Lower Colorado River Multi-Species Conservation Program

Balancing Resource Use and Conservation

Post-Development and System-Wide Monitoring of Rodent Populations

Fiscal Year 2017

May 2018

Work conducted under LCR MSCP Work Tasks D10 and F3

Lower Colorado River Multi-Species Conservation Program Steering Committee Members

Federal Participant Group

Bureau of Reclamation
U.S. Fish and Wildlife Service
National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

Arizona Participant Group

Arizona Department of Water Resources
Arizona Electric Power Cooperative, Inc.
Arizona Game and Fish Department
Arizona Power Authority
Central Arizona Water Conservation District
Cibola Valley Irrigation and Drainage District
City of Bullhead City
City of Lake Havasu City
City of Mesa
City of Somerton
City of Yuma
Electrical District No. 3, Pinal County, Arizona
Golden Shores Water Conservation District
Mohave County Water Authority
Mohave Valley Irrigation and Drainage District
Mohave Water Conservation District
North Gila Valley Irrigation and Drainage District
Town of Fredonia
Town of Thatcher
Town of Wickenburg
Salt River Project Agricultural Improvement and Power District
Unit "B" Irrigation and Drainage District
Wellton-Mohawk Irrigation and Drainage District
Yuma County Water Users' Association
Yuma Irrigation District
Yuma Mesa Irrigation and Drainage District

Other Interested Parties Participant Group

QuadState Local Governments Authority
Desert Wildlife Unlimited

California Participant Group

California Department of Fish and Wildlife
City of Needles
Coachella Valley Water District
Colorado River Board of California
Bard Water District
Imperial Irrigation District
Los Angeles Department of Water and Power
Palo Verde Irrigation District
San Diego County Water Authority
Southern California Edison Company
Southern California Public Power Authority
The Metropolitan Water District of Southern California

Nevada Participant Group

Colorado River Commission of Nevada
Nevada Department of Wildlife
Southern Nevada Water Authority
Colorado River Commission Power Users
Basic Water Company

Native American Participant Group

Hualapai Tribe
Colorado River Indian Tribes
Chemehuevi Indian Tribe

Conservation Participant Group

Ducks Unlimited
Lower Colorado River RC&D Area, Inc.
The Nature Conservancy

Lower Colorado River Multi-Species Conservation Program

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Fiscal Year 2017

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ACRONYMS AND ABBREVIATIONS

km	kilometer(s)
LCR	lower Colorado River
LCR MSCP	Lower Colorado River Multi-Species Conservation Program
MEFF	mobile electronic field form
UTM	Universal Transverse Mercator

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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 Fremont cottonwood-Goodding's willow [*Populus fremontii-Salix gooddingii*], 1,320 acres of honey mesquite [*Prosopis glandulosa*], 512 acres of marsh, and 360 acres of backwater) for 27 covered species, including the Colorado River cotton rat (*Sigmodon arizonae plenus*) and Yuma hispid cotton rat (*Sigmodon hispidus eremicus*). The *sobrinus* subspecies of the desert pocket mouse (*Chaetodipus penicillatus*) is being evaluated to determine if it should be added as a covered species. The presence of Colorado River cotton rats, Yuma hispid cotton rats, and desert pocket mice at existing habitat along the lower Colorado River and at LCR MSCP conservation areas was monitored under Work Task D10 (System Monitoring of Rodent Populations) and Work Task F3 (Small Mammal Colonialization of Conservation Areas). Trapping was conducted in eight conservation areas and four system-wide survey sites during fiscal year 2017. Seven Colorado River cotton rat captures were recorded at conservation areas (Big Bend Conservation Area, Palo Verde Ecological Reserve, Cibola Valley Conservation Area, and Cibola National Wildlife Refuge Unit #1 Conservation Area), and none were captured during system-wide surveys. Fifteen Yuma hispid cotton rats were captured in conservation areas (Yuma East Wetlands and Hunters Hole), and none were captured during system-wide surveys. Forty-five desert pocket mice were captured in conservation areas (Big Bend Conservation Area, Beal Lake Conservation Area, Palo Verde Ecological Reserve, Cibola Valley Conservation Area, Cibola National Wildlife Refuge Cottonwood Genetics Fields, and Laguna Division Conservation Area), and four were captured during system-wide surveys. A genetic analysis was not conducted, so it is unknown if these mice were of the *sobrinus* subspecies, which is thought to be restricted to southeast Nevada, northwestern Arizona, and extreme southwestern Utah.

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 27 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 Fremont cottonwood-Goodding's willow [*Populus fremontii-Salix gooddingii*] [hereafter cottonwood-willow], 1,320 acres of honey mesquite [*Prosopis glandulosa*], 512 acres of marsh, and 360 acres of backwater).

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. These include the Colorado River cotton rat (*Sigmodon arizonae plenus*) and Yuma hispid cotton rat (*Sigmodon hispidus eremicus*). The *sobrinus* subspecies of the desert pocket mouse (*Chaetodipus penicillatus*) is being evaluated to determine if it should be added as a covered species.

Within the LCR MSCP habitat creation goals, 125 acres of habitat are to be created for the Colorado River cotton rat, and 76 acres are to be created for the Yuma hispid cotton rat. It is currently believed that the ranges of these two cotton rat species do not overlap. Those captured south of the Trigo and Chocolate Mountains in the area of the Imperial National Wildlife Refuge and south of the Yuma, Arizona, area to date are Yuma hispid cotton rats. Those captured north of the aforementioned mountain ranges to date are Colorado River cotton rats. The northernmost historic records of Colorado River cotton rats are from an area just south of Laughlin, Nevada (Hall 1946; Bradley 1966). Colorado River cotton rats were captured in 2012 at the Big Bend Conservation Area, marking the first record of the species in Nevada since 1966.

Desert pocket mice occur in creosote bush (*Larrea tridentata*) 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, but it is believed to be within Clark County, Nevada, and may be present farther south. The desert pocket mice caught during the 2017 small mammal surveys were not evaluated to determine whether or not they were of the *sobrinus* subspecies.

The Bureau of 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 is being monitored under Work Task D10 (System Monitoring of Rodent Populations) and Work Task F3 (Small Mammal Colonialization of Conservation Areas). In addition, Work Task C27 (Small Mammal Population Studies) was conducted to identify distribution, genetics, and habitat requirements and to establish monitoring protocols for the covered small mammal species.

METHODS

Sherman live traps (3 x 3.75 x 12 inches) were placed non-randomly in areas with the highest likelihood of encountering the 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 (Work Task C27) (Goertz 1964). 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 are focused on determining the presence of cotton rat species. All other captures are incidental to the main focus, and the methods were not designed to estimate abundance; therefore, the numbers of individuals of each species (including Colorado River cotton rats and Yuma hispid cotton rats) reported here are rough indices that do not provide reliable means of analyzing population trends.

Sherman live traps are triggered by an animal stepping on a pressure plate that then closes a trap door behind it. 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. The 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 is estimated with pacing and is not measured exactly; it may vary if the more densely vegetated areas are dispersed across the trapping area.

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).

The approximate location of each trap was recorded, and the traps were collected the following morning using a Trimble Juno Global Positioning System unit

running a mobile electronic field form (MEFF) using the software Terrasync. 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. Data were entered by hand on paper data sheets and electronically on the Global Positioning System unit using the MEFF.

Captured animals were either viewed inside the trap or transferred into a clear plastic bag and identified to species. The animals were identified using the Mammals of California field guide (Jameson and Peeters 2004), the Kays and Wilson field guide (2002), and 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 (juvenile, subadult, and adult). The age classes of the cotton rats were determined based on the general size of an 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 juvenile or adult, and gender was not determined. Measurements were taken, if needed, for identification. A MEFF was used to record information on all animals captured, whether they were 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 on a paper data sheet as backup. 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.

STUDY AREAS

Trapping was conducted in eight LCR MSCP conservation areas and three system-wide survey sites within Reaches 2–7 (figure 1).

LCR MSCP Conservation Areas

Big Bend Conservation Area

The Big Bend Conservation Area is located in Nevada 5 miles (8 kilometers [km]) south of Laughlin, Nevada, along the Needles Highway (see figure 1). 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 mule fat (*Baccharis salicifolia*) (figure 2). The majority of the small mammal captures were located at the interface of a grassy area comprised of dallisgrass (*Paspalum dilatum*) and bushy bluestem (*Andropogon glomeratus*) with the upland shrubs.

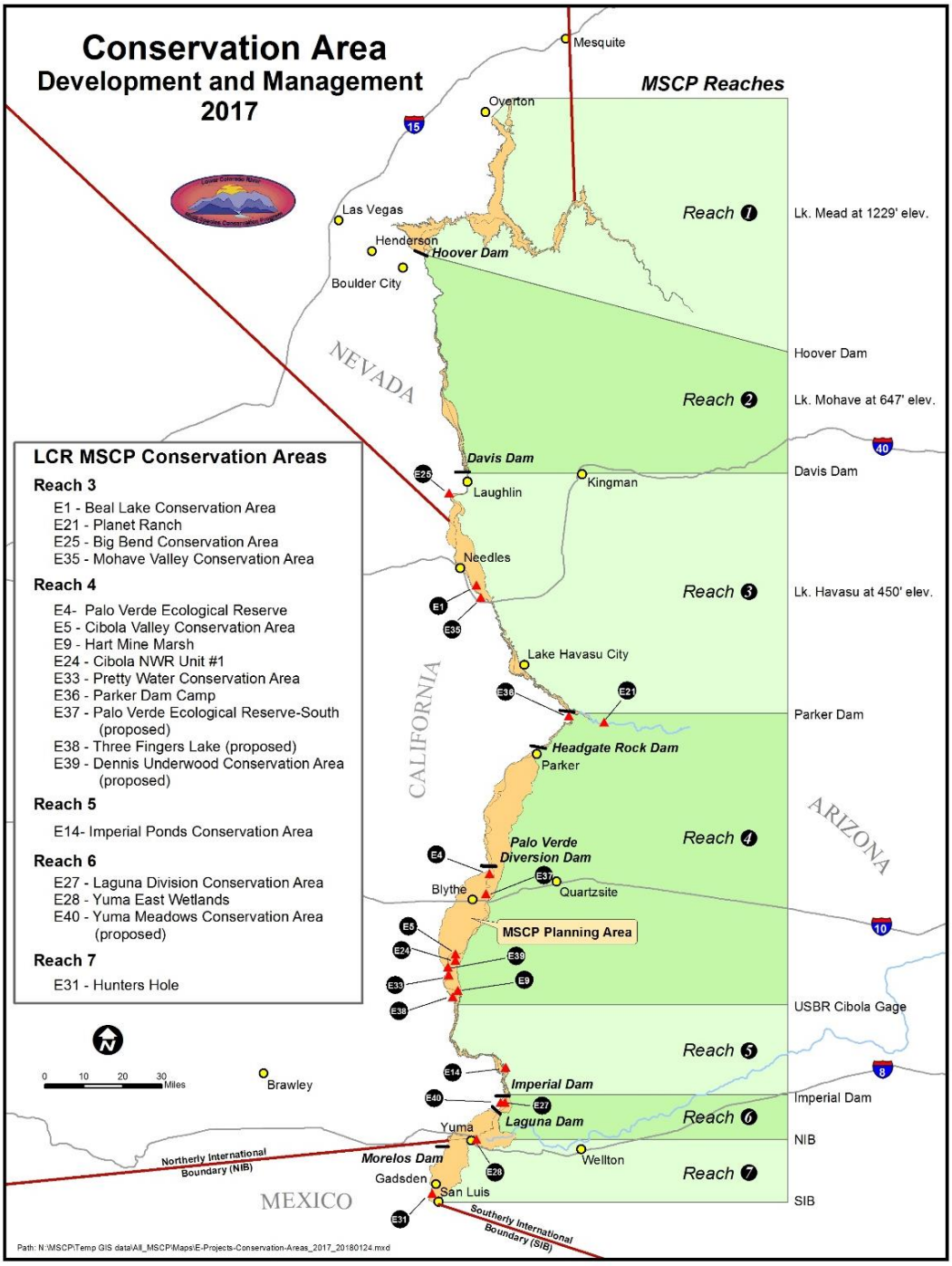


Figure 1.—LCR MSCP conservation areas.

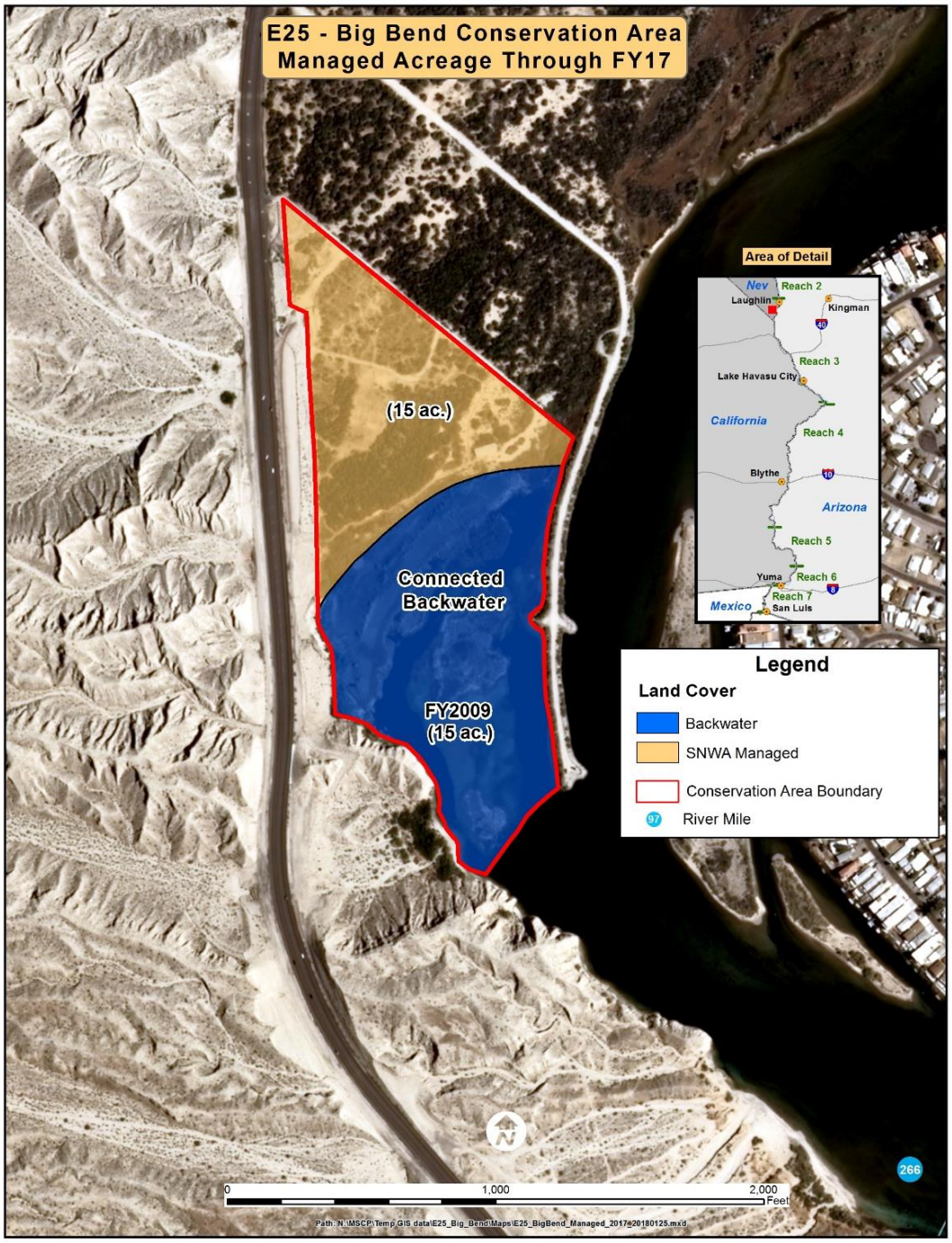
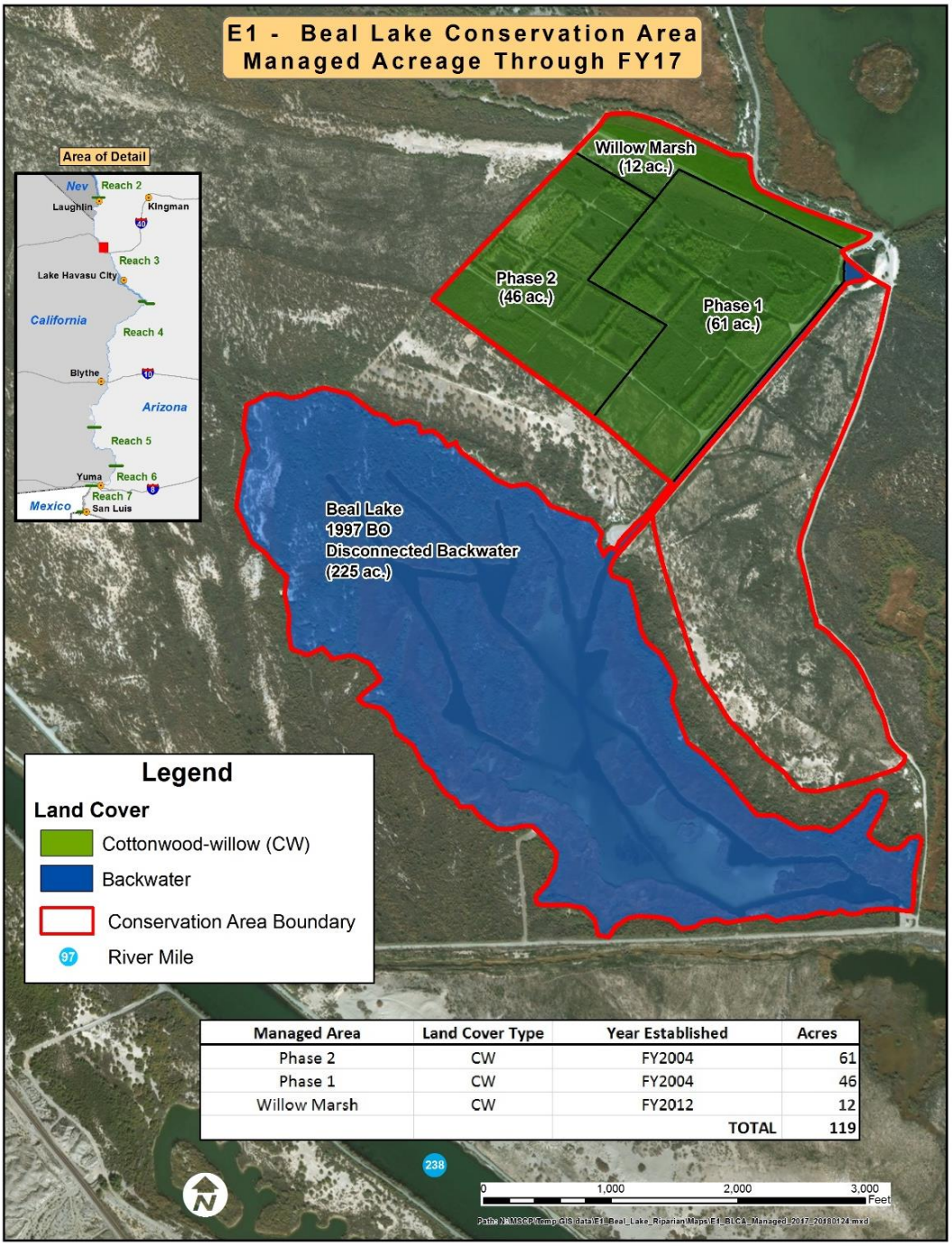


Figure 2.—Big Bend Conservation Area managed acreage through fiscal year 2017.

Beal Lake Conservation Area

The Beal Lake Conservation Area is 100 acres adjacent to Beal Lake and Topock Marsh, inside the Havasu National Wildlife Refuge on the Arizona side of the Colorado River (see figure 1). The site is within Reach 3. It is a two-phase habitat creation project that was initiated in spring 2003 (figure 3). The site was planted with Fremont cottonwood, Goodding's willow, coyote willow (*Salix exigua*), honey mesquite, and screwbean mesquite (*Prosopis pubescens*). Arrowweed and some baccharis (*Baccharis* spp.) have begun to fill in the open areas and edges of most of the plots in the site.

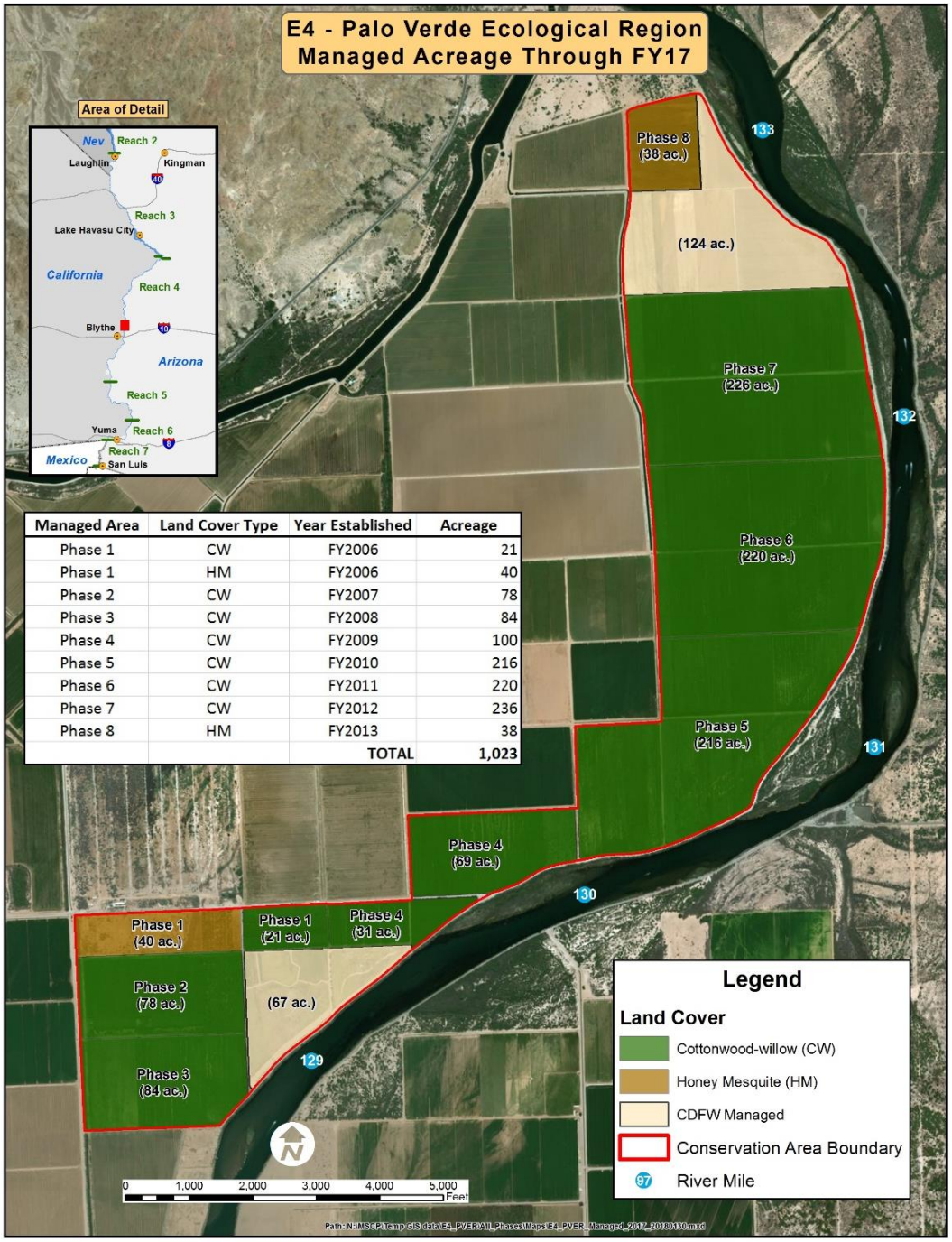


Managed Area	Land Cover Type	Year Established	Acres
Phase 2	CW	FY2004	61
Phase 1	CW	FY2004	46
Willow Marsh	CW	FY2012	12
		TOTAL	119

Figure 3.—Beal Lake Conservation Area managed acreage through fiscal year 2017.

Palo Verde Ecological Preserve

The Palo Verde Ecological Preserve is a conservation area located 5 miles (8 km) north of Blythe, California, along the California side of the Colorado River (see figure 1). The site is within Reach 4. It encompasses 1,300 acres. The acreages are separated into nine different phases, with one phase planted every year through 2014 (figure 4). In spring 2006, a 31-acre nursery (Phase 1) was planted. In spring 2007, Phase 2 was planted with 80 acres of Fremont cottonwood, Goodding's willow, coyote willow, and other riparian plants. Phase 3 was planted in spring 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 honey mesquite and a mix of native grasses. Phases 5, 6, and 7 were planted in 2010, 2011, and 2012, respectively, with cottonwood-willow habitat. Phase 8 was planted in 2013 with 38 acres of honey mesquite and quailbush (*Atriplex lentiformis*) habitat.

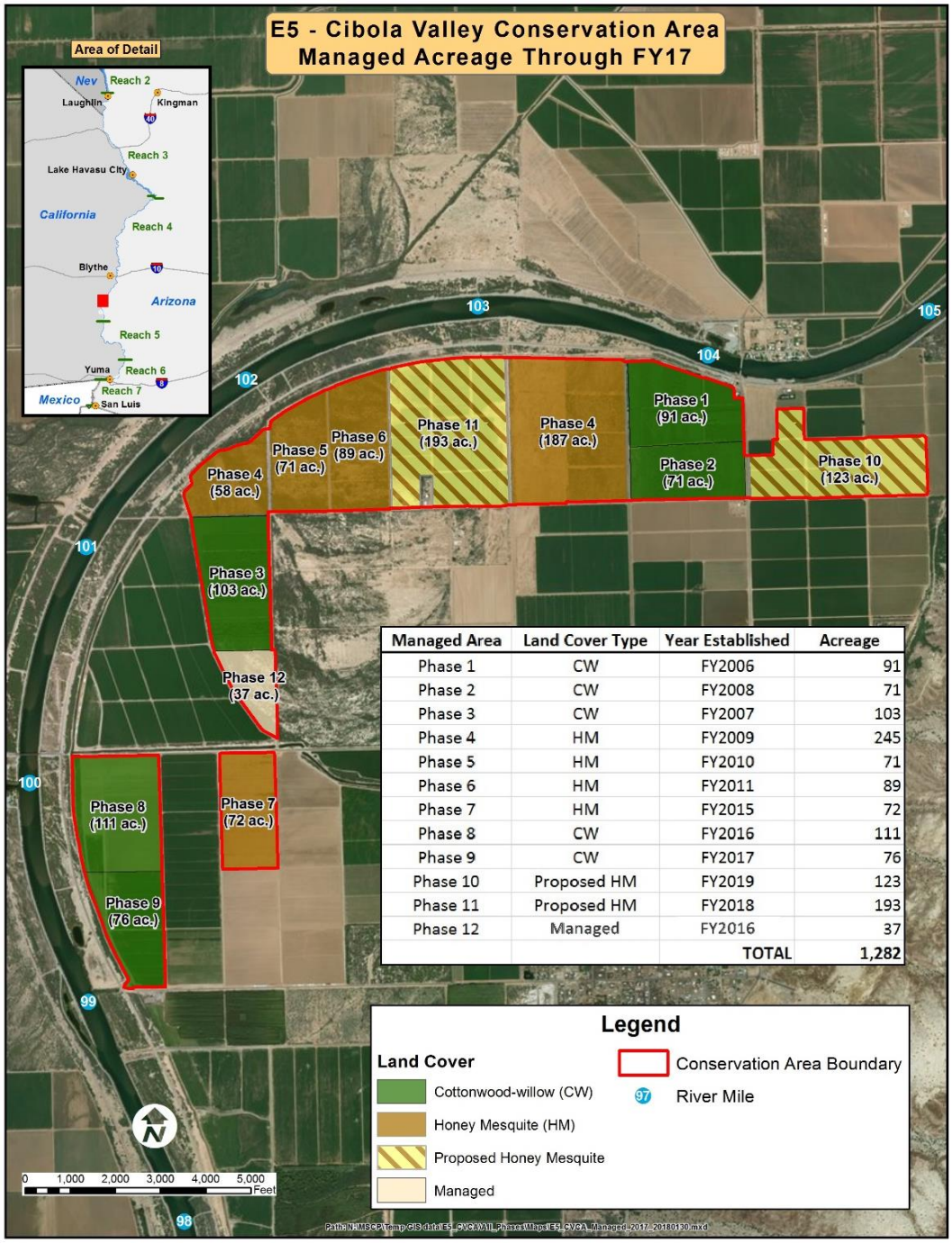


Managed Area	Land Cover Type	Year Established	Acreage
Phase 1	CW	FY2006	21
Phase 1	HM	FY2006	40
Phase 2	CW	FY2007	78
Phase 3	CW	FY2008	84
Phase 4	CW	FY2009	100
Phase 5	CW	FY2010	216
Phase 6	CW	FY2011	220
Phase 7	CW	FY2012	236
Phase 8	HM	FY2013	38
		TOTAL	1,023

Figure 4.—Palo Verde Ecological Reserve managed acreage through fiscal year 2017.

Cibola Valley Conservation Area

The Cibola Valley Conservation Area is located in Arizona adjacent to the Colorado River, approximately 15 miles (24 km) south of Blythe, California (see figure 1). The site is within Reach 4. It will encompass about 1,235 acres when completed. Three phases included the planting of Fremont cottonwood, Goodding's willow, coyote willow, and other riparian plant species. Phase 1 was planted in spring 2006 and contains a 22-acre nursery and a 64-acre area of cottonwood-willow habitat. Phase 3 was planted in spring 2007 and contains over 80 acres of cottonwood-willow planted in different combinations (figure 5). Phase 3 also includes 11 acres of baccharis mixed with some cottonwood-willow. Phase 2 was planted in spring 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 honey mesquite and quailbush. Phase 5 was planted in 2010 with 71 acres of honey mesquite and quailbush. Phase 6 was planted in 2011 with 89 acres of honey mesquite and quailbush.

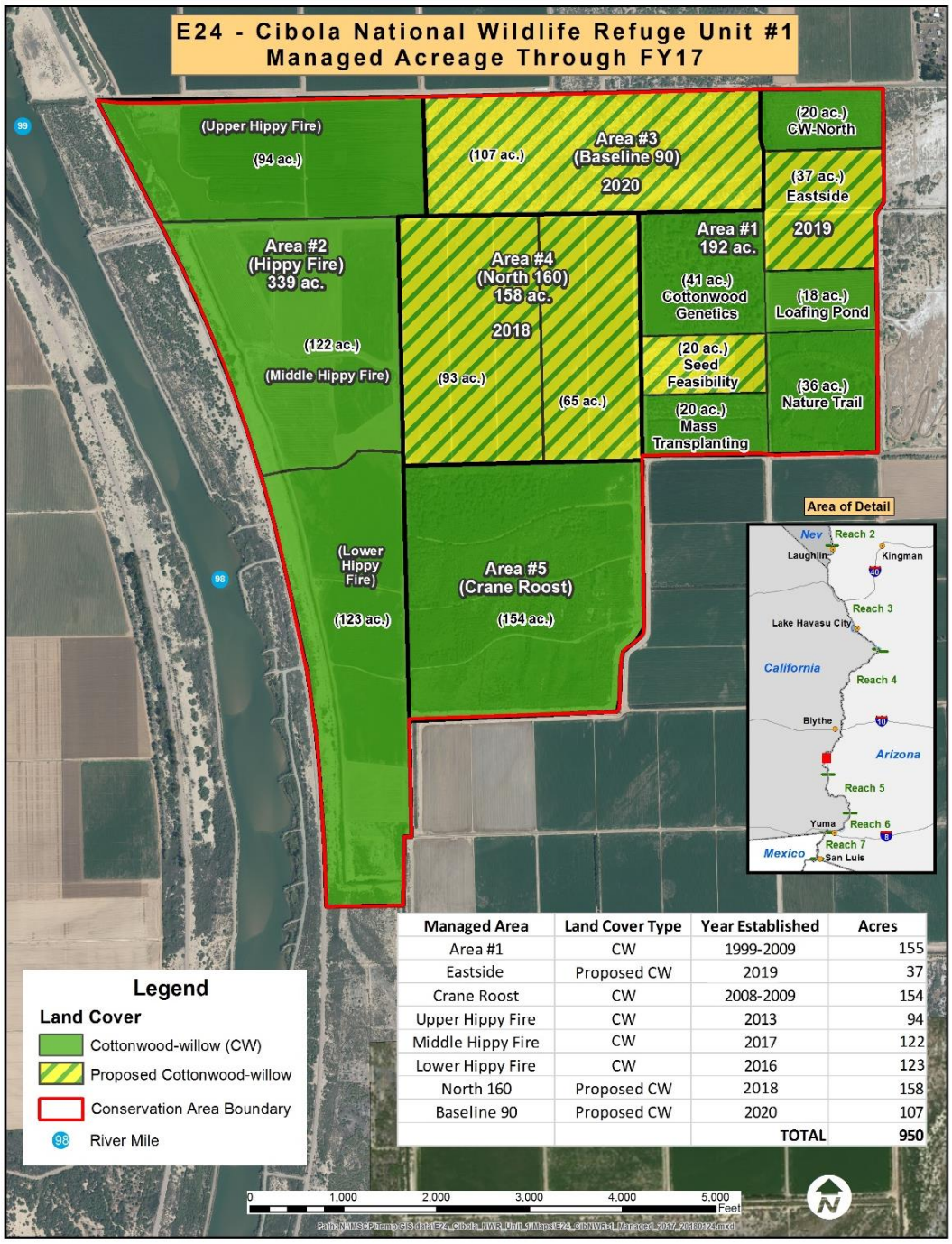


Managed Area	Land Cover Type	Year Established	Acreage
Phase 1	CW	FY2006	91
Phase 2	CW	FY2008	71
Phase 3	CW	FY2007	103
Phase 4	HM	FY2009	245
Phase 5	HM	FY2010	71
Phase 6	HM	FY2011	89
Phase 7	HM	FY2015	72
Phase 8	CW	FY2016	111
Phase 9	CW	FY2017	76
Phase 10	Proposed HM	FY2019	123
Phase 11	Proposed HM	FY2018	193
Phase 12	Managed	FY2016	37
		TOTAL	1,282

Figure 5.—Cibola Valley Conservation Area managed acreage through fiscal year 2017.

Cibola National Wildlife Refuge Unit #1 Conservation Area

The Cibola National Wildlife Refuge is located approximately 30 miles (48 km) south of Blythe, California, along 12 miles (19 km) of the LCR in Arizona and California (see figure 1). The site is within Reach 4. The Cibola National Wildlife Refuge is divided into six management units, of which the Cibola National Wildlife Refuge Unit #1 Conservation Area comprises approximately 949 acres (figure 6). The Nature Trail was planted in 1999 with 34 acres of cottonwood-willow and honey mesquite habitat. The central portion of the site is a mix of dense Johnsongrass (*Sorghum halepense*) and baccharis. The Cottonwood Genetics field was planted in 2007 with Fremont cottonwood as part of a Northern Arizona University study. It has a sparse canopy structure, and dense patches of Johnsongrass have come into the open areas.

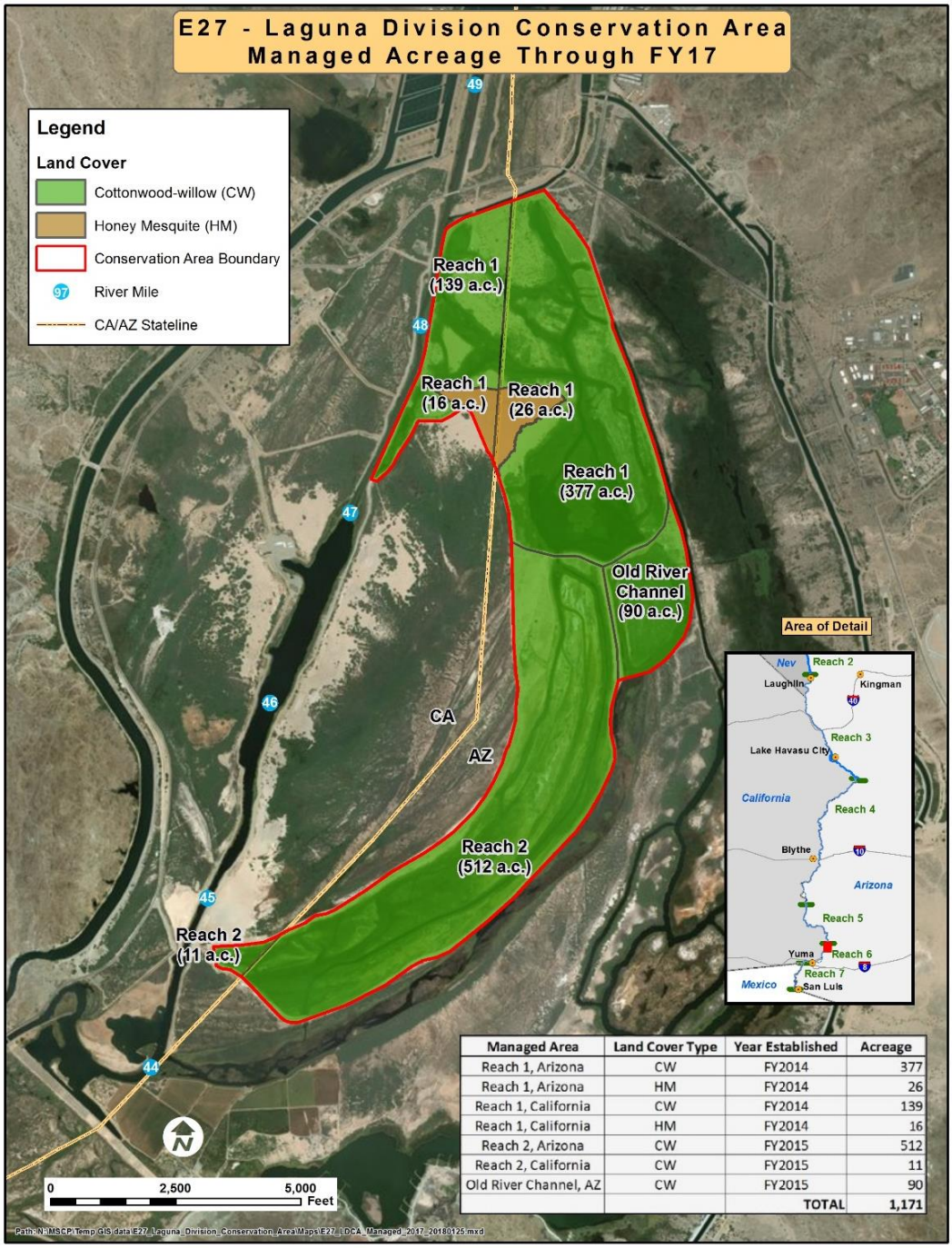


Managed Area	Land Cover Type	Year Established	Acres
Area #1	CW	1999-2009	155
Eastside	Proposed CW	2019	37
Crane Roost	CW	2008-2009	154
Upper Hippy Fire	CW	2013	94
Middle Hippy Fire	CW	2017	122
Lower Hippy Fire	CW	2016	123
North 160	Proposed CW	2018	158
Baseline 90	Proposed CW	2020	107
		TOTAL	950

Figure 6.—Cibola National Wildlife Refuge Unit #1 Conservation Area managed acreage through fiscal year 2017.

Laguna Division Conservation Area

The Laguna Division Conservation Area is located 20 miles (32 km) north of Yuma Arizona, between the Imperial Dam and Laguna Dam (see figure 1). The site is within Reach 6. The site covers 1100 acres, straddling the California/Arizona State boundary. The Laguna Division Conservation Area comprises approximately 200 acres of open water and marsh, 430 acres of cottonwood-willow, and 400 acres of honey mesquite habitat. Planting was completed in 2016 (figure 7).

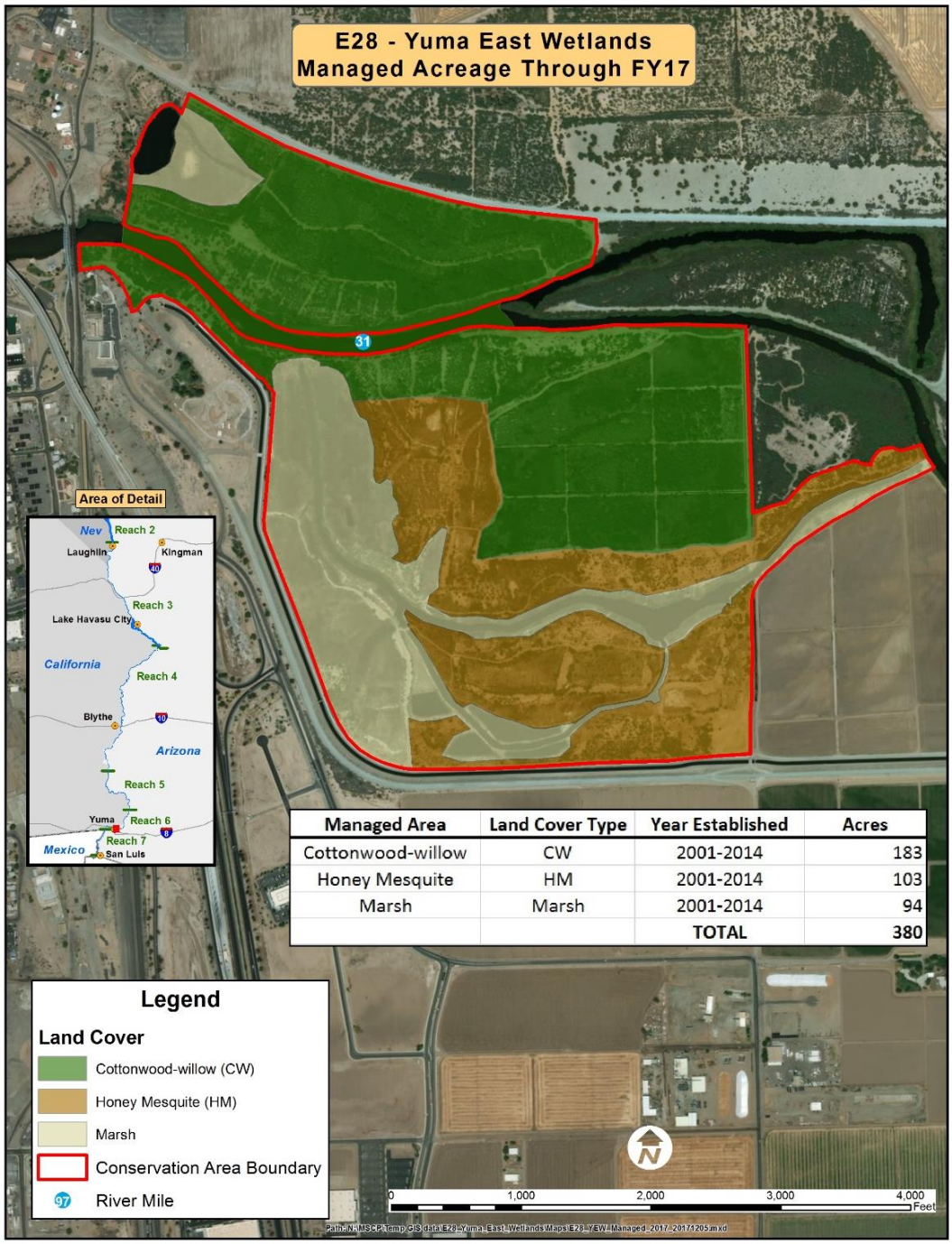


Managed Area	Land Cover Type	Year Established	Acreage
Reach 1, Arizona	CW	FY2014	377
Reach 1, Arizona	HM	FY2014	26
Reach 1, California	CW	FY2014	139
Reach 1, California	HM	FY2014	16
Reach 2, Arizona	CW	FY2015	512
Reach 2, California	CW	FY2015	11
Old River Channel, AZ	CW	FY2015	90
		TOTAL	1,171

Figure 7.—Laguna Division Conservation Area managed acreage through fiscal year 2017.

Yuma East Wetlands

Yuma East Wetlands is a 392-acre conservation area consisting of lands 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 1). Habitat restoration activities began in Yuma East Wetlands in 2004. The majority of the planting took place in 2009, including 115 acres of cottonwood-willow habitat, 102 acres of marsh habitat, and 175 acres of honey mesquite habitat (figure 8). In 2013, the LCR MSCP entered into partnership with the Quechan Indian Tribe, the city of Yuma, the Arizona Game and Fish Commission, and the 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 Yuma hispid cotton rat colonization.

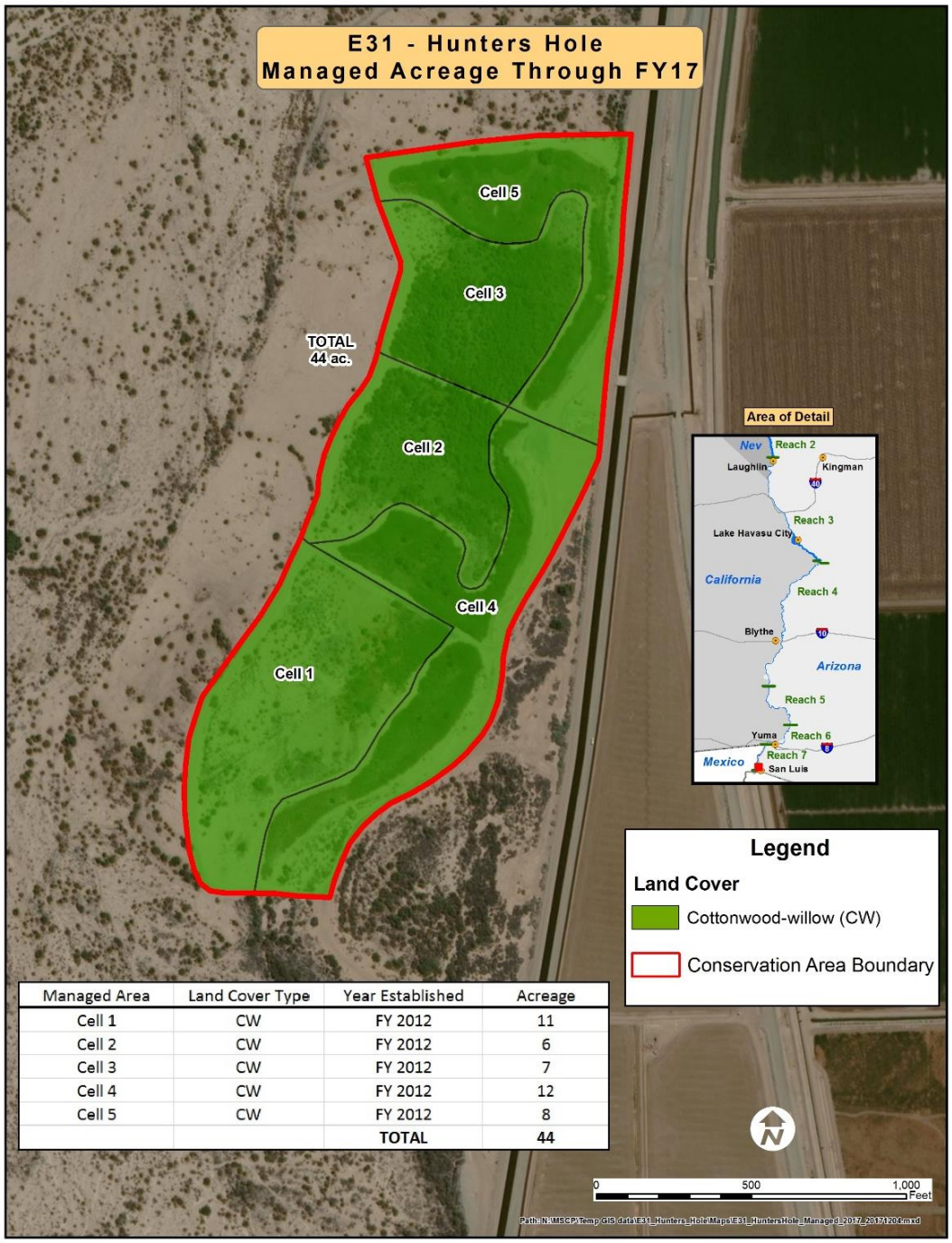


Managed Area	Land Cover Type	Year Established	Acres
Cottonwood-willow	CW	2001-2014	183
Honey Mesquite	HM	2001-2014	103
Marsh	Marsh	2001-2014	94
		TOTAL	**380**

Figure 8.—Yuma East Wetlands managed acreage through fiscal year 2017.

Hunters Hole

Hunters Hole is a conservation area located near the community of San Luis, 18 miles (29 km) south of Yuma, Arizona (see figure 1). The site is within Reach 7. It was added to the LCR MSCP in 2011. The site was planted in spring 2012 with approximately 44 acres of habitat (figure 9) consisting of cottonwood-willow, honey mesquite, and marsh.



Managed Area	Land Cover Type	Year Established	Acreage
Cell 1	CW	FY 2012	11
Cell 2	CW	FY 2012	6
Cell 3	CW	FY 2012	7
Cell 4	CW	FY 2012	12
Cell 5	CW	FY 2012	8
		TOTAL	**44**

Figure 9.—Hunters Hole managed acreage through fiscal year 2017.

RESULTS

Conservation Areas

Big Bend Conservation Area

Trapping occurred along the interface of a grassy area comprised of dallisgrass and bushy bluestem with baccharis 1 night in each season. Fall trapping (figure 10) produced captures of 17 desert pocket mice, and 1 Colorado River cotton rat and 1 desert pocket mouse were captured in spring (table 1).

Figure 10.—Big Bend Conservation Area trapping areas.

Table 1.—Big Bend Conservation Area captures, 2016 and 2017

Species	Fall 2016 (October 7, 2016)	Spring 2017 (April 11, 2017)
Colorado river cotton rat (*Sigmodon arizonae plenus*)	0	1
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	17	1
Cactus mouse (*Peromyscus eremicus*)	18	8
Deer mouse (*Peromyscus maniculatus*)	0	1
Harvest mouse (*Reithrodontomys megalotis*)	0	4
Western spotted skunk (*Spilogale gracilis*)	1	0
Total captures	**36**	**15**
Traps/nights	**80/1**	**40/1**

Beal Lake Conservation Area

Trapping occurred in the Beal Lake Conservation Area riparian fields within a narrow patch of arrowweed with patches of various grass species with potentially suitable structure for Colorado River cotton rats (figure 11). In recent years, the patch has narrowed, becoming increasingly dominated by arrowweed. Trapping was also conducted at the willow marsh area to the north. Fall trapping produced no Colorado River cotton rats and five desert pocket mice over 1 night in the riparian fields (table 2) and no LCR MSCP rodent species over 1 night at the willow marsh (table 3). Spring trapping produced no Colorado River cotton rats and one desert pocket mouse captured over 1 night (table 2).

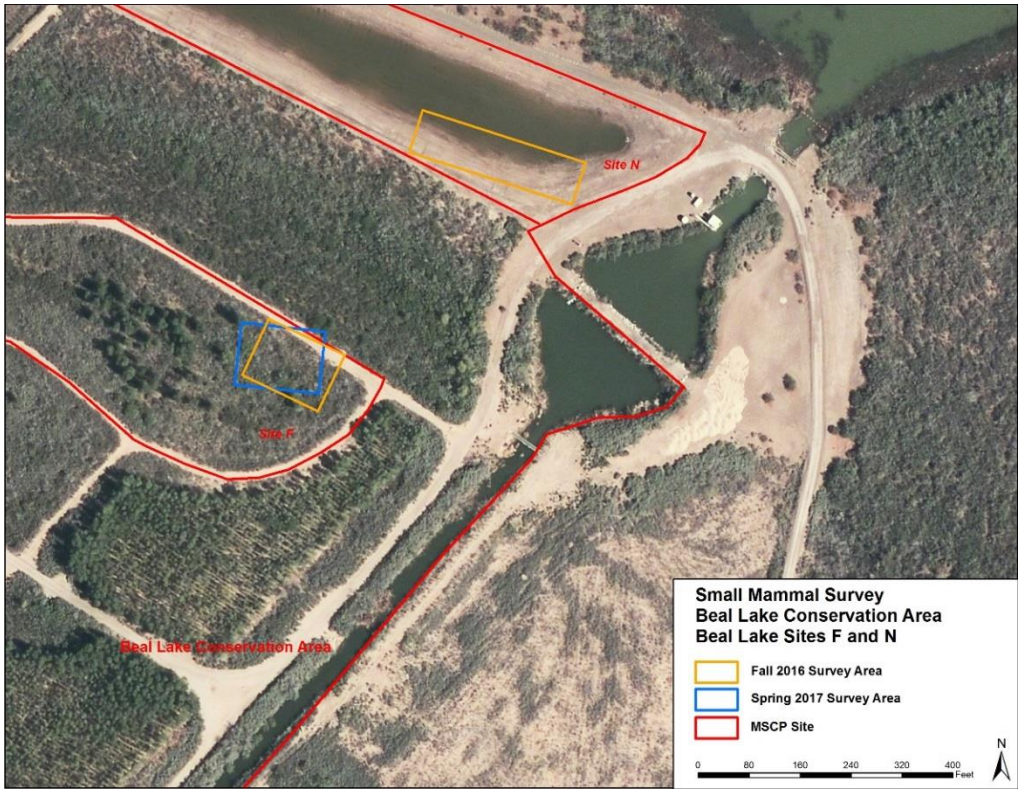


Figure 11.—Beal Lake Conservation Area trapping areas.

Table 2.—Beal Lake Conservation Area Field F captures, 2016 and 2017

Species	Fall 2016 (October 6, 2016)	Spring 2017 (April 28, 2017)
Colorado river cotton rat (*Sigmodon arizonae plenus*)	0	0
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	5	1
Cactus mouse (*Peromyscus eremicus*)	4	0
Deer mouse (*Peromyscus maniculatus*)	0	2
White-throated wood rat (*Neotoma albigula*)	0	1
Total captures	**9**	**4**
Traps/nights	**40/1**	**40/1**

Table 3.—Beal Lake Conservation Area willow marsh captures, 2016

Species	Fall 2016 (October 6, 2016)
Colorado river cotton rat (*Sigmodon arizonae plenus*)	0
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	0
Total captures	**0**
Traps/nights	**20/1**

Palo Verde Ecological Reserve

This site consists of multiple planting phases with a variety of habitat types. All of the areas trapped contained a grass and/or shrub component. Two phases were trapped. Phase 4 was planted with honey mesquite and quailbush and is now intermixed with Bermudagrass (*Cynodon dactylon*) and other grasses and forbs. Phase 5 was planted with honey mesquite, alkali sacaton (*Sporobolus airoides*), and blue grama (*Bouteloua gracilis*), though the trapping area is now a mix of alkali sacaton and Bermudagrass in various densities. Trapping occurred in Phase 4 (figure 12) and Phase 5 (figure 13). Fall trapping sessions produced no Colorado River cotton rat or desert pocket mouse captures in Phase 4 (table 4). There were two Colorado River cotton rat captures and one desert pocket mouse capture in Phase 8 (table 5).

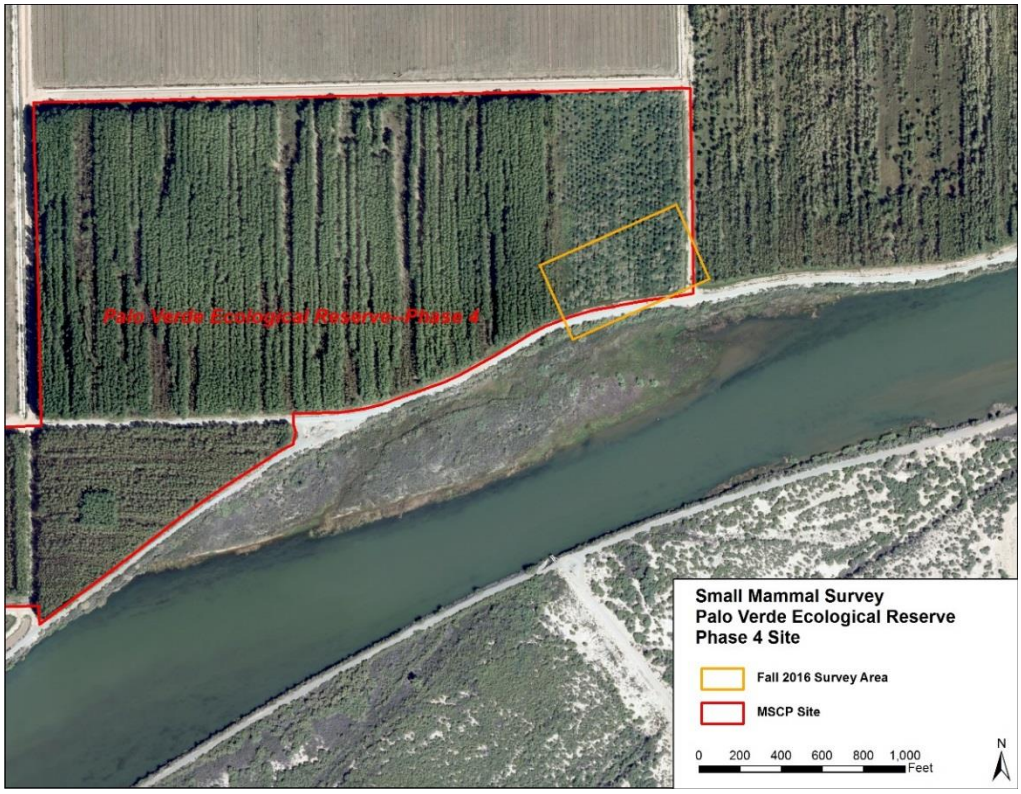


Figure 12.—Palo Verde Ecological Reserve Phase 4 trapping areas.

Table 4.—Palo Verde Ecological Reserve Phase 4 captures, 2016

Species	Fall 2016 (October 12, 2016)
Colorado river cotton rat (*Sigmodon arizonae plenus*)	0
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	0
Cactus mouse (*Peromyscus eremicus*)	3
Total captures	**3**
Traps/nights	**60/1**

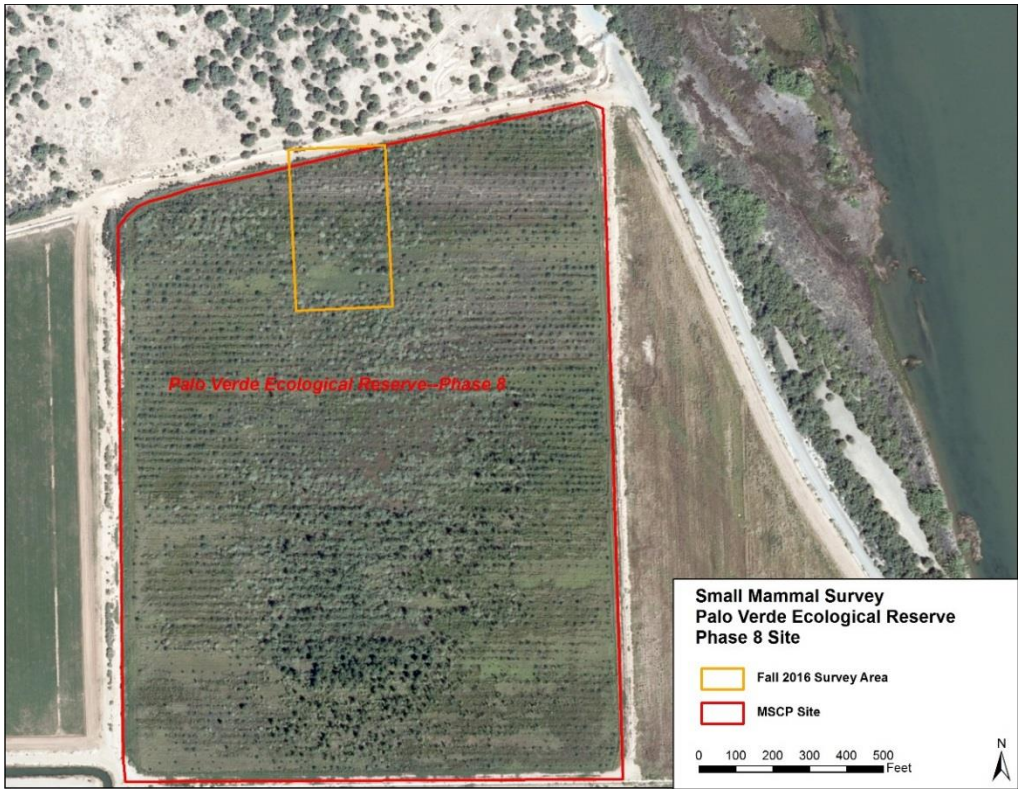


Figure 13.—Palo Verde Ecological Reserve Phase 8 trapping areas.

Table 5.—Palo Verde Ecological Reserve Phase 8 captures, 2016

Species	Fall 2016 (October 12, 2016)
Colorado river cotton rat (*Sigmodon arizonae plenus*)	2
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	1
Cactus mouse (*Peromyscus eremicus*)	3
Total captures	**6**
Traps/nights	**40/1**

Cibola Valley Conservation Area

Phases one and two of the Cibola Valley Conservation Area were trapped (figure 14). The Phase 1 traps were set in two areas of dense Bermudagrass adjacent to coyote willow. The Phase 2 trapping area consisted of senesced shrubs with some live quailbush and Bermudagrass. Three Colorado River cotton rats and one desert pocket mouse were captured in Phase 1 (table 6). No Colorado River cotton rats and eight desert pocket mice were captured in Phase 2 (table 7.)

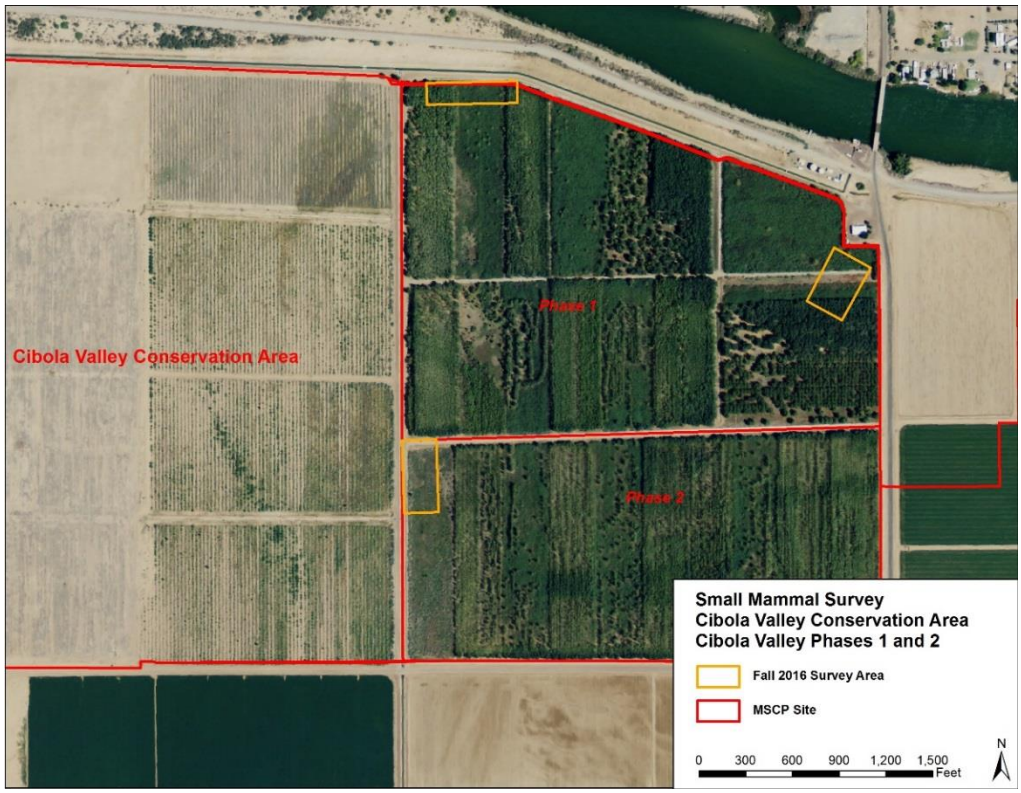


Figure 14.—Cibola Valley Conservation Area trapping areas.

Table 6.—Cibola Valley Conservation Area Phase 1 captures, 2016

Species	Fall 2016 (October 13, 2016)
Colorado river cotton rat (*Sigmodon arizonae plenus*)	3
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	1
Cactus mouse (*Peromyscus eremicus*)	1
Total captures	**5**
Traps/nights	**90/1**

Table 7.—Cibola Valley Conservation Area Phase 2 captures, 2016

Species	Fall 2016 (October 13, 2016)
Colorado river cotton rat (*Sigmodon arizonae plenus*)	0
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	8
Cactus mouse (*Peromyscus eremicus*)	2
Total captures	**10**
Traps/nights	**60/1**

Cibola National Wildlife Refuge Unit #1 Conservation Area

Surveys within the Cibola National Wildlife Refuge Unit #1 Conservation Area occurred in two areas: the Cottonwood Genetics field (figure 15) and the Nature Trail area. Trapping in the Cottonwood Genetics field occurred in a more open, homogenous area of Johnsongrass. Trapping in the Nature Trail area occurred in sparse alkali sacaton and Bermudagrass. No Colorado River cotton rats and three desert pocket mice were captured in the Cottonwood Genetics field (table 8). One Colorado River cotton rat and no desert pocket mice were captured in the Nature Trail (table 9).

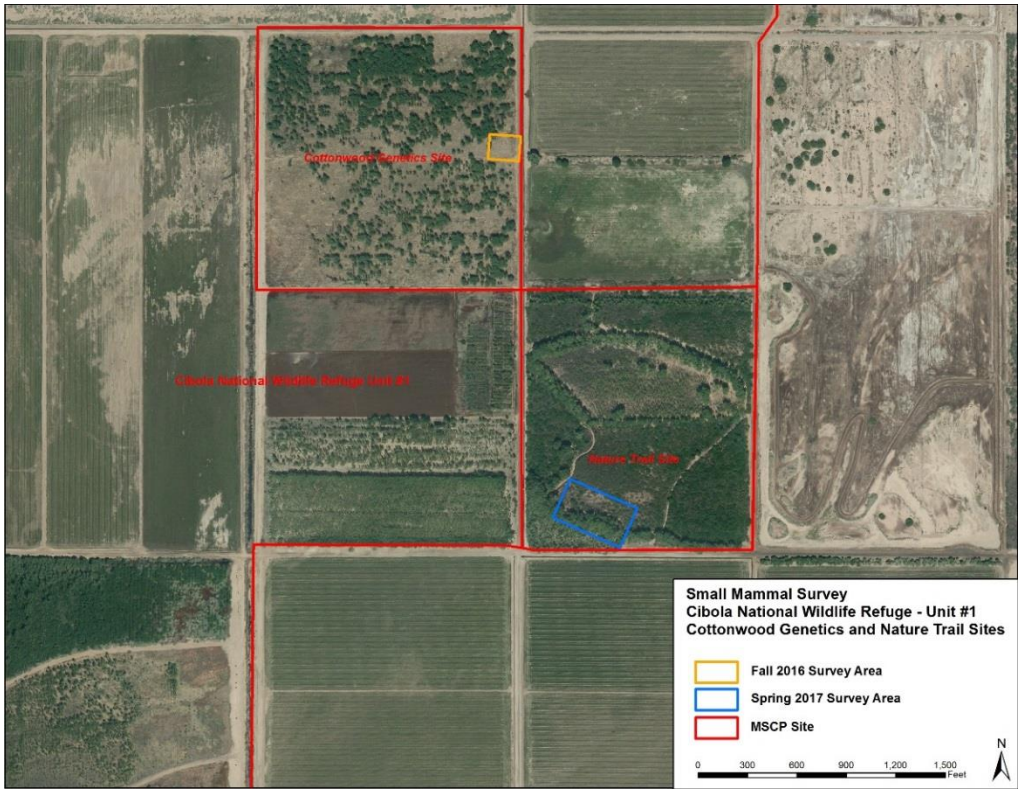


Figure 15.—Cibola National Wildlife Refuge Unit #1 Conservation Area trapping areas.

Table 8.—Cibola National Wildlife Refuge Unit #1 Conservation Area Cottonwood Genetics field captures, 2016

Species	Fall 2016 (October 14, 2016)
Colorado river cotton rat (*Sigmodon arizonae plenus*)	0
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	3
Harvest mouse (*Reithrodontomys megalotis*)	1
Total captures	**4**
Traps/nights	**60/1**

Table 9.—Cibola National Wildlife Refuge Unit #1 Conservation Area Nature Trail captures, 2017

Species	Spring 2017 (April 4, 2017)
Colorado river cotton rat (*Sigmodon arizonae plenus*)	1
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	0
Cactus mouse (*Peromyscus eremicus*)	8
White-throated wood rat (*Neotoma albigula*)	2
Total captures	**11**
Traps/nights	**60/1**

Laguna Division Conservation Area

Trapping occurred in two areas within the Laguna Division Conservation Area (figure 16). Trapping areas were comprised of sparse alkali sacaton and arrowweed. A total of 120 traps set over 1 night produced 8 desert pocket mice (table 10). No Yuma hispid cotton rats were encountered.

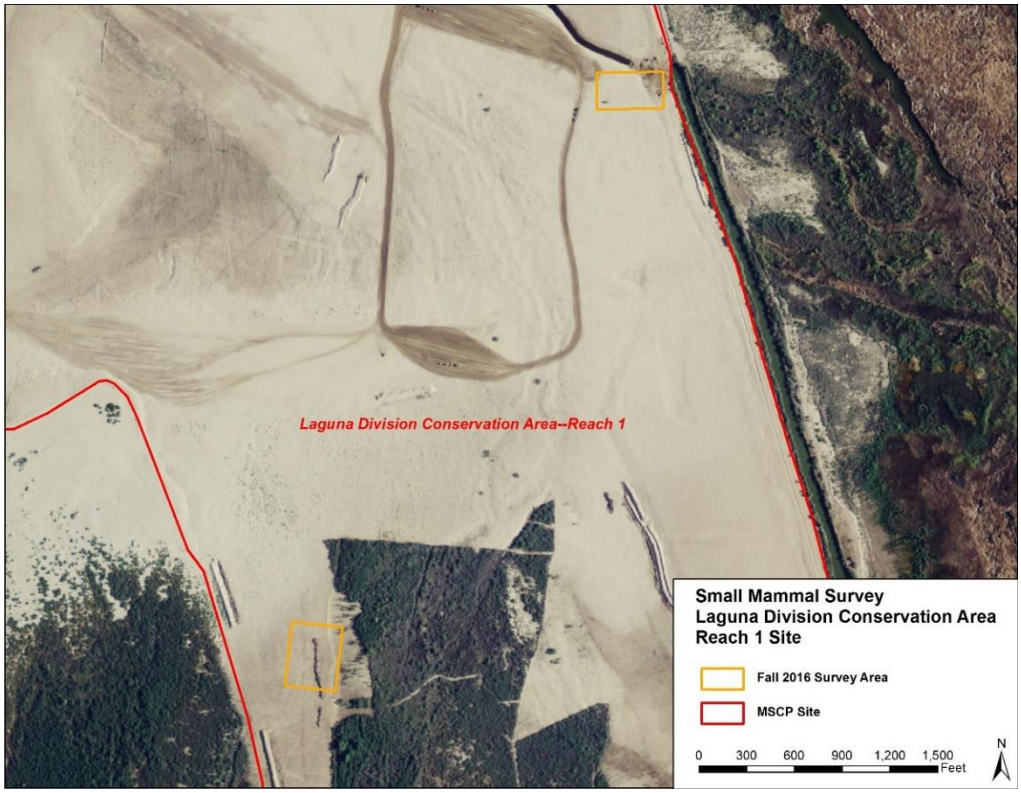


Figure 16.—Laguna Division Conservation Area trapping areas.

Table 10.—Laguna small mammal captures, 2016

Species	Fall 2016 (October 26, 2016)
Yuma hispid cotton rat (*Sigmodon hispidus eremicus*)	0
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	8
Cactus mouse (*Peromyscus eremicus*)	2
House mouse (*Mus musculus*)	2
Total captures	**12**
Traps/nights	**120/1**

Yuma East Wetlands

Surveys occurred in Cell C (figure 17) in Yuma East Wetlands. The trapping area consisted of a mix of alkali sacaton and baccharis and some honey mesquite plantings. The fall 2016 survey produced no Yuma hispid cotton rats or desert pocket mice (table 11). The spring 2017 survey produced no Yuma hispid cotton rats or desert pocket mice in Cell I (table 12). Cell C produced two Yuma hispid cotton rats and no desert pocket mice in spring 2017 (table 13).

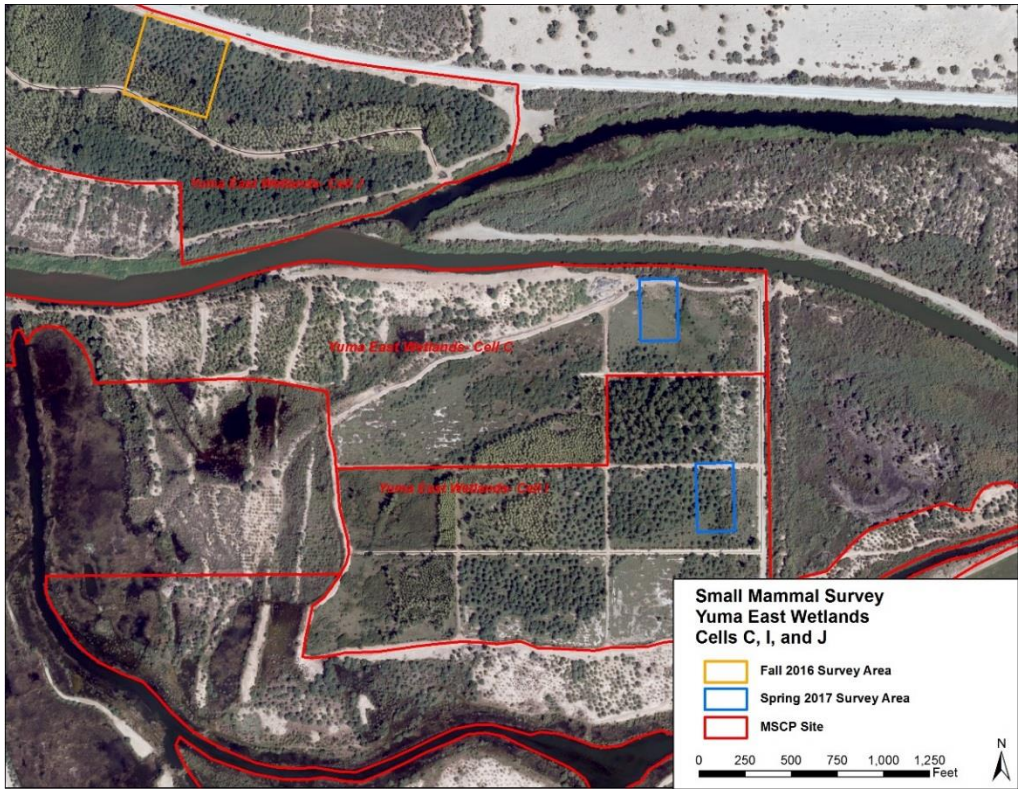


Figure 17.—Yuma East Wetlands trapping areas.

Table 11.—Yuma East Wetlands Cell J captures, 2016

Species	Fall 2016 (October 24, 2016)
Yuma hispid cotton rat (*Sigmodon hispidus eremicus*)	0
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	0
Cactus mouse (*Peromyscus eremicus*)	1
White-throated wood rat (*Neotoma albigula*)	1
Total captures	**2**
Traps/nights	**60/1**

Table 12.—Yuma East Wetlands Cell I captures, 2017

Species	Spring 2017 (February 10, 2017)
Yuma hispid cotton rat (*Sigmodon hispidus eremicus*)	0
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	0
Cactus mouse (*Peromyscus eremicus*)	1
Total captures	**1**
Traps/nights	**40/1**

Table 13.—Yuma East Wetlands Cell C captures, 2017

Species	Spring 2017 (February 10, 2017)
Yuma hispid cotton rat (*Sigmodon hispidus eremicus*)	2
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	0
Total captures	**2**
Traps/nights	**40/1**

Hunters Hole

Surveys occurred in Cell 2 and Cell 3 (figure 18). The trapping areas were planted with Fremont cottonwood, Goodding's willow, coyote willow, and honey mesquite along with alkali sacaton and blue grama. Both trapping areas were dominated by grasses, and in Cell 3, baccharis had also become established in moderately dense amounts. Fall 2016 surveys produced seven Yuma hispid cotton rats and no desert pocket mice in Cell 2 (table 14) and six Yuma hispid cotton rats and no desert pocket mice in Cell 3 (table 15).

Figure 18.—Hunters Hole trapping areas.

Table 14.—Hunters Hole Cell 2 captures, 2016

Species	Fall 2016 (October 25, 2016)
Yuma hispid cotton rat (*Sigmodon hispidus eremicus*)	7
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	0
Total captures	**7**
Traps/nights	**60/1**

Table 15.—Hunters Hole Cell 3 captures, 2016

Species	Fall 2016 (October 25, 2016)
Yuma hispid cotton rat (*Sigmodon hispidus eremicus*)	6
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	0
Total captures	**6**
Traps/nights	**60/1**

System-Wide Monitoring Sites

Imperial National Wildlife Refuge

Trapping in fall 2016 occurred at the south end of the Imperial National Wildlife Refuge in an area comprised of Johnsongrass and common reed (*Phragmites australis*) (figure 19). Trapping in spring 2017 occurred north of the refuge headquarters in an area comprised of Johnsongrass and common reed (figure 20). The trapping areas were outside of the LCR MSCP conservation area in an area called Fishers Landing and are included as part of the D10 system-wide monitoring work task. Trapping produced no Yuma hispid cotton rats or desert pocket mice at either location (tables 16 and 17).

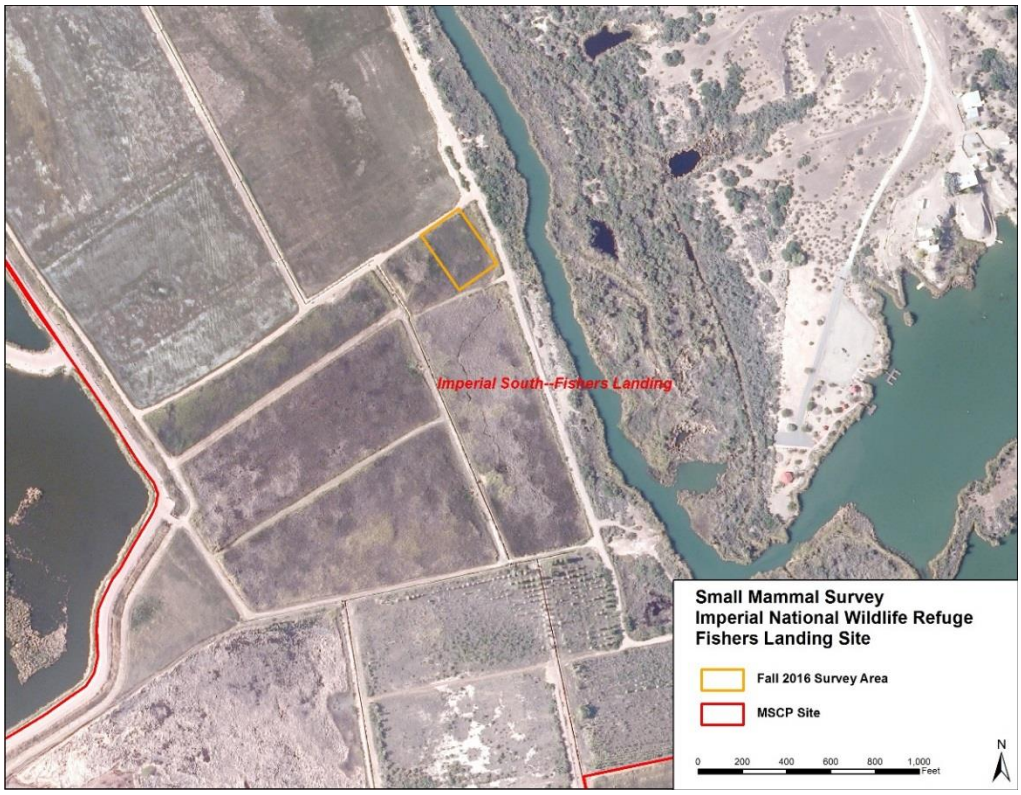


Figure 19.—Imperial National Wildlife Refuge fall 2016 trapping areas.

Table 16.—Imperial National Wildlife Refuge captures, 2016

Species	Fall 2016 (October 27, 2016)
Yuma hispid cotton rat (*Sigmodon hispidus eremicus*)	0
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	0
House mouse (*Mus musculus*)	3
Total captures	**3**
Traps/nights	**60/1**

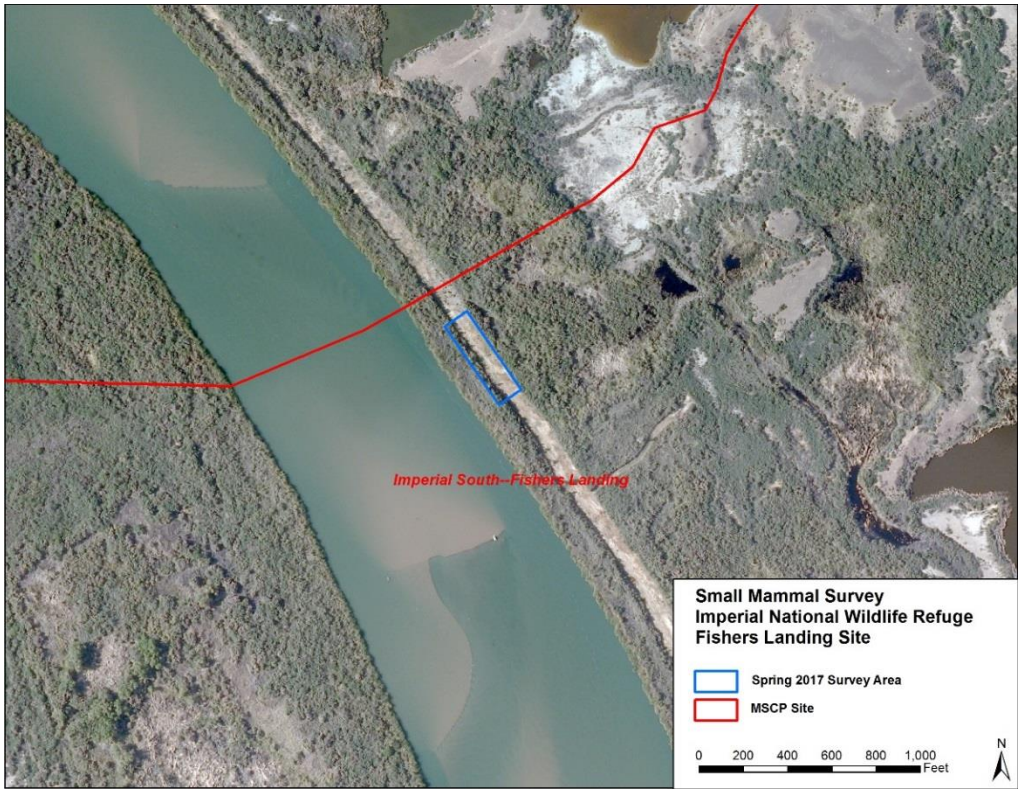


Figure 20.—Imperial National Wildlife Refuge spring 2017 trapping areas.

Table 17.—Imperial National Wildlife Refuge captures, 2017

Species	Spring 2017 (February 8, 2017)
Yuma hispid cotton rat (*Sigmodon hispidus eremicus*)	0
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	0
Cactus mouse (*Peromyscus eremicus*)	3
Total captures	**3**
Traps/nights	**60/1**

Havasu National Wildlife Refuge

Spring 2017 trapping occurred at the south end of the Havasu National Wildlife Refuge in a sandy area comprised primarily of saltcedar (*Tamarix ramosissima*) (figure 21) near Topock Bay. Trapping occurred outside the boundaries of the Beal Lake Conservation Area in an area called Topock Bay and are included as part of the D10 system-wide monitoring work task. Trapping produced no Colorado River cotton rats and four desert pocket mice (table 18).

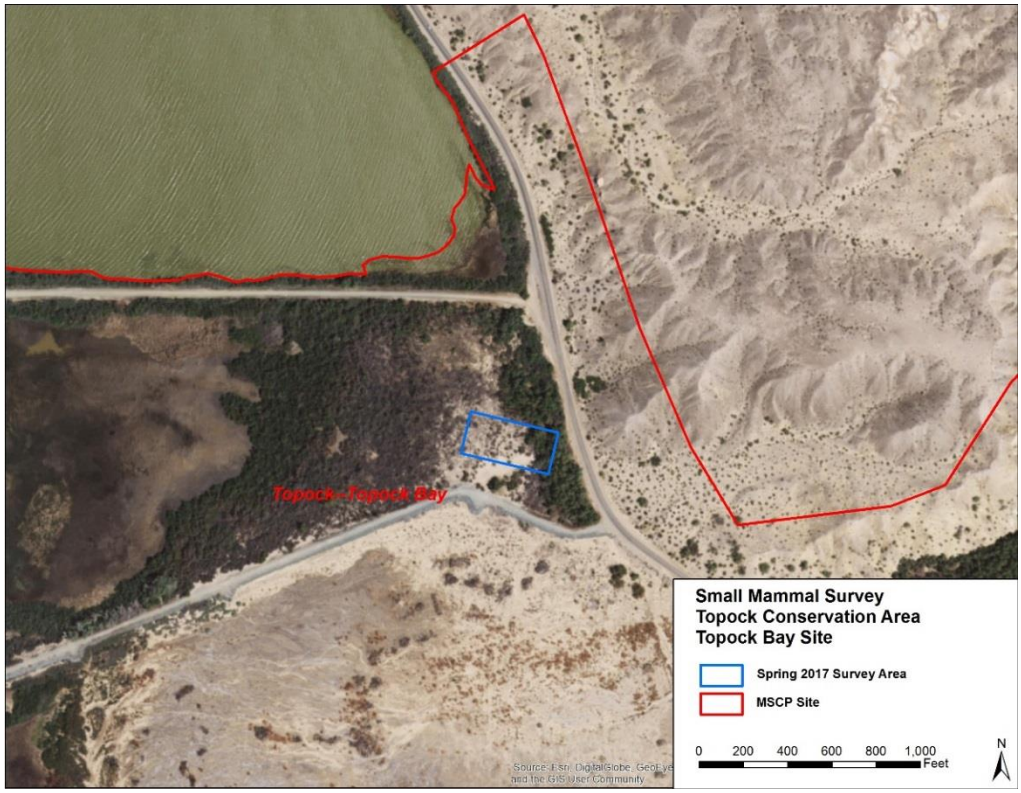


Figure 21.—Havasu National Wildlife Refuge trapping areas.

Table 18.—Havasu National Wildlife Refuge captures, 2017

Species	Spring 2017 (April 12, 2017)
Colorado river cotton rat (*Sigmodon arizonae plenus*)	0
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	4
Cactus mouse (*Peromyscus eremicus*)	5
Harvest mouse (*Reithrodontomys megalotis*)	2
Total captures	**11**
Traps/nights	**40/1**

Picacho State Recreation Area

Trapping occurred 24 miles (39 km) north of Yuma, Arizona, on the California side of the river in a strip of common reed adjacent to the water at the Hoge Ranch area of the Picacho State Recreation Area (figure 22). Efforts produced no Colorado River cotton rats and no desert pocket mice (table 19).

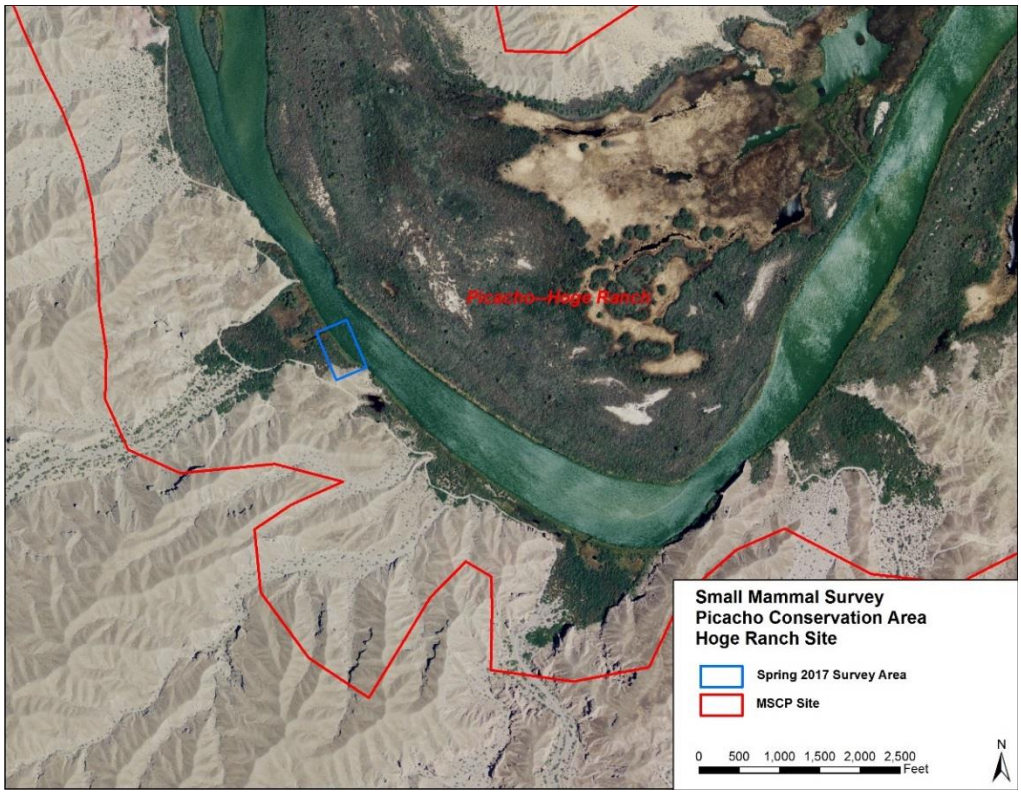


Figure 22.—Picacho State Recreation Area trapping area.

Table 19.—Picacho State Recreation Area captures, 2017

Species	Spring 2017 (February 9, 2017)
Yuma hispid cotton rat (*Sigmodon hispidus eremicus*)	0
Desert pocket mouse (*Chaetodipus penicillatus* sp.)	0
Cactus mouse (*Peromyscus eremicus*)	3
Spiny pocket mouse (*Chaetodipus spinatus*)	2
Harvest mouse (*Reithrodontomys megalotis*)	1
Total captures	**6**
Traps/nights	**40/1**

LITERATURE CITED

Bradley, W.G. 1966. Status of the cotton rat in Nevada. Journal of Mammalogy 47:349–350.

Goertz, J.W. 1964. The influence of habitat quality upon density of cotton rat populations. Ecological Monographs:359–381.

Hall, E.R. 1946. Mammals of Nevada. University of Nevada Press, Reno and Las Vegas, Nevada.

Jameson, E.W. and H.J. Peeters. 2004. Mammals of California; California Natural History Guide No. 66. University of California Press, Berkeley and Los Angeles, California.

Kays, R.W. and D.E. Wilson. 2002. Mammals of North America. Princeton University Press, Princeton, New Jersey.

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 samples (tail/ear clipping) for Colorado River cotton rats (*Sigmodon arizonae plenus*) (CRCR) and Yuma hispid cotton rats (*Sigmodon hispidus eremicus*) (YHCR). If a sample was taken previously, mark as recapture. In the title, circle whether or not this survey is for post-development or system-wide purposes.

Notes: