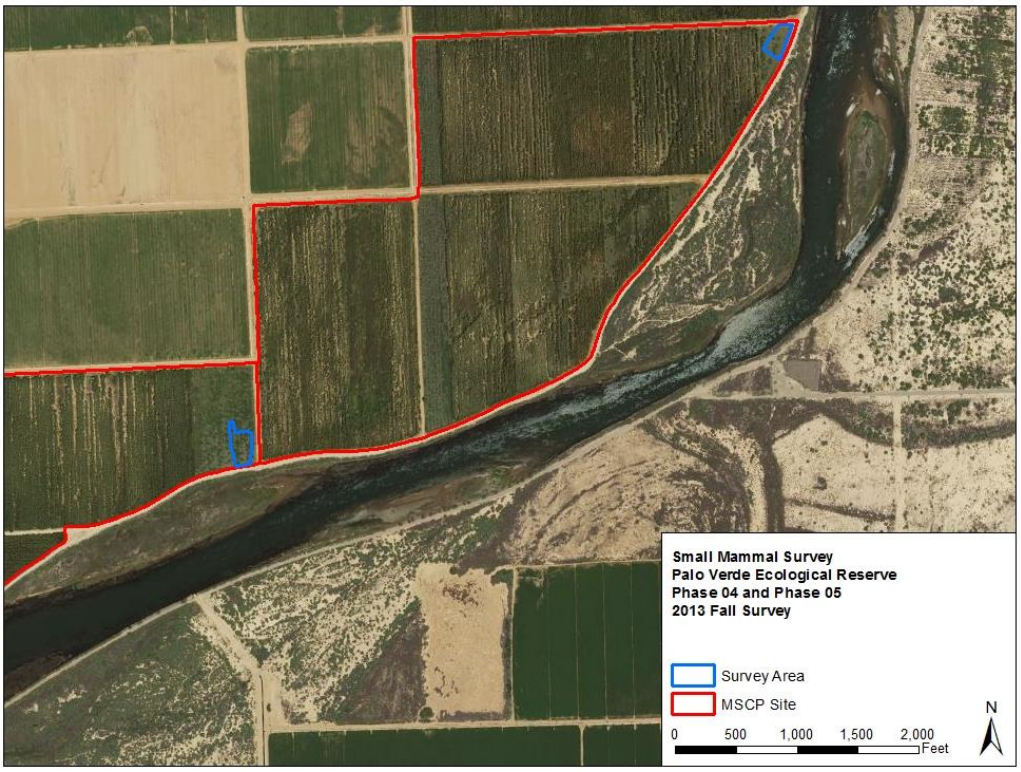


Figure 19.—Survey areas at Palo Verde Ecological Reserve Phases 4 and 5, fall 2013.

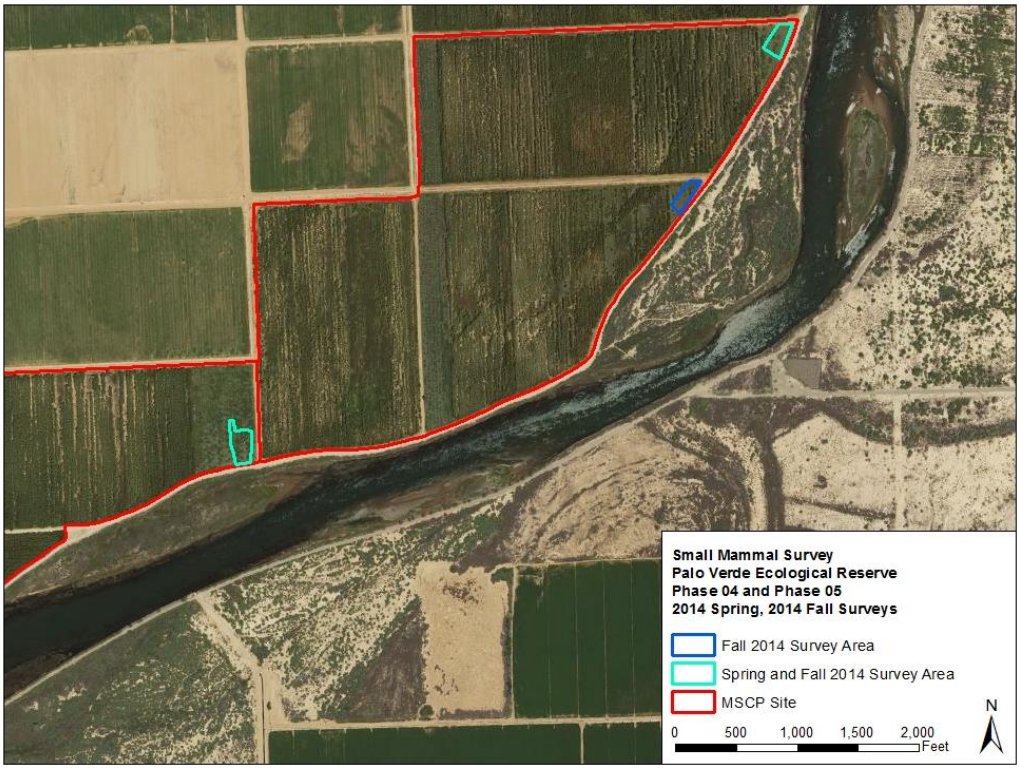


Figure 20.—Survey areas at Palo Verde Ecological Reserve Phases 4 and 5, spring and fall 2014.

Table 8.—Summary of small mammal surveys at Palo Verde Ecological Reserve Phase 6

Species	Spring 2013	Fall 2013
Colorado River cotton rat	0	2
Deer mouse	0	2
House mouse	9	5
Total captures	**9**	**9**
Traps/nights	40/1	60/1

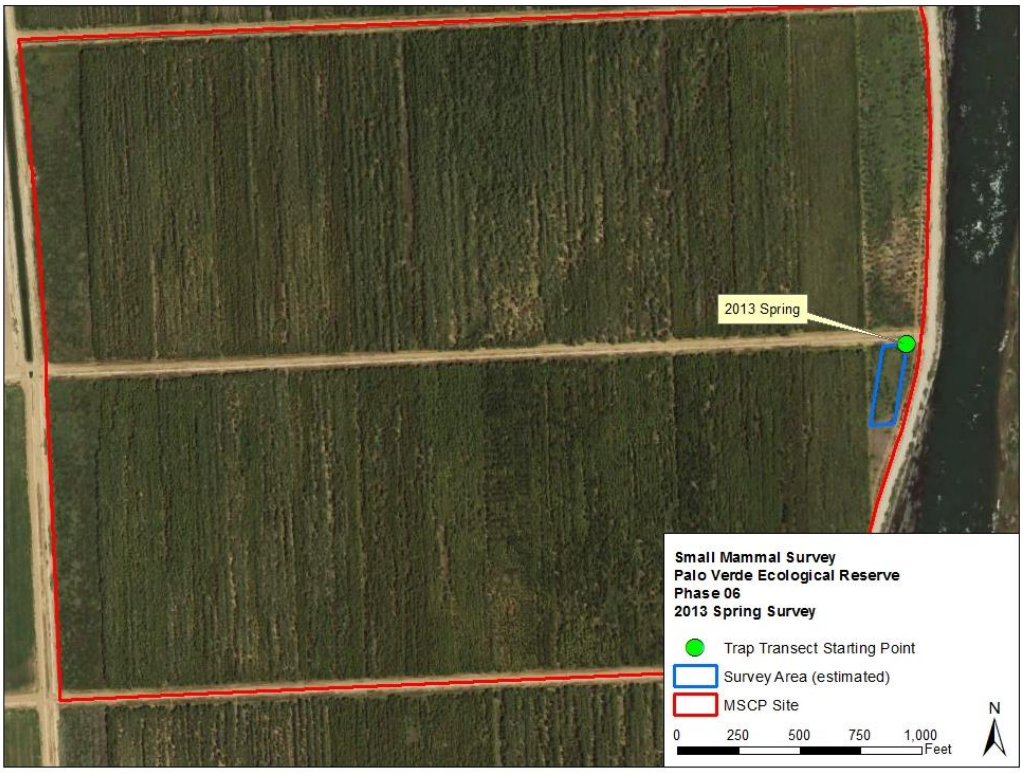


Figure 21.—Survey areas at Palo Verde Ecological Reserve Phase 6, spring 2013.

Figure 22.—Survey areas at Palo Verde Ecological Reserve Phase 6, fall 2013.

Table 9.—Summary of small mammal surveys at Palo Verde Ecological Reserve Phase 8

Species	Spring 2014	Fall 2014
Colorado River cotton rat	0	2
Desert pocket mouse	0	1
Harvest mouse	0	8
House mouse	15	6
Total captures	**15**	**17**
Traps/nights	60/1	60/1

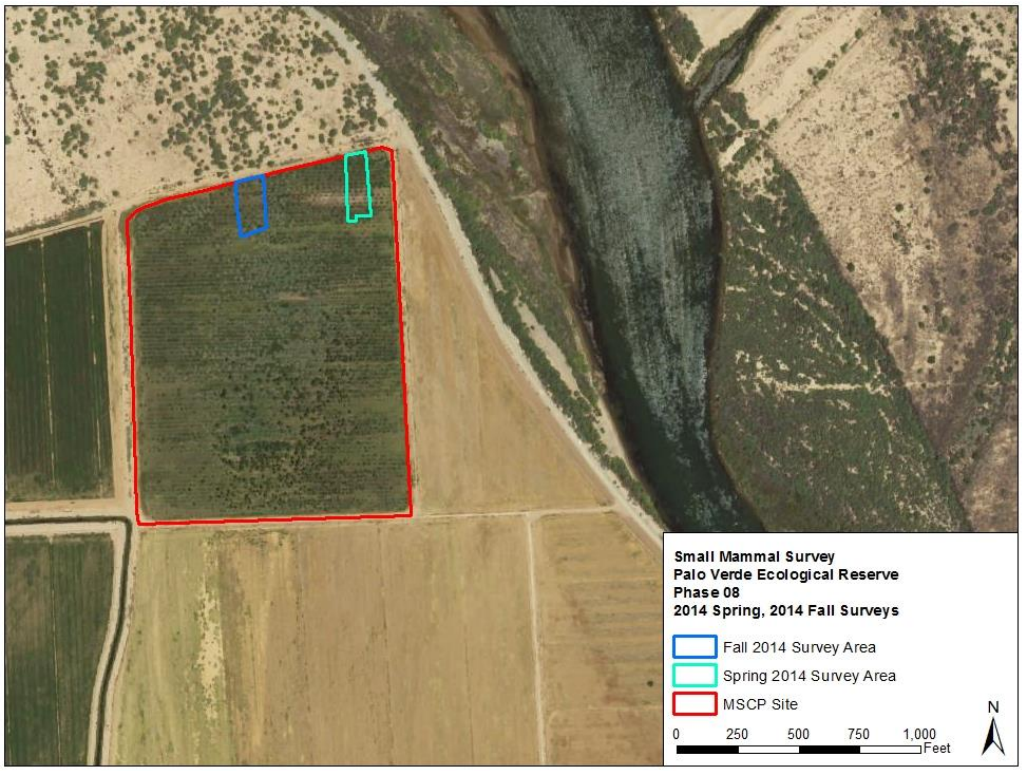


Figure 23.—Survey areas at Palo Verde Ecological Reserve Phase 8, spring and fall 2014.

Table 10.—Summary of small mammal surveys at Palo Verde Ecological Reserve Accretion Bench

Species	Fall 2011	Fall 2012	Fall 2013
Colorado River cotton rat	128	3	31
Cactus mouse	15	0	31
Deer mouse	20	0	1
Harvest mouse	22	0	23
House mouse	1	0	0
Total captures	**186**	**3**	**86**
Traps/nights	120/4	30/1	120/4

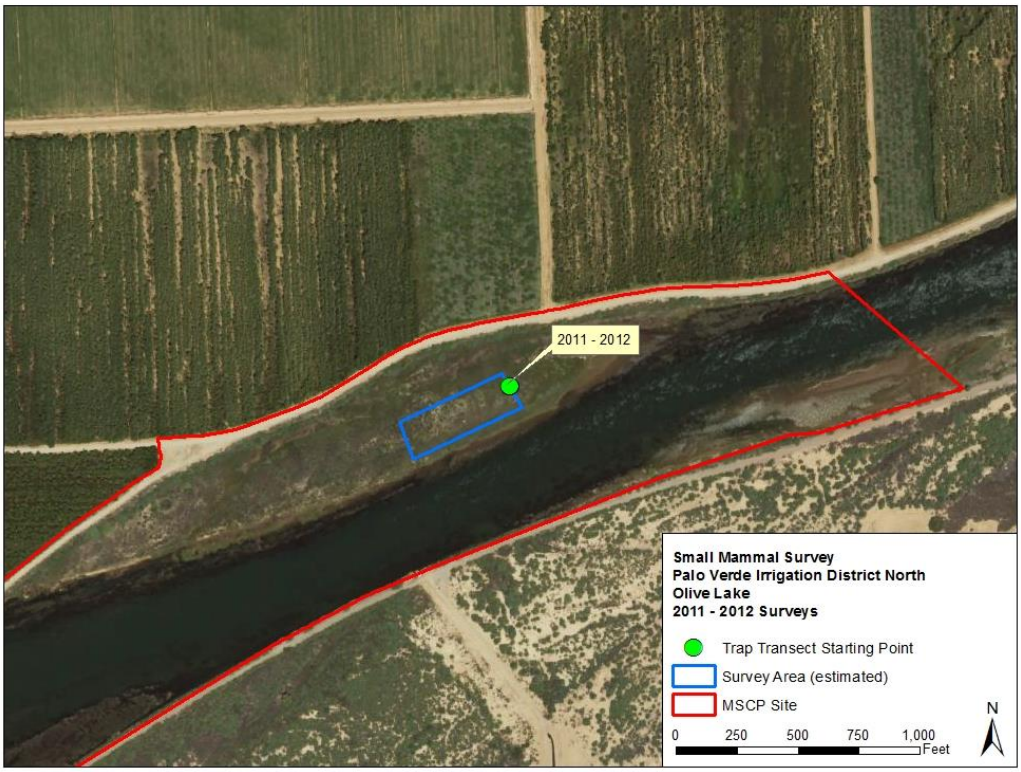


Figure 24.—Survey areas at Palo Verde Ecological Reserve Accretion Bench, 2011–12.

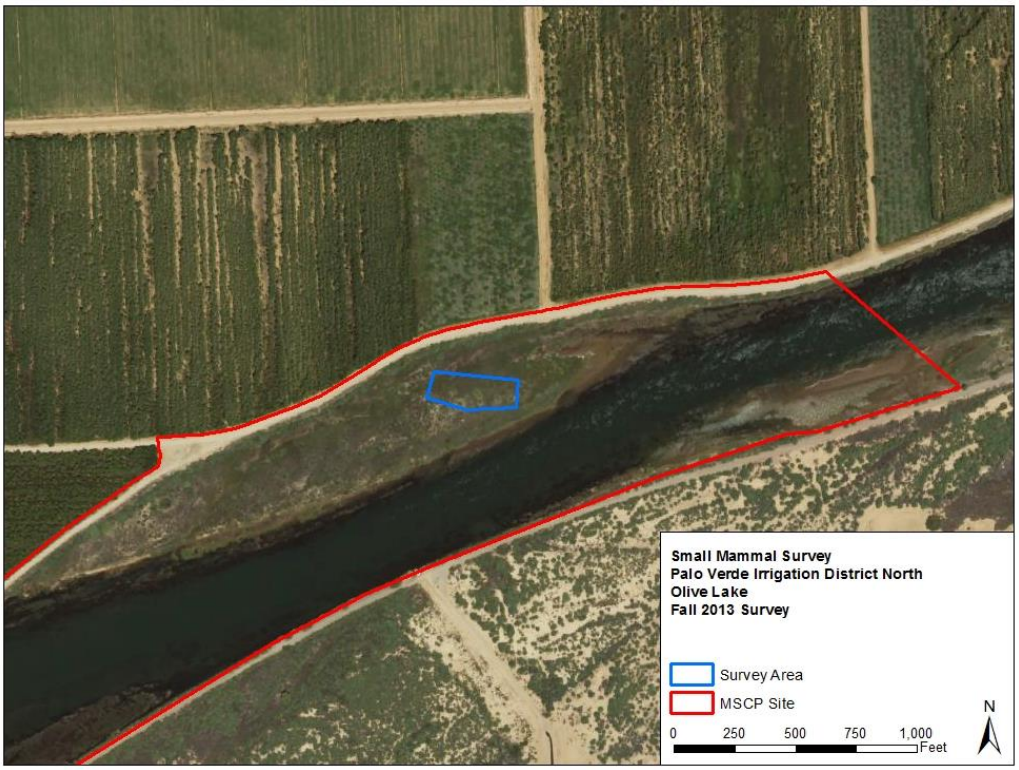


Figure 25.—Survey areas at Palo Verde Ecological Reserve Accretion Bench, fall 2013.

Cibola Valley Conservation Area

Surveys have been conducted at the Cibola Valley Conservation Area since 2006. Below are summaries of the surveys since 2012 (see figures 26–32). Areas that were dominated by a dense herbaceous understory of grass and/or shrubs were the focus of trapping efforts. Seven species have been captured since 2012 (tables 11–15). Cotton rats have been captured in phases 1, 2 and 4. DPMO have been captured in phases 2 and 4.

Table 11.—Summary of small mammal surveys at the Cibola Valley Conservation Area

Species	Spring 2012	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Colorado River cotton rat	7	2	7	2	8	4
Desert pocket mouse	7	1	0	5	9	6
Cactus mouse	4	1	0	0	2	1
Deer mouse	4	0	1	0	2	0
Harvest mouse	7	6	1	0	2	7
House mouse	0	3	0	0	0	0
Merriam's kangaroo rat	0	0	0	0	2	0
Total captures	**29**	**13**	**9**	**7**	**25**	**18**
Traps/nights	165/1	90/1	180/1	160/1	180/1	160/1

Table 12.—Summary of small mammal surveys at Cibola Valley Conservation Area Phase 1

Species	Spring 2012	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Colorado River cotton rat	1	1	6	2	7	4
Cactus mouse	0	0	0	0	2	1
Harvest mouse	5	5	0	0	0	7
Total captures	**6**	**6**	**6**	**2**	**9**	**12**
Traps/nights	30/1	30/1	100/1	60/1	90/1	80/1

Table 13.—Summary of small mammal surveys at Cibola Valley Conservation Area Phase 2

Species	Spring 2012	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Colorado River cotton rat	5	1	1	0	1	0
Desert pocket mouse	0	1	0	4	7	6
Cactus mouse	0	1	0	0	0	0
Deer mouse	1	0	1	0	0	0
Harvest mouse	0	1	1	0	1	0
Total captures	**6**	**4**	**3**	**4**	**9**	**6**
Traps/nights	45/1	30/1	80/1	60/1	60/1	80/1

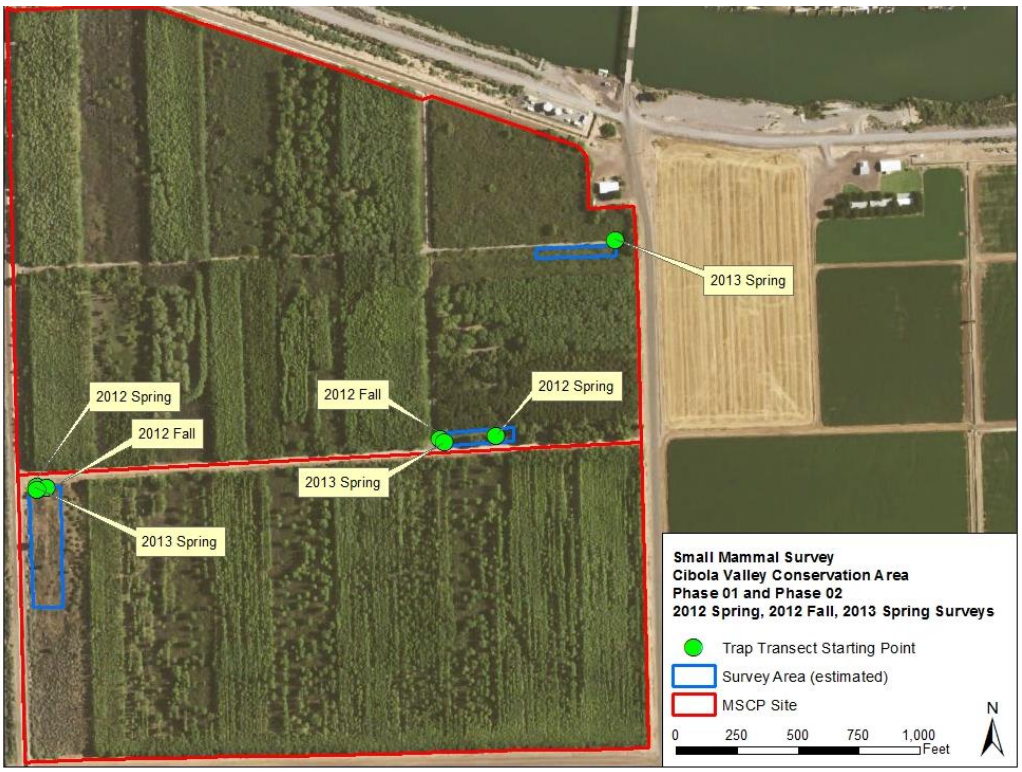


Figure 26.—Survey areas at Cibola Valley Conservation Area Phases 1 and 2, spring 2012 through spring 2013.

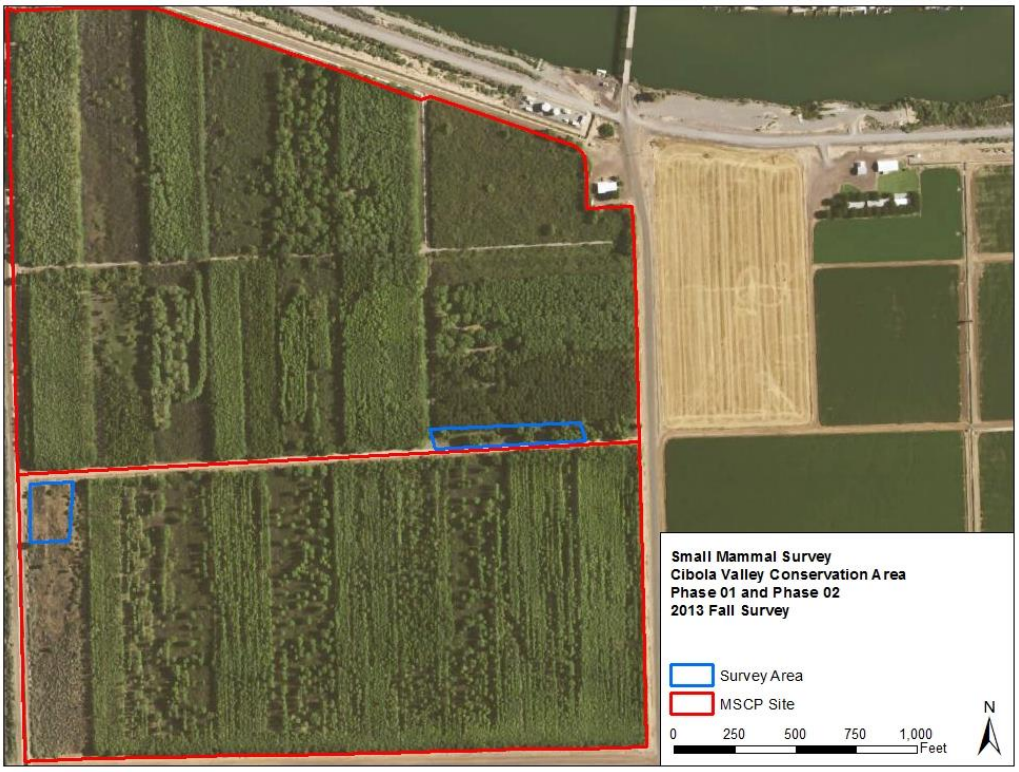


Figure 27.—Survey areas at Cibola Valley Conservation Area Phases 1 and 2, fall 2013.

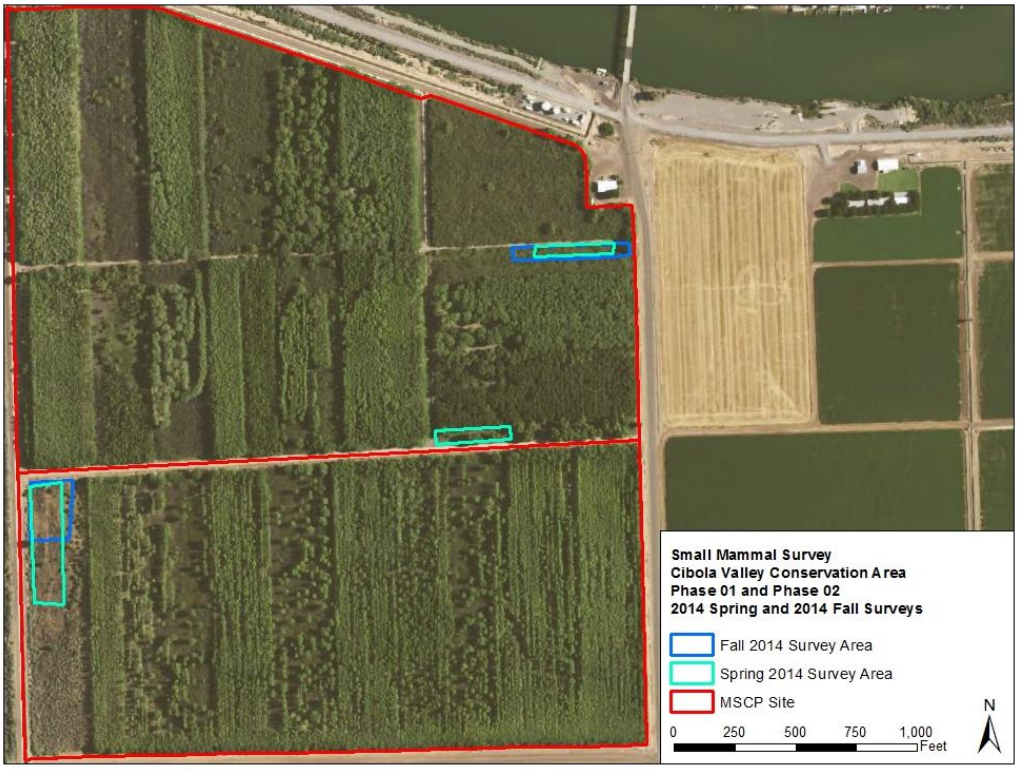


Figure 28.—Survey areas at Cibola Valley Conservation Area Phases 1 and 2, spring and fall 2014.

Table 14.—Summary of small mammal surveys at Cibola Valley Conservation Area Phase 3

Species	Spring 2012	Fall 2012	Fall 2013
Desert pocket mouse	0	0	1
Cactus mouse	2	0	0
Deer mouse	0	0	0
Harvest mouse	1	0	0
House mouse	0	3	0
Total captures	**3**	**3**	**1**
Traps/nights	45/1	30/1	40/1

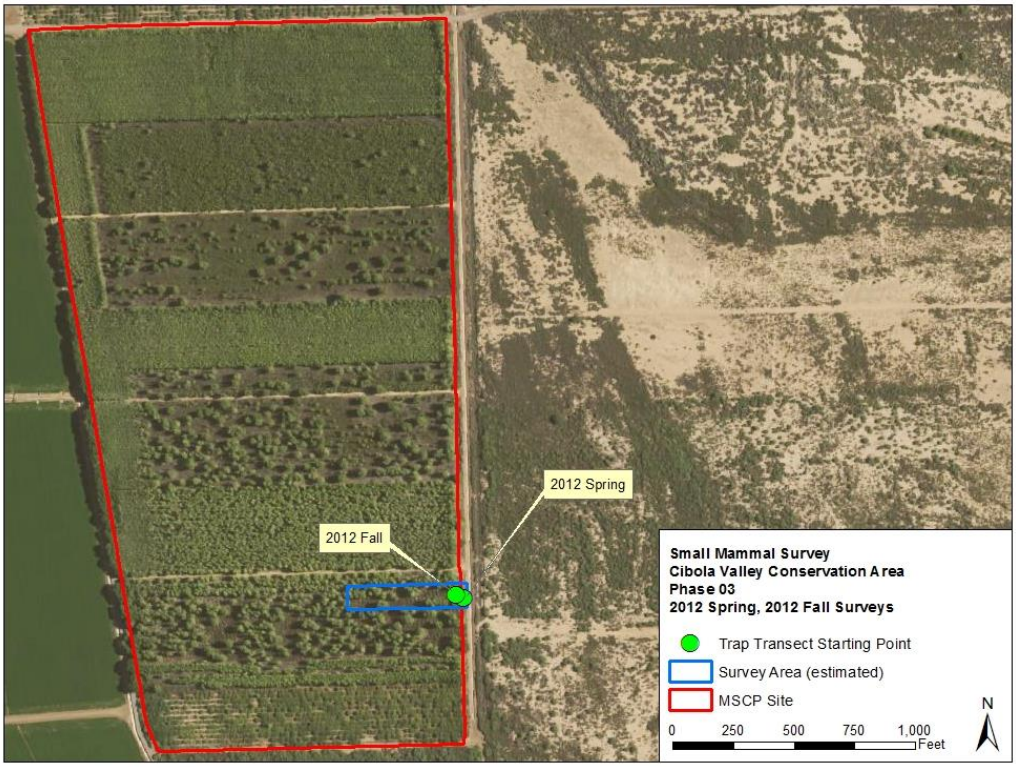


Figure 29.—Survey areas at Cibola Valley Conservation Area Phase 3, spring and fall 2012.

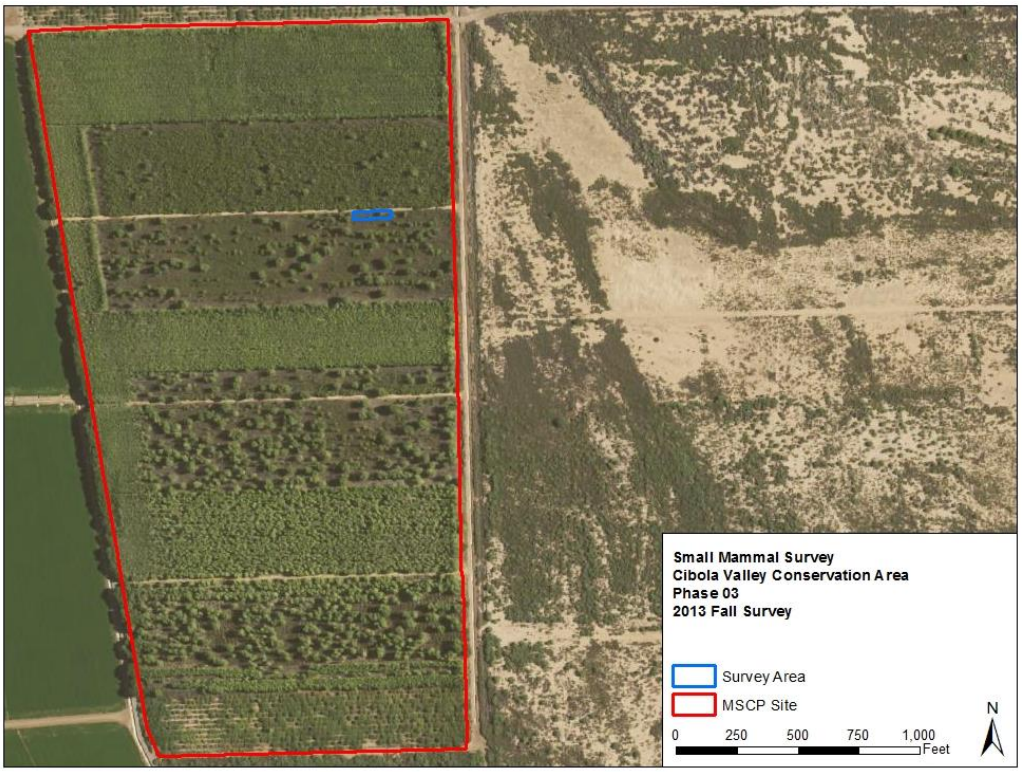


Figure 30.—Survey areas at Cibola Valley Conservation Area Phase 3, fall 2013.

Table 15.—Summary of small mammal surveys at Cibola Valley Conservation Area Phase 4

Species	Spring 2012	Fall 2012	Spring 2014
Colorado River cotton rat	1	0	0
Desert pocket mouse	7	18	2
Cactus mouse	2	2	0
Deer mouse	3	1	2
Harvest mouse	1	0	1
Merriam's kangaroo rat	0	0	2
Total captures	**14**	**21**	**7**
Traps/nights	45/1	30/1	30/1

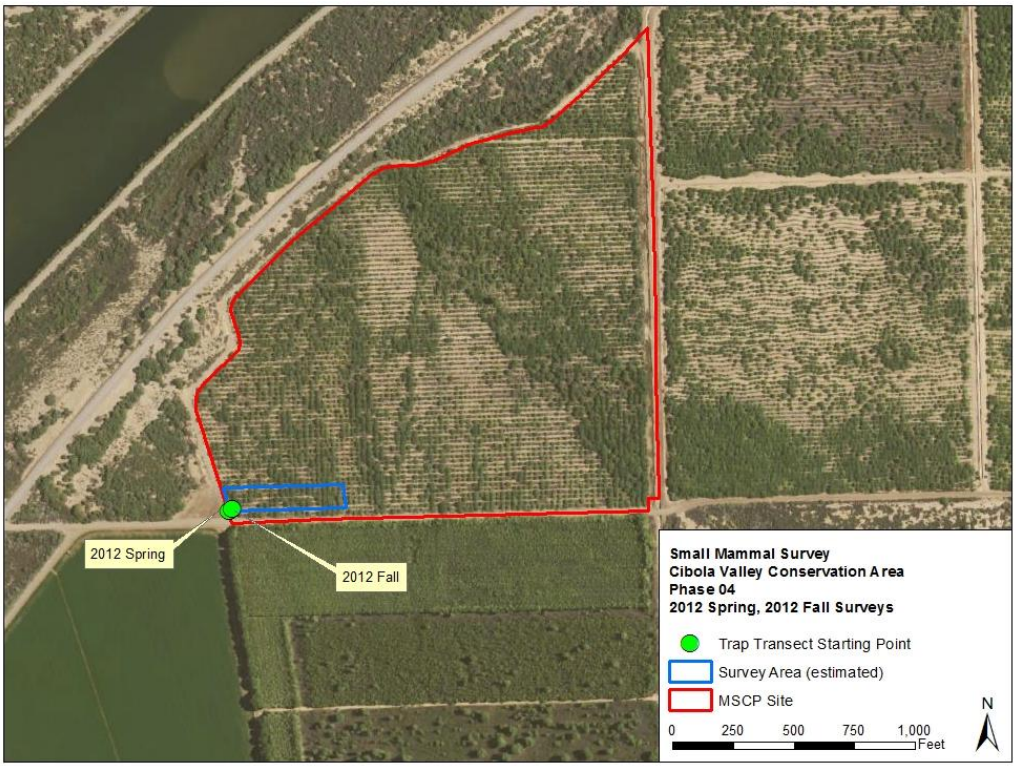


Figure 31.—Survey areas at Cibola Valley Conservation Area Phase 4, spring and fall 2012.

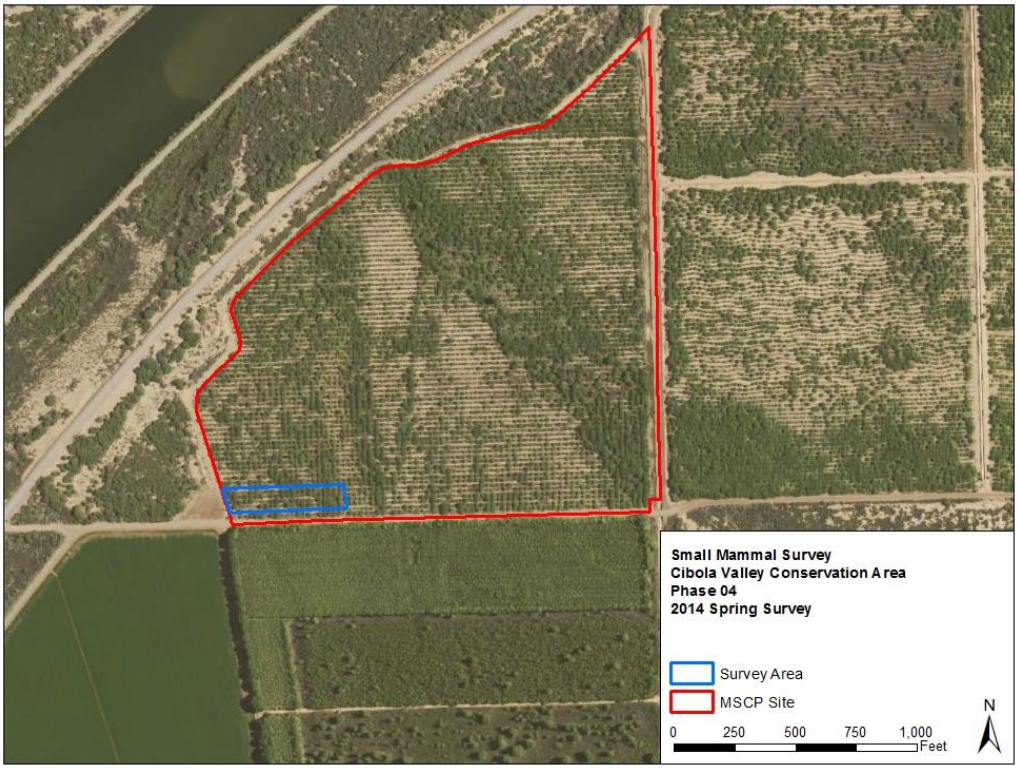


Figure 32.—Survey areas at Cibola Valley Conservation Area Phase 4, spring 2014.

Cibola National Wildlife Refuge Unit #1 Conservation Area

Surveys have been conducted at the Cibola National Wildlife Refuge since 2004. Trapping at the Cibola National Wildlife Refuge Unit #1 Conservation Area Nature Trail (Cibola Nature Trail) occurs in an area in the middle of the site dominated by Johnsongrass and baccharis (see figures 33–38). Since 2012, five species have been captured at the Cibola Nature Trail, six species at the NAU Cottonwood Genetics study fields, and five species at the Hippy Burn area (tables 16–20). Trapping in the Cottonwood Genetics field occurs in a more open homogenous area of Johnsongrass. The site has consistently produced CRCR captures since trapping began. The area of the Hippy Burn trapping was dominated by grasses.

Table 16.—Summary of small mammal surveys at the Cibola National Wildlife Refuge Unit #1 Conservation Area

Species	Spring 2012	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Colorado River cotton rat	4	0	21	8	7	6
Desert pocket mouse	0	0	4	1	2	1
Cactus mouse	0	8	4	49	4	8
Deer mouse	0	8	10	22	6	1
Harvest mouse	2	6	12	10	17	2
House mouse	0	0	1	1	1	0
White-throated wood rat	0	0	2	37	5	5
Total captures	**6**	**22**	**54**	**128**	**42**	**23**
Traps/nights	45/1	45/1	160/1	120/1 120/4	120/1	180/1

Table 17.—Summary of small mammal surveys at the Cibola Nature Trail

Species	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Colorado River cotton rat	0	4	7	0	6
Cactus mouse	8	4	49	4	7
Deer mouse	8	10	19	6	1
Harvest mouse	6	10	9	12	1
White-throated wood rat	0	2	37	5	5
Total captures	**22**	**30**	**121**	**27**	**20**
Traps/nights	45/1	80/1	120/4	60/1	60/1

Table 18.—Summary of small mammal surveys at the NAU Cottonwood Genetics study field

Species	Spring 2012	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Colorado River cotton rat	4	0	17	1	7	0
Desert pocket mouse	0	0	0	1	2	0
Cactus mouse	0	0	0	0	0	1
Deer mouse	0	0	0	0	0	0
Harvest mouse	2	1	2	2	3	0
House mouse	0	4	1	0	1	0
White-throated wood rat	0	0	0	0	0	0
Total captures	**6**	**5**	**20**	**4**	**13**	**1**
Traps/nights	45/1	45/1	80/1	60/1	60/1	60/1

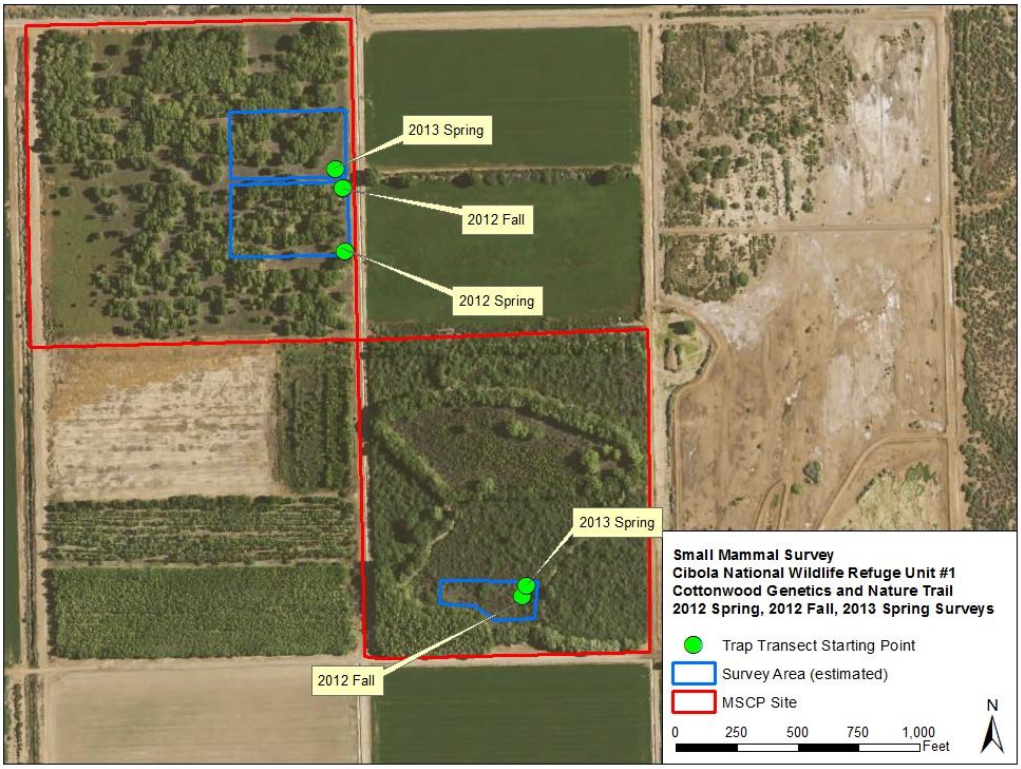


Figure 33.—NAU Cottonwood Genetics and Cibola Nature Trail survey areas at the Cibola National Wildlife Refuge Unit #1 Conservation Area, spring 2012 through spring 2013.

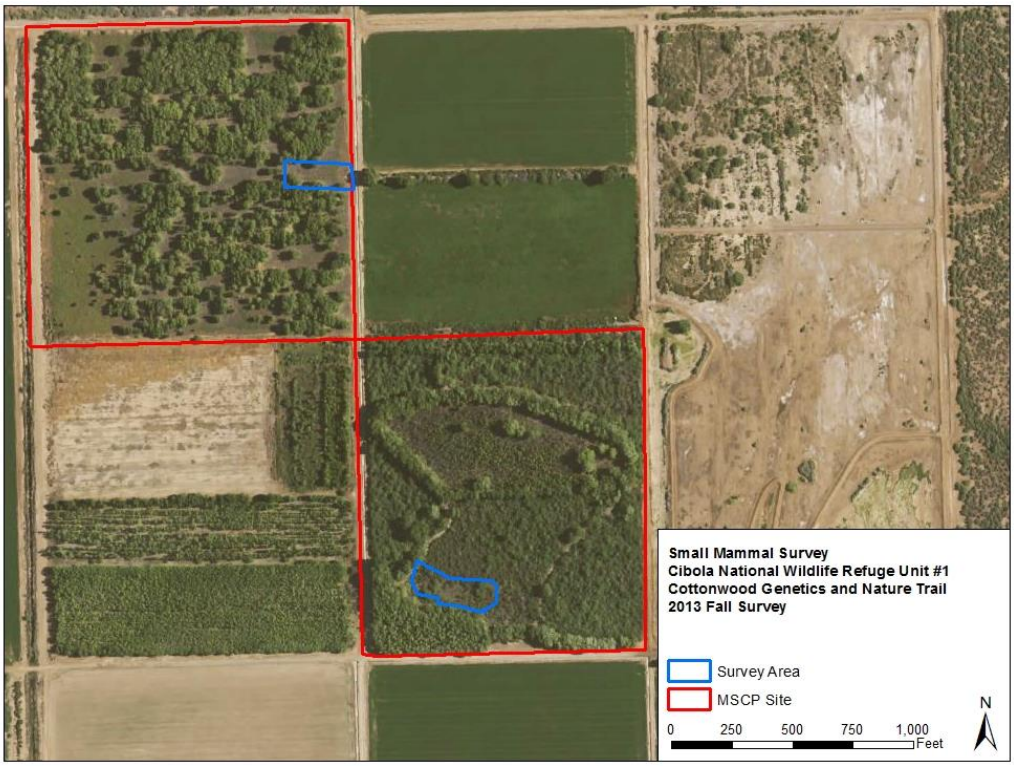


Figure 34.—NAU Cottonwood Genetics and Cibola Nature Trail survey areas at the Cibola National Wildlife Refuge Unit #1 Conservation Area, fall 2013.

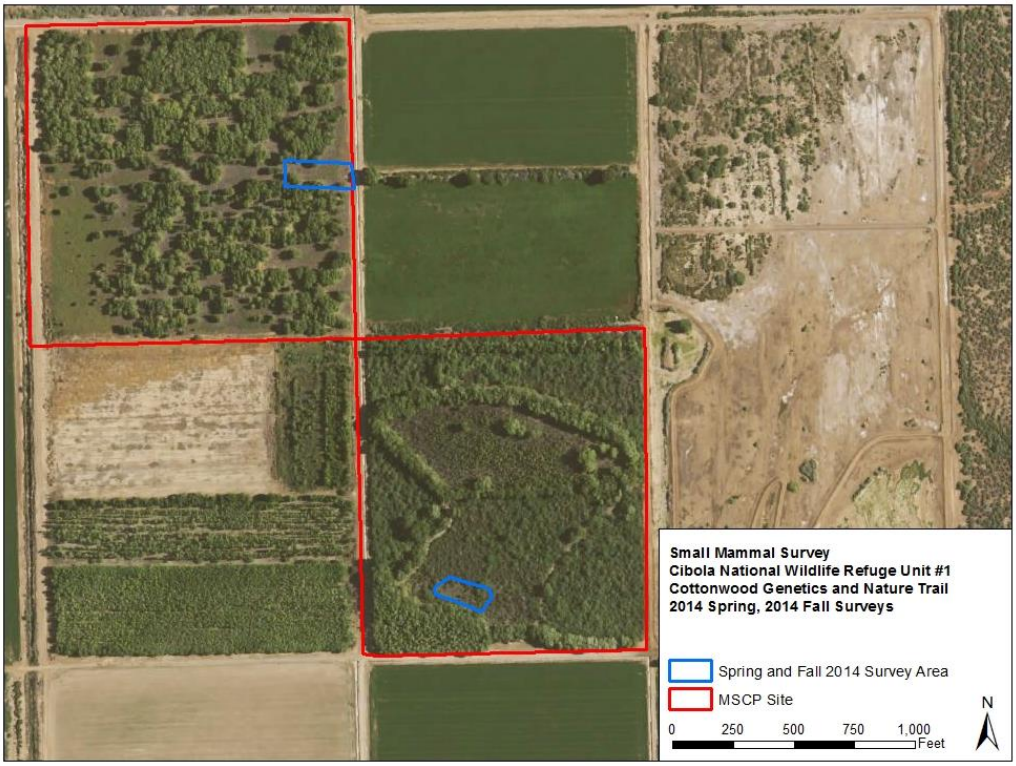


Figure 35.—NAU Cottonwood Genetics and Cibola Nature Trail survey areas at the Cibola National Wildlife Refuge Unit #1 Conservation Area, 2014.

Table 19.—Summary of small mammal surveys at the Cibola National Wildlife Refuge Unit #1 Conservation Area, Hippy Burn

Species	Fall 2013	Fall 2014
Desert pocket mouse	0	1
Deer mouse	3	0
Harvest mouse	0	2
House mouse	1	0
Total captures	**4**	**3**
Traps/nights	60/1	60/1

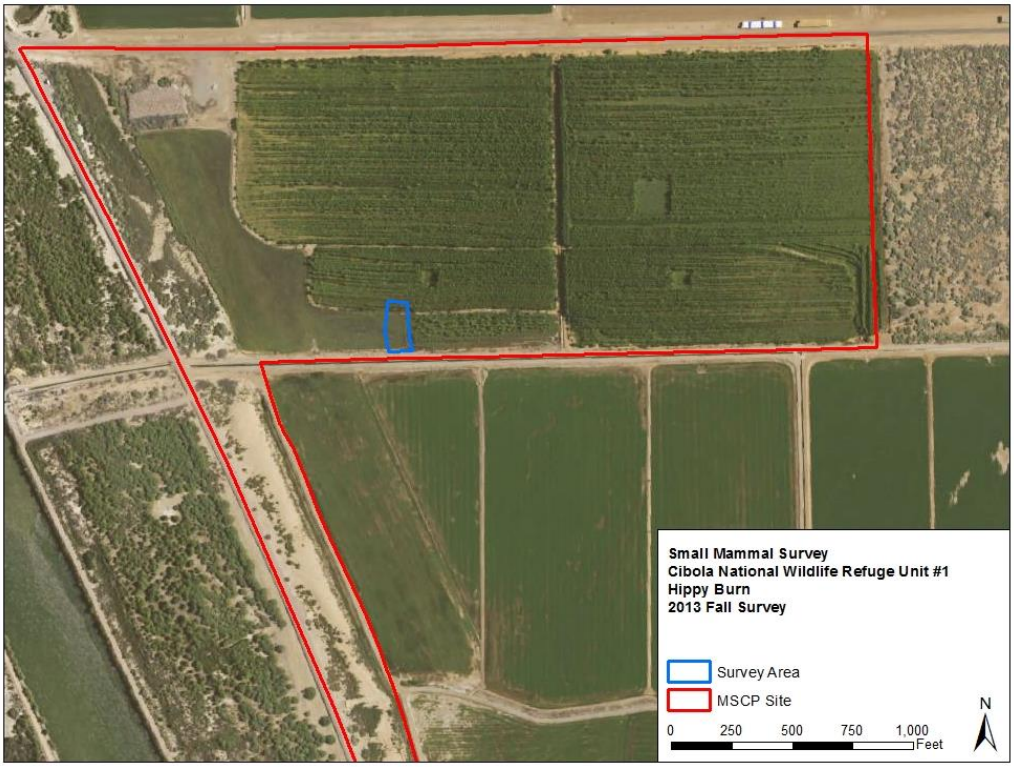


Figure 36.—Survey areas at the Cibola National Wildlife Refuge Unit #1 Conservation Area, Hippy Burn, fall 2013.

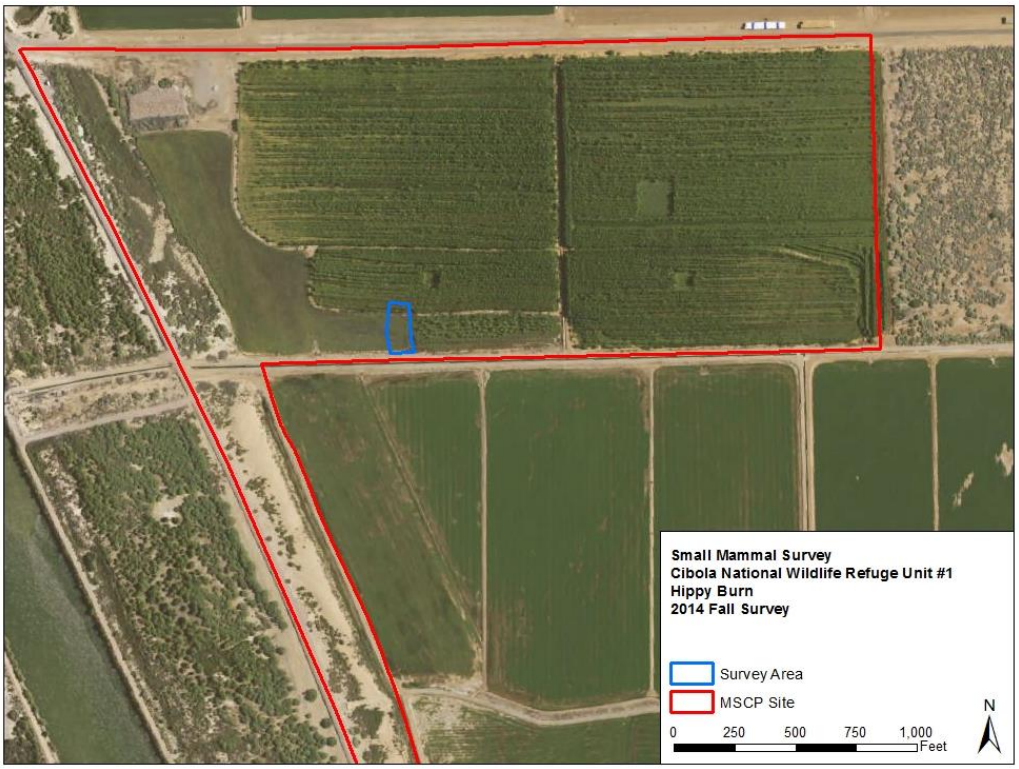


Figure 37.—Survey areas at the Cibola National Wildlife Refuge Unit #1 Conservation Area, Hippy Burn, fall 2014.

Table 20.—Summary of small mammal surveys at the Cibola National Wildlife Refuge Unit #1 Conservation Area, Crane Roost

Species	Spring 2012
Harvest mouse	2
Total captures	**2**
Traps/nights	45/1

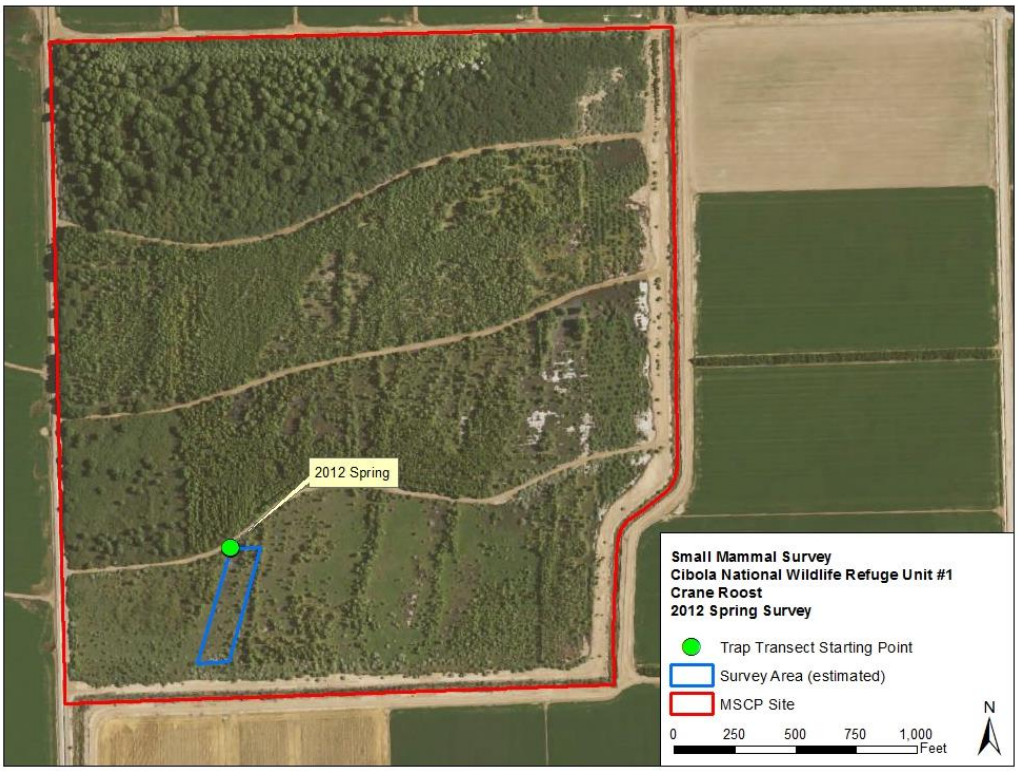


Figure 38.—Survey areas at the Cibola National Wildlife Refuge Unit #1 Conservation Area, Crane Roost, spring 2012.

Yuma East Wetlands

Surveys have occurred at Yuma East Wetlands since 2012 (see figures 39–42). Trapping occurred in areas that have a dense grass layer primarily consisting of alkali sacaton (*Sporobolus airoides*). Baccharis shrubs were interspersed in some areas and either mesquite or cottonwood trees were planted in the area. Five species were captured (tables 21–24). YHCR were detected during all surveys (fall 2012, spring 2013, fall 2013, spring 2014, and fall 2014). DPMO were detected during fall 2012, fall 2013, and fall 2014 surveys.

Table 21.—Summary of small mammal surveys at Yuma East Wetlands

Species	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Yuma hispid cotton rat	2	1	13	5	23
Desert pocket mouse	7	0	1	0	1
Cactus mouse	9	0	0	0	2
Deer mouse	0	0	0	0	0
House mouse	0	0	0	0	1
Total captures	**18**	**1**	**14**	**5**	**27**
Traps/nights	89/1	60/1	120/1	140/1	120/2 60/1

Table 22.—Summary of small mammal surveys at Yuma East Wetlands Cell C

Species	Fall 2012
Yuma hispid cotton rat	2
Desert pocket mouse	7
Cactus mouse	9
Total captures	**18**
Traps/nights	89/1

Table 23.—Summary of small mammal surveys at Yuma East Wetlands Cell F

Species	Spring 2013
Yuma hispid cotton rat	1
Deer pocket mouse	5
Total captures	**6**
Traps/nights	60/1

Table 24.—Summary of small mammal surveys at Yuma East Wetlands Cell I

Species	Fall 2013	Spring 2014	Fall 2014
Yuma hispid cotton rat	13	2	22
Desert pocket mouse	1	0	1
Cactus mouse	0	0	0
Total captures	**14**	**2**	**23**
Traps/nights	120/1	60/1	120/2

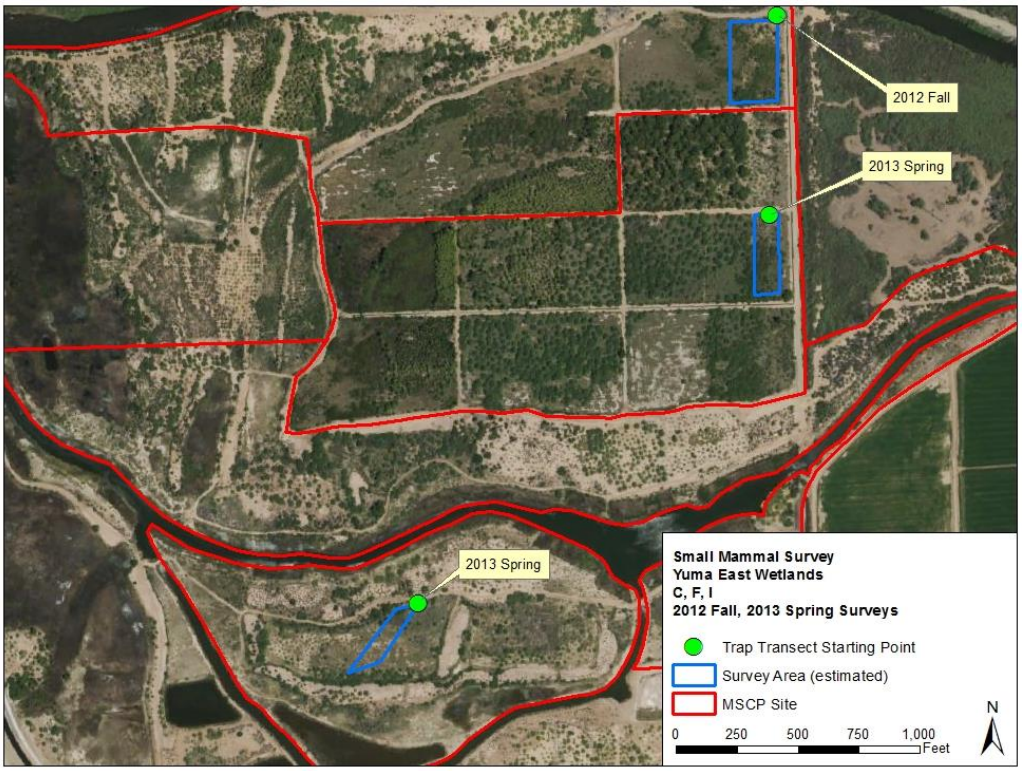


Figure 39.—Survey areas at Yuma East Wetlands Cells C, F, and I, fall 2012 through spring 2013.

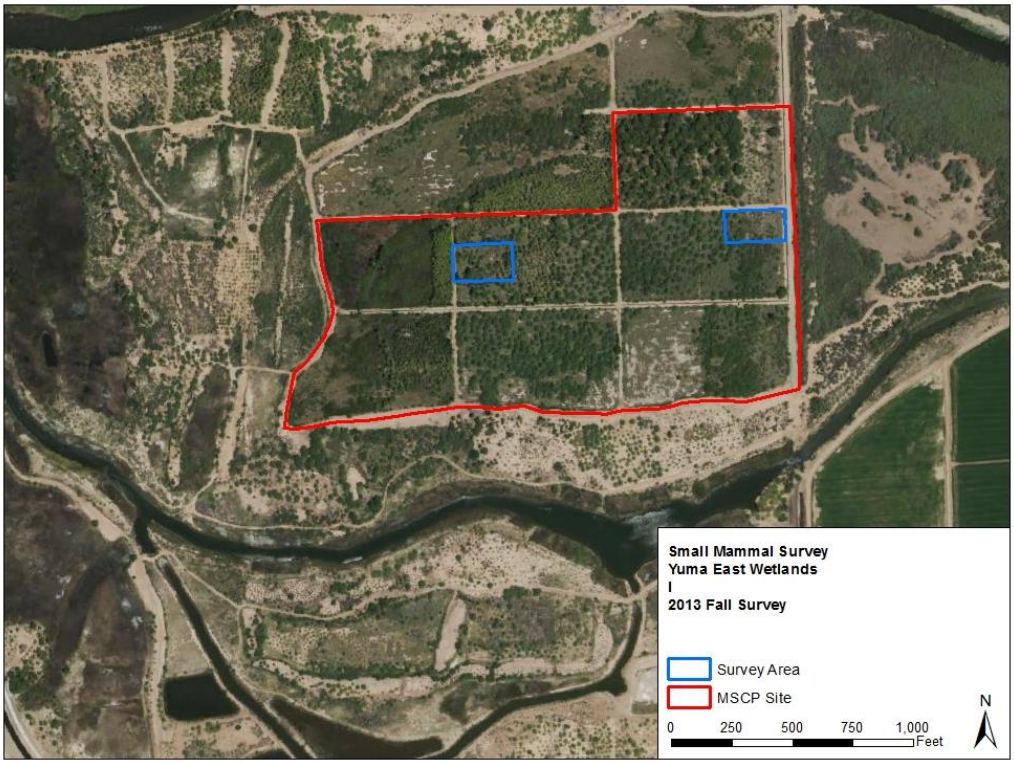


Figure 40.—Survey areas at Yuma East Wetlands Cell I, fall 2013.

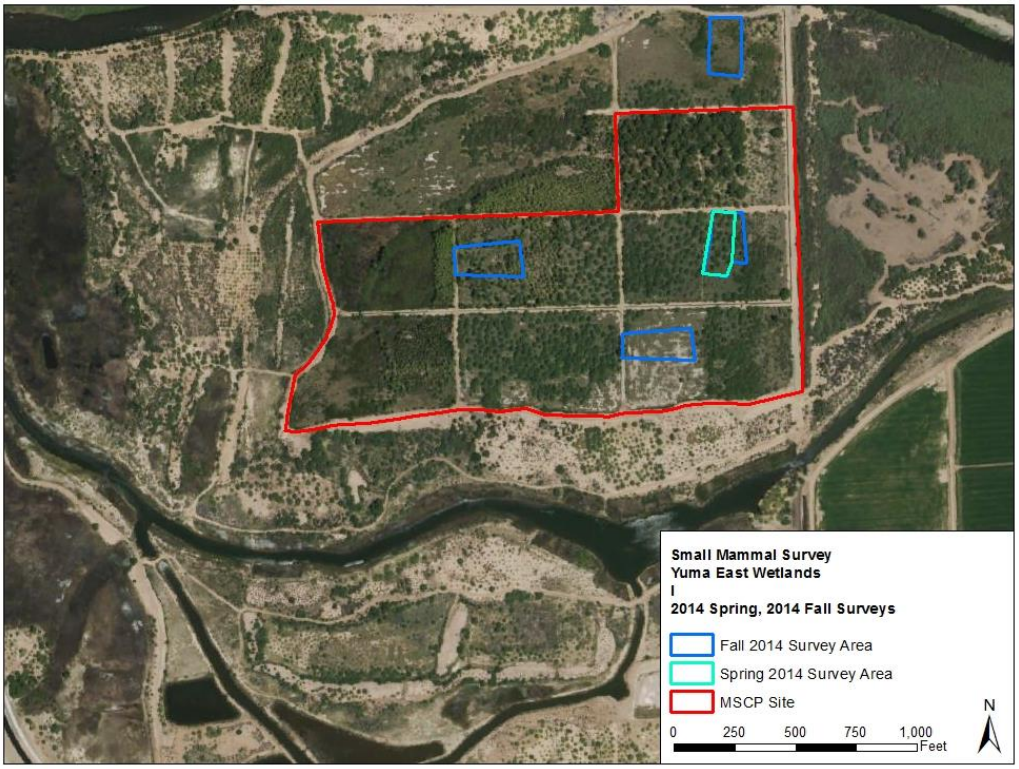


Figure 41.—Survey areas at Yuma East Wetlands Cell I, spring and fall 2014.

Table 25.—Summary of small mammal surveys at Yuma East Wetlands Cell J

Species	Spring 2014	Fall 2014
Yuma hispid cotton rat	3	1
Cactus mouse	0	2
Deer mouse	0	0
House mouse	0	1
Total captures	**3**	**4**
Traps/nights	80/1	60/1

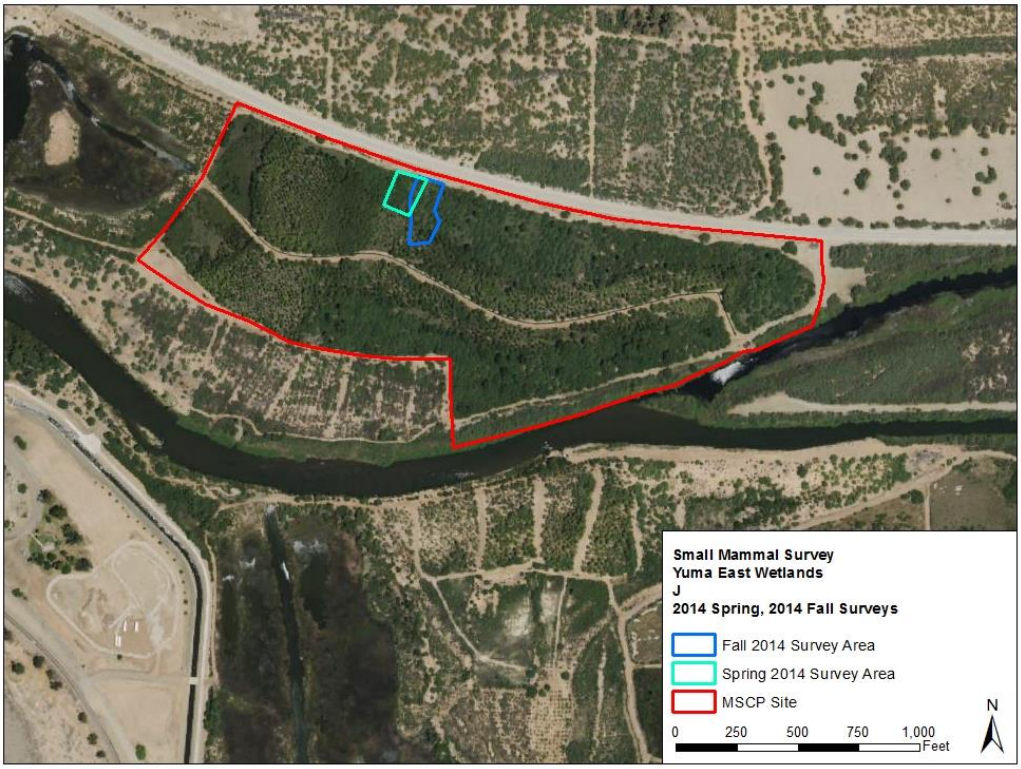


Figure 42.—Survey areas at Yuma East Wetlands Cell J, spring and fall 2014.

Hunters Hole

Surveys have occurred at Hunters Hole since 2012 (see figures 43–44). Trapping was conducted in areas where a dense ground cover of grass dominated by alkali sacaton was present. Four species have been captured at the site (tables 26–28). No cotton rats have been captured at Hunters Hole. DPMO have been detected during the fall 2012, spring and fall 2013, and fall 2014 surveys.

Table 26.—Summary of small mammal surveys at Hunters Hole

Species	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Desert pocket mouse	3	1	2	0	3
Cactus mouse	0	0	6	3	9
Deer mouse	0	0	0	0	2
Harvest mouse	0	0	0	0	0
House mouse	12	2	6	3	4
Kangaroo rat	1	0	0	0	0
Total captures	**16**	**3**	**14**	**6**	**18**
Traps/nights	90/1	60/1	120/1	120/1	160/1

Table 27.—Summary of small mammal surveys at Hunters Hole Cell 2

Species	Fall 2013	Spring 2014
Desert pocket mouse	1	0
Cactus mouse	3	2
Deer mouse	0	0
House mouse	3	2
Total captures	**7**	**4**
Traps/nights	60/1	60/1

Table 28.—Summary of small mammal surveys at Hunters Hole Cell 3

Species	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Desert pocket mouse	3	1	1	0	3
Cactus mouse	0	0	3	1	9
Deer mouse	0	0	0	0	2
Harvest mouse	0	0	0	0	0
House mouse	12	2	3	1	4
Kangaroo rat	1	0	0	0	0
Total captures	**16**	**3**	**7**	**2**	**18**
Traps/nights	90/1	60/1	60/1	60/1	160/1

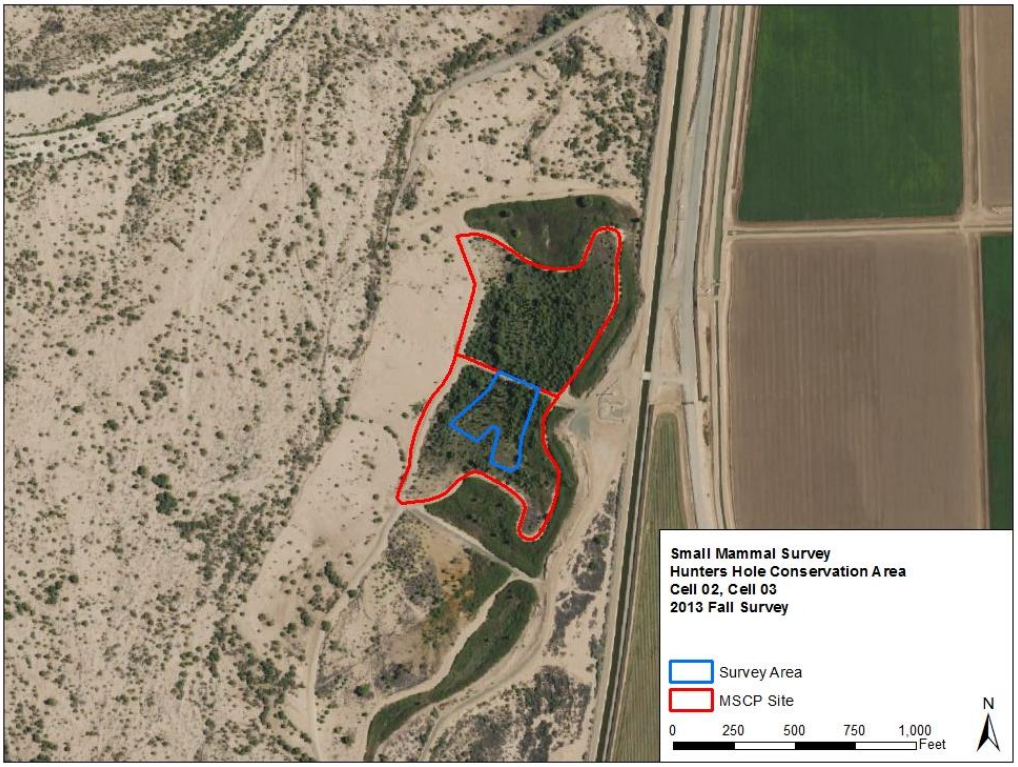


Figure 43.—Survey areas at Hunters Hole Cells 2 and 3, fall 2013.

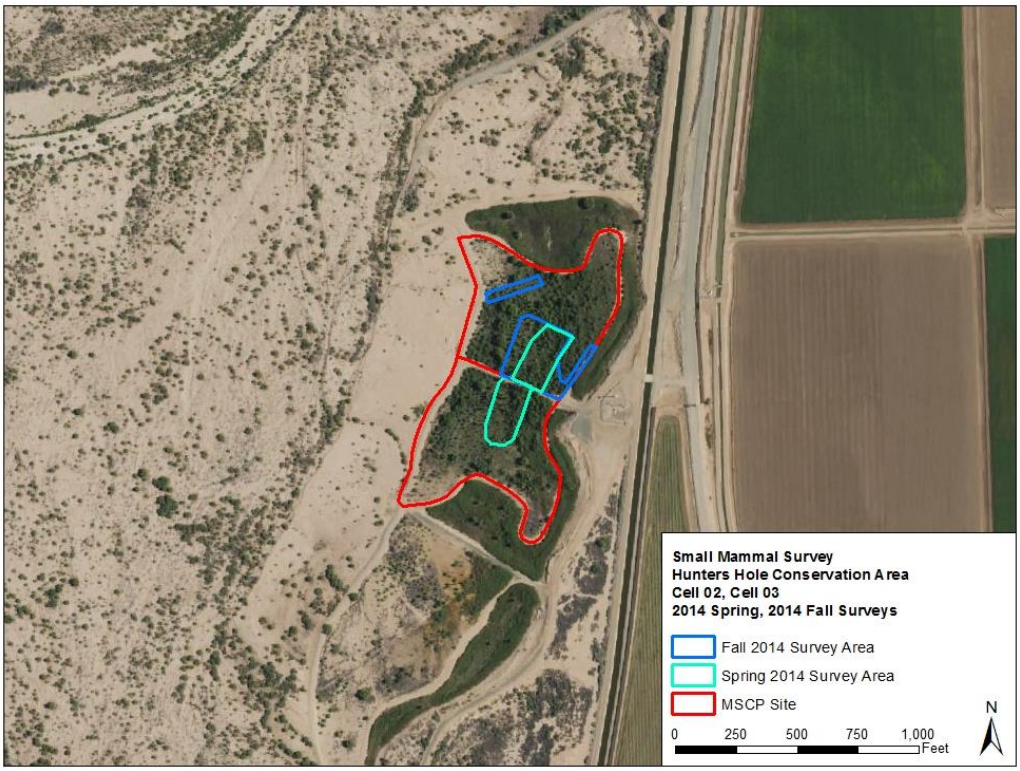


Figure 44.—Survey areas at Hunters Hole Cells 2 and 3, spring and fall 2014.

System Monitoring Areas

Pintail Slough

Pintail Slough is a field located at the southern end of the Havasu NWR (see figures 45–47). The trapping area was dominated be a dense area of Mexican devil weed interspersed with Bermuda grass, Johnsongrass, and some baccharis shrubs. Since 2011, eight species have been captured at the site (table 29). The site has historically supported CRCR and was used in LCR MSCP Work Task C27 (Small Mammal Populations Studies), but CRCR numbers in recent years have dropped. Trapping was intensified during the fall 2011 and fall 2013 trapping sessions because this site was part of the LCR MSCP Work Task C27 demography study.

Table 29.—Summary of small mammal surveys at Pintail Slough

Species	Fall 2012	Spring 2013	Fall 2013	Spring 2014	Fall 2014
Colorado River cotton rat	1	1	1	0	0
Desert pocket mouse	0	2	22	5	1
Cactus mouse	0	1	83	2	5
Deer mouse	0	0	1	0	0
Harvest mouse	0	0	6	3	4
House mouse	0	0	0	0	1
Merriam's kangaroo rat	0	0	0	0	0
White-throated wood rat	1	0	4	0	1
Total captures	**2**	**4**	**117**	**10**	**12**
Traps/nights	60/1	60/1	150/4 40/1	60/1	60/1

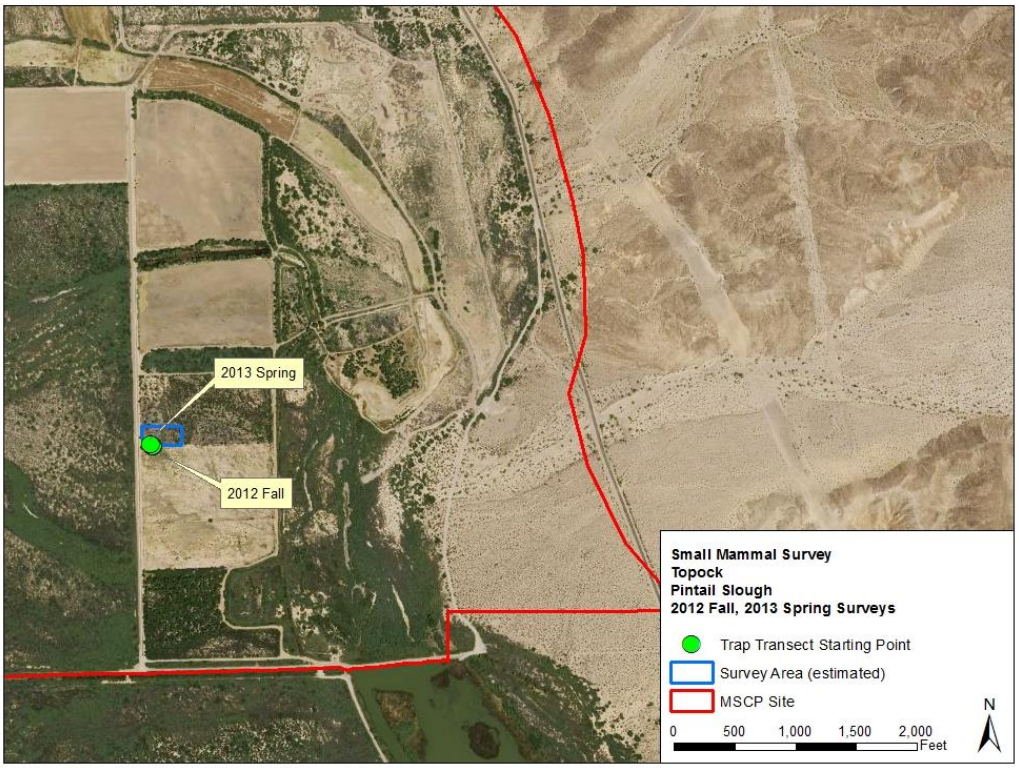


Figure 45.—Survey areas at Pintail Slough, fall 2012 through spring 2013.

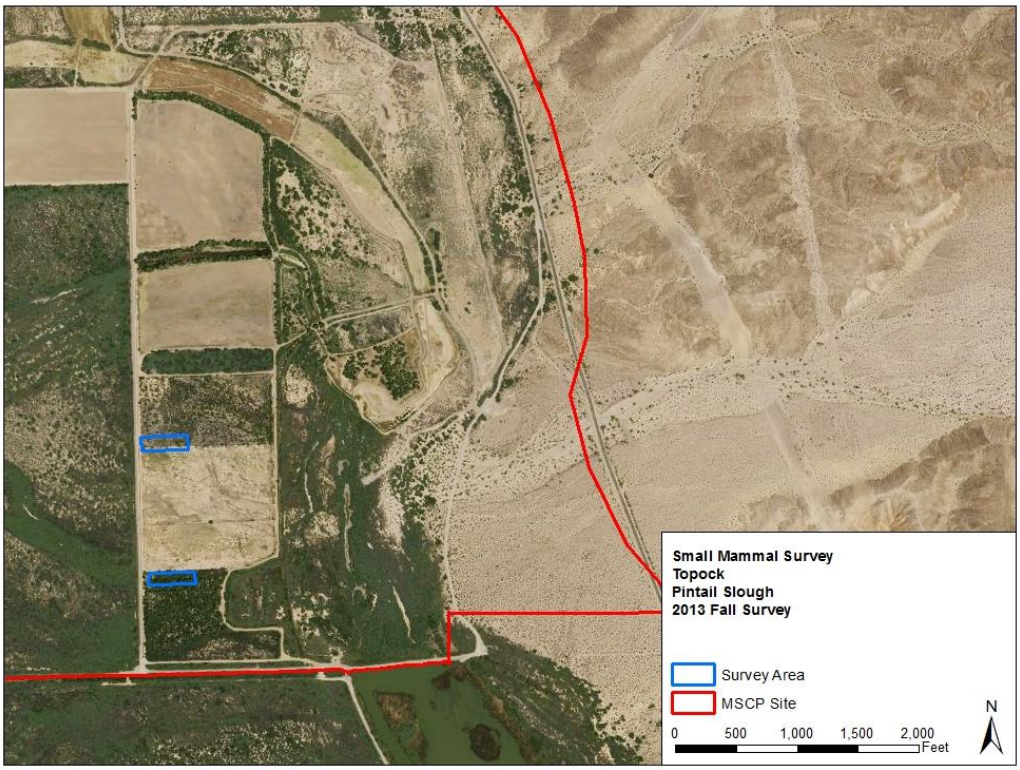


Figure 46.—Survey areas at Pintail Slough, fall 2013.

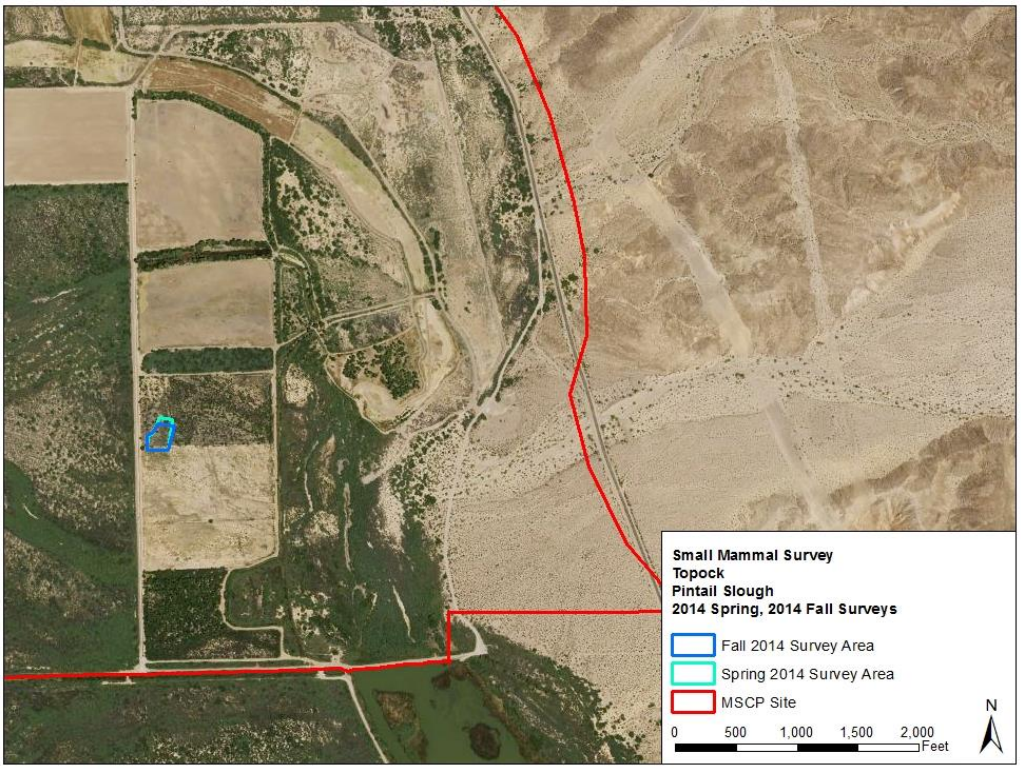


Figure 47.—Survey areas at Pintail Slough, spring and fall 2014.

Gila River

This area is located in a side channel of the Gila River just east of Highway 95 (see figure 48). Two areas had been trapped, including an arrowweed and baccharis shrub mixed area, as well as an area of dense bulrush mixed with some baccharis shrubs. Three YHCR were detected during the spring 2012 survey in dense bulrush (table 30).

Table 30.—Summary of small mammal surveys at Gila River/Highway 95

Species	Spring 2012	Fall 2012
Yuma hispid cotton rat	3	0
Cactus mouse	6	4
Deer mouse	0	1
Harvest mouse	1	0
White-throated wood rat	1	0
Total captures	**11**	**5**
Traps/nights	60/1	30/1

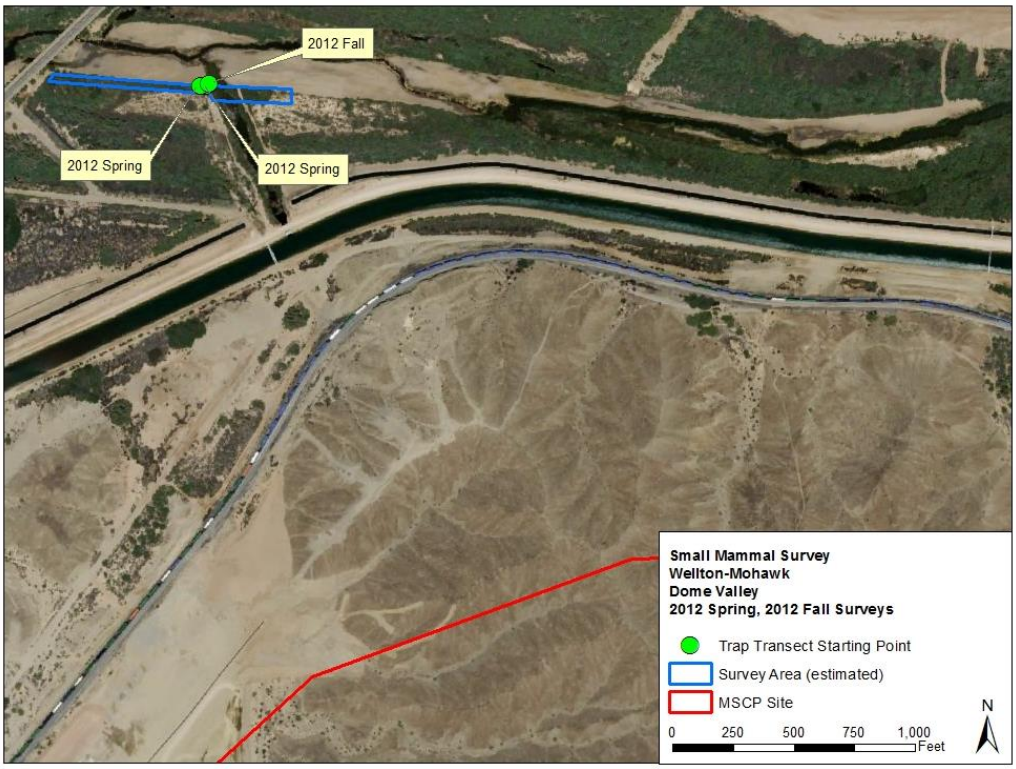


Figure 48.—Survey areas at Gila River, spring and fall 2012.

Kohen Ranch (Bill Williams River National Wildlife Refuge)

Kohen Ranch was surveyed in 2012 due to the presence of Bermuda grass and a patch of Mexican devil weed in a planted mesquite bosque (see figure 49). Three species were captured, including the DPMO; however, no cotton rats were captured (table 31).

Table 31.—Summary of small mammal surveys at Kohen Ranch

Species	Fall 2012
Desert pocket mouse	2
Cactus mouse	15
White-throated wood rat	3
Total captures	**20**
Traps/nights	90/1

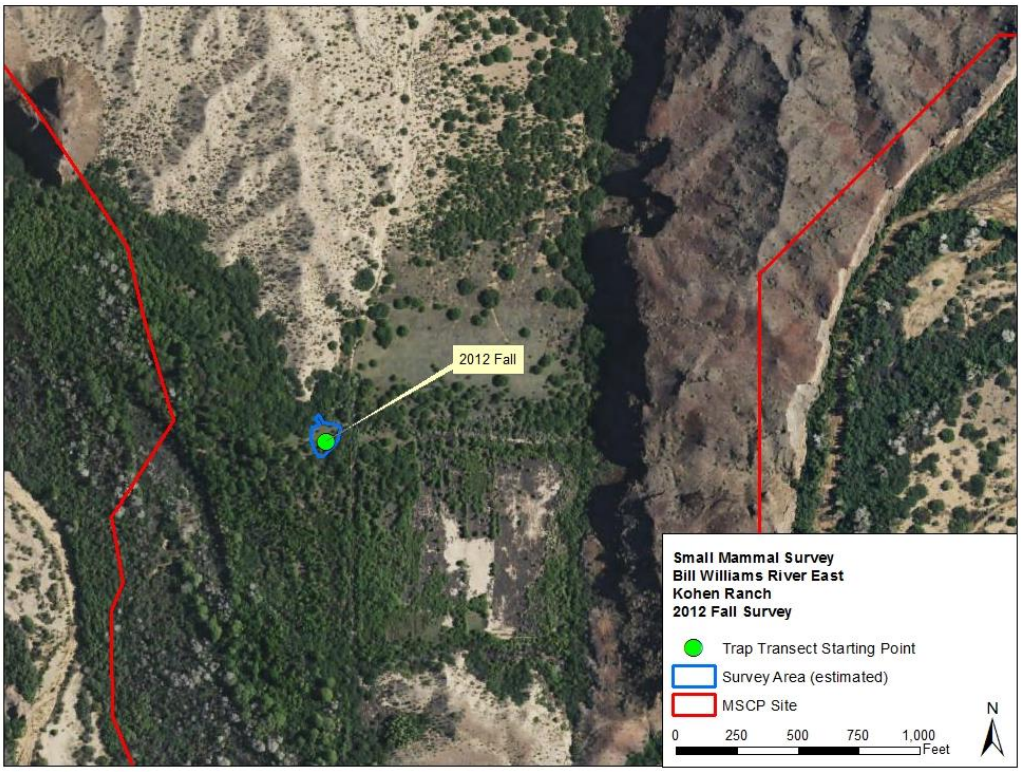


Figure 49.—Survey areas at Kohen Ranch, fall 2012.

Laguna Dam

The area around Laguna Dam where trapping was conducted was dominated by common reed (see figure 50). Four species were captured, including one YHCR (table 32). Only one survey was conducted at this site.

Table 32.—Summary of small mammal surveys at Laguna Dam

Species	Spring 2012
Yuma hispid cotton rat	1
Cactus mouse	3
Deer mouse	4
House mouse	5
Total captures	**13**
Traps/nights	30/1

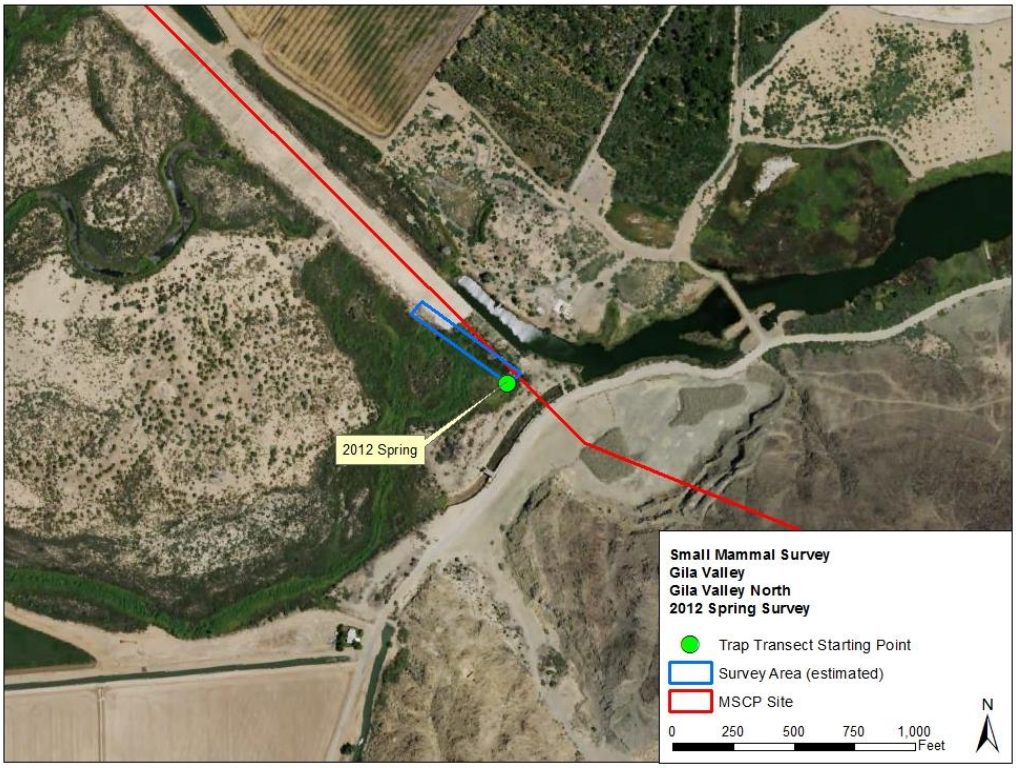


Figure 50.—Survey areas at Laguna Dam, spring 2012.

Pratt Agricultural Lease Restoration Area

The Pratt Agricultural Lease Restoration Area and the adjacent BLM revegetation fields were trapped in spring and fall 2012 and fall 2014 (see figures 51–52). Traps were set in areas where a dense understory of grass or shrubs was found. Five species were captured (table 33). No cotton rats or DPMO were captured.

Table 33.—Summary of small mammal surveys at the Pratt Agricultural Lease Restoration Area and BLM revegetation fields

Species	Spring 2012	Fall 2012	Fall 2014
Cactus mouse	0	1	0
Deer mouse	8	0	8
Harvest mouse	0	0	1
House mouse	6	10	0
White-throated wood rat	0	0	2
Total captures	**14**	**11**	**11**
Traps/nights	30/1	30/1	60/1

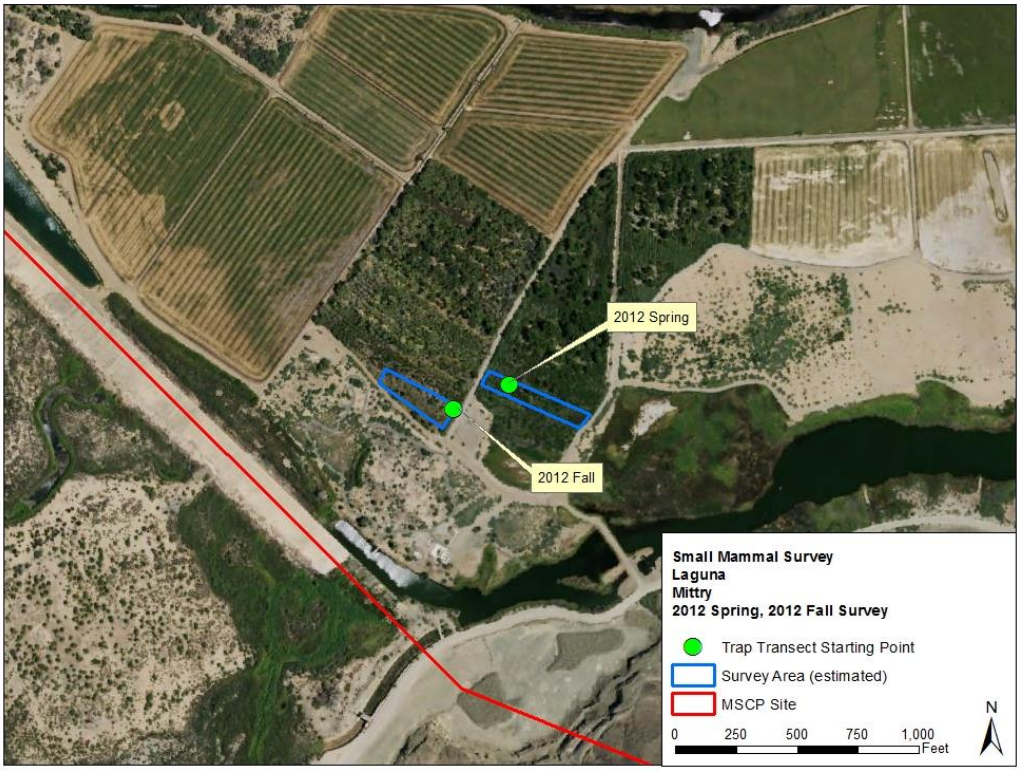


Figure 51.—Survey areas at the Pratt Agricultural Lease Restoration Area and BLM revegetation fields, spring and fall 2012.

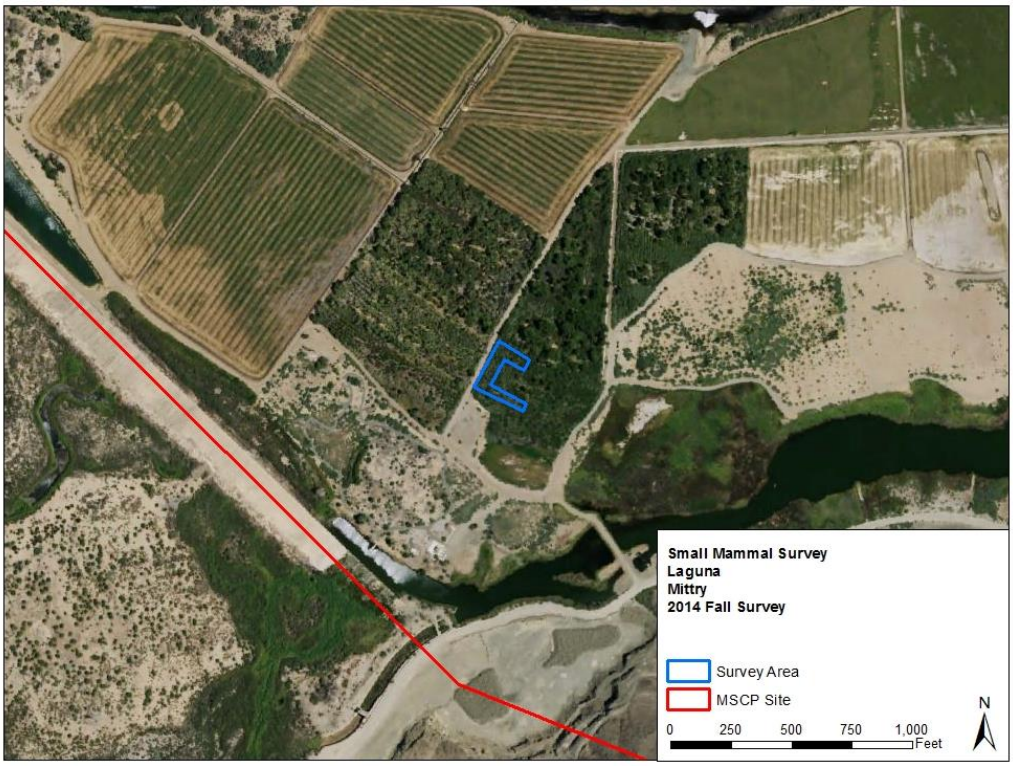


Figure 52.—Survey areas at the Pratt Agricultural Lease Restoration Area and BLM revegetation fields, fall 2014.

Ehrenberg Southwestern Willow Flycatcher Site, Ehrenberg, Arizona

The Ehrenberg Southwestern Willow Flycatcher Site near Ehrenberg, Arizona, was trapped a single time in 2012 (see figure 53). The area trapped had a dense understory of baccharis and dead woody underbrush. Two species were captured (table 34). No cotton rats or DPMO were detected.

Table 34.—Summary of small mammal surveys at the Ehrenberg Southwestern Willow Flycatcher Site

Species	Spring 2012
Cactus mouse	6
White-throated wood rat	5
Total captures	**11**
Traps/nights	45/1

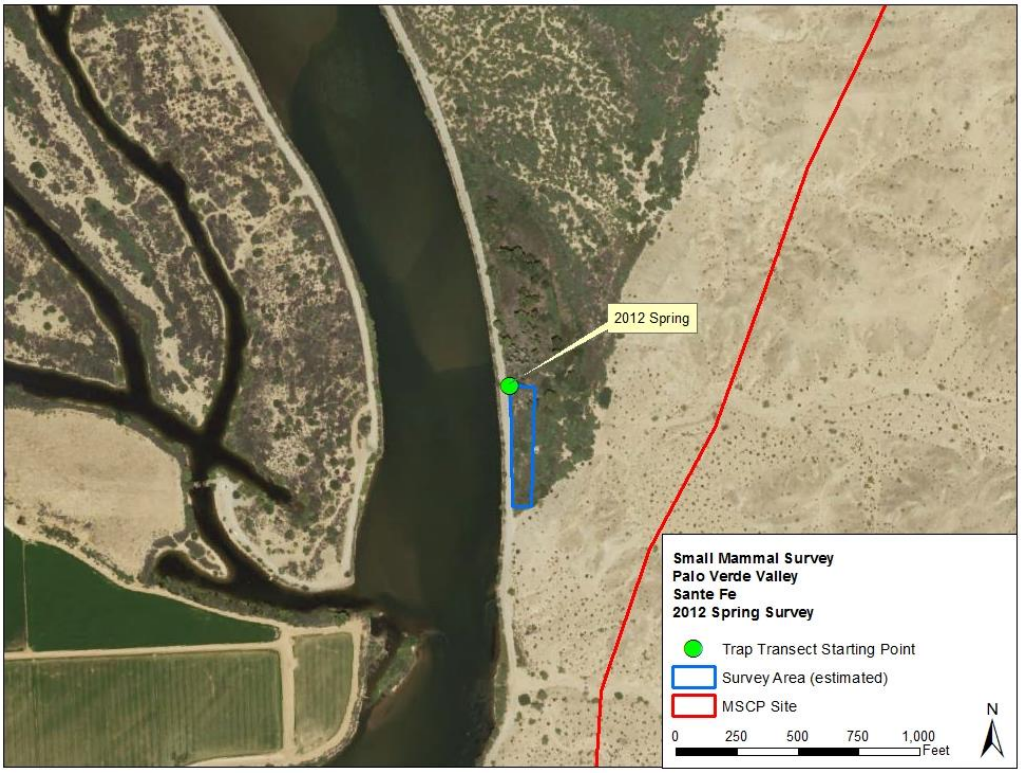


Figure 53.—Survey areas at the Ehrenberg Southwestern Willow Flycatcher Site, spring 2012.

Highline Canal

The Highline Canal was trapped in 2012 (see figure 54). The area was dominated by dense common reed with some baccharis mixed in. Six species were captured, including cotton rats and a DPMO (table 35).

Table 35.—Summary of small mammal surveys at Highline Canal

Species	Fall 2012
Yuma hispid cotton rat	2
Desert pocket mouse	1
Cactus mouse	10
Deer mouse	2
House mouse	5
White-throated wood rat	2
Total captures	**22**
Traps/nights	90/1

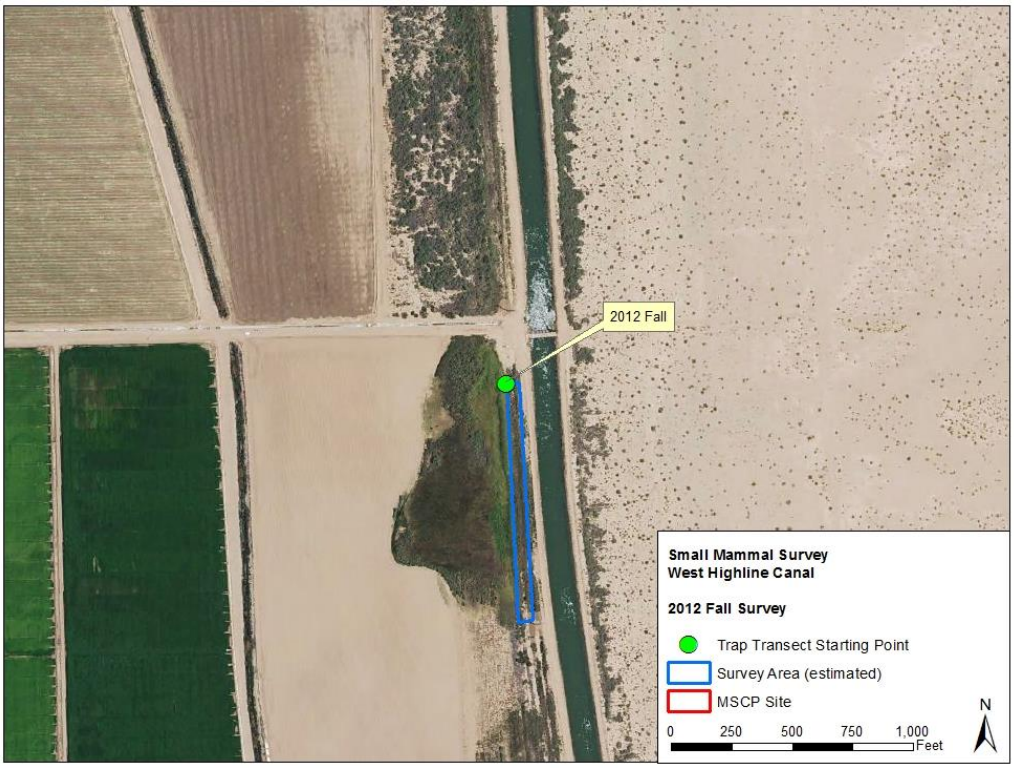


Figure 54.—Survey areas at Highline Canal, fall 2012.

Limitrophe Area in the Yuma Valley

The Limitrophe Area in the Yuma Valley was trapped a single time in 2013 (see figure 55). The area trapped was a mix of dense common reed and other areas of grass and shrubs. Four species were captured, including one cotton rat and a DPMO (table 36).

Table 36.—Summary of small mammal surveys at the Limitrophe Area in the Yuma Valley

Species	Fall 2013
Yuma hispid cotton rat	1
Desert pocket mouse	1
Cactus mouse	5
House mouse	1
Total captures	**8**
Traps/nights	20/1

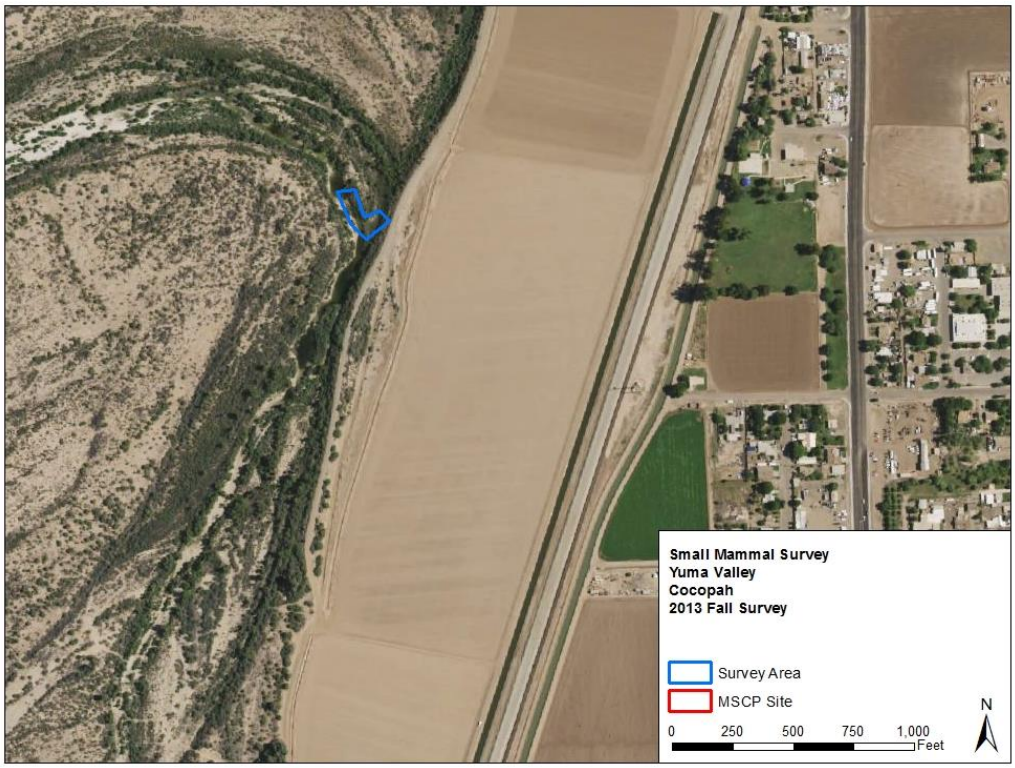


Figure 55.—Survey areas at the Limitrophe Area in the Yuma Valley, fall 2013.

DISCUSSION

Conservation Areas

CRCR have been caught at the BBCA every trapping session since spring 2012. Prior to this, they had not been captured in Nevada since the last recorded CRCR capture in Nevada in 1966 (Bradley 1966). This lag in captures may reflect a lack of effort in the area prior to LCR MSCP trapping, the stochasticity of CRCR population fluctuations, and/or a change in available habitat allowing for a population to sustain itself in the area. DPMO have been caught in varying numbers consistently since fall 2012. The trapping area is adjacent to sandy habitat suitable for DPMO, which is the likely cause of the high capture rate during some trapping sessions.

DPMO have been consistently captured from Reach 3 to Reach 7 in both system-wide and post-development monitoring efforts. It is unclear whether the individuals captured are of the *sobrinus* subspecies, which can be identified through genetic analyses. Prior research has shown the *sobrinus* subspecies to occur on either side of the LCR south to the southern tip of Nevada (Jezkova et al. 2009). Reading from the range maps in the Jezkova 2009 paper, individuals caught south of the documented *C. p. sobrinus* range south to the international border, if not *C. p. sobrinus*, are likely *C. p. penicillatus.*

No CRCR have been captured in the BLCA since fall 2012. Surveys are conducted within a narrow strip of marginal habitat within the conservation area, which may not be large enough to sustain a population of CRCR for any amount of time more than a temporary stopover. Should the habitat change to reflect the preferred habitat of CRCR, the site may experience an increase in numbers. The site will continue to be assessed for additional suitable habitat.

The Accretion Bench adjacent to the PVER has sustained a fluctuating population of CRCR since trapping began there and may serve as a source population for the restoration site. Seasonal variability in water levels leading to extended flooding of the area and changing habitat characteristics may be driving lower capture numbers.

Although in years prior to 2011 the Cibola Nature Trail has supported large numbers of CRCR captures, recent years have produced fewer captures. This is likely due to either changing habitat dynamics, with Johnsongrass increasingly being shaded out by the baccharis, or natural fluctuations in the CRCR population size.

Yuma East Wetlands has proven to be a consistently successful site, producing YHCR captures during every survey conducted and DPMO in three of four surveys. This is likely due to the structural heterogeneity and diversity of habitat types within the site supporting populations of both LCR MSCP species.

Hunters Hole has not produced any YHCR captures yet. The site has structural characteristics that are similar to sites where cotton rats have been captured. As YHCR have been captured in system-wide survey sites nearby, monitoring at Hunters Hole may result in YHCR captures once a successful colonization event occurs or if populations increase, if they are present and not yet detected.

System-Wide Areas

CRCR were captured in the Highline Canal and Pintail Slough system-wide monitoring areas in 2012–13. Pintail Slough produced only three CRCR captures over five survey sessions, which is a drastic reduction in the number of captures from the 2009 and 2010 survey periods. This decline in capture numbers may be due to a change in the watering schedule of Pintail Slough, resulting in habitat senescence.

YHCR were captured in Reaches 6 and 7 during system-wide surveys conducted in 2012–13. The line between CRCR and YHCR appears to lie somewhere between the Cibola and Imperial Ponds National Wildlife Refuges. It is unlikely that delineating the species boundary will be pursued, as it is not essential to the completion of the LCR MSCP conservation measures.

Future system-wide monitoring will be focused on identifying potential habitat outside of conservation areas and determining the continued presence of LCR MSCP species within those habitat patches.

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ATTACHMENT 1

Example Data Sheet

LCR MSCP Post-Development/System-Wide Monitoring
Small Mammal Presence/Absence Data Sheet

Site:_____ Date:_____ Observers:_____

# of transects in grid:_____ # of stations per transect:_____ # of traps per station:_____

Trimble filename:_____ Grid starting point UTM:_____

Direction of transect A:_____ Direction where other transects begin:_____

Transect	Station #	Species	Age	Sex	UTM of Sigmodon/PIT tag ID/DNA sample/other

If two traps are set per station, they are labeled 1a and 1b, 2a and 2b, etc. Measurements are only taken when needed for ID.

PIT tag and DNA sample (tail/ear clipping) only for *Sigmodon* spp.; if sample taken previously, mark as recapture.

In title, circle whether or not this survey is for post-development or system-wide purposes.

Notes: