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Appendix A. Covered Species accounts

This appendix provides detailed species account information for the Covered Species. Information includes the conservation status of each species, its global and local distribution, and key natural history information including threats that affect the species. The appendix also summarizes the projected take and anticipated mitigation for the species included within the MSCP. Finally, the appendix includes the conservation commitments that Pima County is agreeing to implement to avoid, minimize, and mitigate for Covered Activities. The proposed management activities in this appendix are in addition to the numerous avoidance, minimization, and mitigation tools that are covered in detail throughout the MSCP. For purposes of brevity, only those management activities that are specific to a particular species (or group of species) are highlighted in this appendix. Proposed monitoring commitments are discussed in detail in Appendix N and cited literature for this and other appendices are found in Appendix S.

For all Covered Species, Pima County will encourage the research community to gain a better understanding of species status and ecology, especially: abundance, distribution, habitat use and associations, and movement patterns; both within the County's preserve system as well as other areas of Pima County and southern Arizona. As part of our monitoring commitment, Pima County will develop a database to store observations of Covered Species and track other efforts that are monitoring or researching the species.

Calculation of Habitat Take and Mitigation Acres

The following species accounts highlight the amount of habitat lost and mitigation that is modeled to occur during the course of the 30-year permit. Acres of habitat lost are calculated using the growth model in Appendix D. The acres of mitigation that occurs in the current (February 2014) portfolio of mitigation lands is calculated using the 25% credit for State Trust lands under lease by Pima County (see Table 4.4 for the MSCP for more information).

Conservation rankings

In the following species accounts, conservation rankings are noted, which were taken from the Priority Ranking Definitions compiled by the Arizona Game and Fish Department Heritage Data Management System (e.g., Arizona Game and Fish Department 2009b).

Global Rank: priority ranking (1 to 5) based on the number of occurrences throughout the entire range of the element (species or subspecies)

G1 Very Rare: 1 to 5 occurrences or very few individuals or acres.
G2 Rare: 6 to 20 occurrences or few individuals or acres.
G3 Uncommon or Restricted: 21 to 100 occurrences, rather rare throughout a fairly wide range, or fairly common in a rather restricted range.

G4 Apparently Secure: more than 100 occurrences, though it could be quite rare in some parts of its range.
G5 Demonstrably secure: more than 100 occurrences throughout its range.

State Rank: priority ranking (1 to 5) based on the number of occurrences of the species in Arizona.

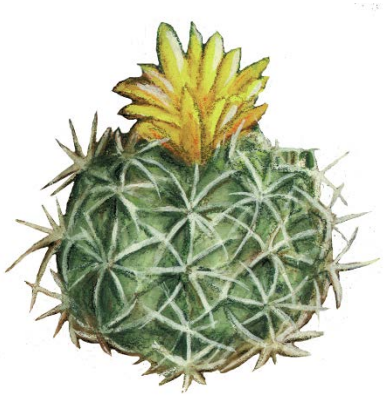
S1 Very Rare: 1 to 5 occurrences in Arizona or very few individuals or acres within the state.
S2 Rare: 6 to 20 occurrences in Arizona or few individuals or acres within the state.
S3 Uncommon or Restricted: 21 to 50 occurrences in Arizona, either rather rare throughout a fairly wide range or fairly common in a rather restricted range within the state.
S3 Fairly Common: 51 to 100 occurrences and found over a rather wide range within Arizona.
S4 Apparently Secure: more than 100 occurrences within Arizona, though it could be quite rare in some parts of the state.
S5 Demonstrably secure: more than 100 occurrences within Arizona.

Plants

Pima Pineapple Cactus (*Coryphantha scheeri* var. *robustispina*)

Conservation Status

Endangered Species Act Status: Listed as endangered by USFWS in 1993 (U.S. Fish and Wildlife Service 1993). Recent genetic evidence by Baker and Butterworth (2013) found strong evidence for the uniqueness of this subspecies from conspecifics elsewhere in the species' range, but full species status was not warranted.



State: Arizona Native Plant Law, Highly Safeguarded.

Other: U.S. Forest Service Sensitive; protected from international trade by CITES.

Rankings: G4, S2

Description

The Pima pineapple cactus is a succulent perennial that is hemispherical or cylindroid in shape, is 4.0-18 inches (10.0-46.0 cm) tall and 3.0-7.0 inches (8.0-18.0 cm) in diameter. The spines are very stout and are straw-colored when young, but blacken with age (Ecosphere Environmental Services Inc. 1992). Each spine cluster has 1 strong central

spine that is usually curved or hooked at the abruptly narrowed tip. There are 6 radial spines in young plants, and these increase to 10 to 15 in older plants. The spines vary from 0.76-0.92 inch (19.0-23.0 mm) long and the upper ones are more slender than the lower ones. The areoles are densely covered with deciduous woolly fibers that disappear at maturity. The tubercles are grooved along their upper surface. The stems can branch by developing basal offsets (clones) from the oldest tubercles (Roller 1996b). The plant may occur in clusters which are formed either by producing basal offsets, or when seeds germinate at the base of the mother plant. Flowers are bright silky yellow, or rarely white, with coral edges and have a narrow floral tube. The fruit is green, ellipsoid, succulent, and sweet. The seeds are brown or black and finely veined or netted.

Distribution and Trend

The historic range of the Pima pineapple cactus is assumed to be the same as the present range. The subspecies inhabits southeastern Arizona and north-central Sonora. In southeastern Arizona, the known range lies within Santa Cruz and Pima Counties and is generally bounded to the east by the Santa Rita Mountains, to the west by the Baboquivari Mountains and does not extend to the north past the south side of Tucson (Arizona Game and Fish Department 2001d; Schmalzel 2004; WestLand Resources Inc 2004; Baker 2005a, 2006, 2007; Schmalzel 2008). It is found in low densities in the northern areas of Sonora, Mexico (U.S. Fish and Wildlife Service 2007b). There are populations in the Vail area and just south of Interstate 10 and west of Highway 83, north of Mt. Fagan. Pima County encompasses the majority of this variety's known range.

The Pima pineapple cactus has been confirmed on a number of County owned and managed properties in the Altar (Madera Highlands, Diamond Bell Ranch, King 98 Ranch, Marley Ranch, and Rancho Seco) and Santa Cruz (Bar-V Ranch, Canoa Ranch, Southeast Regional Park, and Elephant Head) valleys.

The USFWS determined that this species is Endangered, citing the amount of habitat loss that had occurred and was likely to continue to occur throughout the range of this species, the amount of habitat modification, the scarcity of individual plants, and the difficulty in protecting an area large enough to maintain a viable population as factors contributing to the need to list this species as endangered (U.S. Fish and Wildlife Service 1993). Populations of the Pima pineapple cactus are believed to be on a downward trend due to loss and degradation of habitat (Arizona Game and Fish Department 2001d). Westland Resources Inc. (2004) attempted to estimate population size for this species, though the USFWS (2007a) found deficiencies in their analysis.

Habitat Requirements

This species is found at elevations below 4,000 ft, in desert scrubland or the ecotone between desert scrubland and desert grassland, on relatively flat areas (less than 10 percent slope) (Benson 1982, U.S. Fish and Wildlife Service 2007b) and in soils that are mostly rocky loams (Arizona Game and Fish Department 2001d). Pima pineapple cactus are associated with alluvium of a wide variety of ages (U.S. Fish and Wildlife Service 2007a).

Although little information is available regarding specific habitat requirements, the limited range and sparsely distributed populations of this cactus suggest specialized needs that may be revealed by further research. Some observers think that this cactus appears to be found most often on degraded lands that are historically and/or currently overgrazed grassland in association with kangaroo rat mounds (R. Schmaltzel, *personal communication* to K. Kingsley, 22 Feb 2000; K. Kingsley, *personal observation*), although others disagree with the observation of association with kangaroo rat mounds (B. Pavlick, *personal observation*). Probably the most consistent observation is that the cactus is found most often in "open" areas not associated with dense grass cover, though to the degree to which this is an artifact of the ease with which it can be found in "open" areas is not known.

Current and Potential Threats

General: The USFWS (1993, 2007b) identified the following factors as affecting the species:

- present or threatened destruction, modification, or curtailment of habitat or range including the increase in exotic, invasive species;
- overutilization (of the plant) for commercial, recreational, scientific, or educational purposes;
- disease and predation; and
- inadequacy of existing regulatory mechanisms.

Existing and potential pest species: Some Pima pineapple cactus appear to have been damaged by the larval stage of a moth in the family Phycitidae, though the effect of this damage is unknown (U.S. Fish and Wildlife Service 1993). An unidentified beetle eats the plant and lays eggs in the plant. Larvae consume the plant from the inside out. This appears to be the proximate cause of death of many plants, but whether it is the ultimate cause is unknown. Competition with non-native grasses, such as bufflegrass, Lehmann's lovegrass, and red brome, may be a problem for this species. The introduction and spread of Lehmann's lovegrass has affected up to 75% of Pima pineapple cactus habitat (U.S. Fish and Wildlife Service 1993) and altered historical fire regimes (Roller 1996b). Individual Pima pineapple cactus plants appear to exhibit less vigor in community types characterized by higher fire frequencies and continuous stands of Lehmann's lovegrass (Roller 1996b).

Threat mechanism: Speculation includes direct loss of individuals, loss or degradation of habitat by trampling or grazing by livestock, recreation, agricultural or land development, poaching, and competition with non-native plants. However, the only threat that has been clearly documented to impact this species is direct disturbance of land with individuals on it. Lack of one of the important pollinators for this species, a ground-nesting bee (*Diadasia rinconis*) may limit the distribution of the cactus (McDonald 2005).

Management Needs

General: The Arizona Game and Fish Department (2001d) identified the following key management needs:

- livestock management needs to be improved;
- education needs to be provided to the public regarding Arizona Native Plant Law and cactus theft;
- additional surveys need to be conducted to better delineate the range, particularly in Mexico;
- further research is needed to determine whether transplantation is successful as a mitigation measure;
- further demographic monitoring should be initiated to determine if existing populations are stable; and
- several preserves that are large enough to sustain viable populations should be set aside.

Current protective measures: The USFWS Final Rule listing this variety as Endangered implements Federal protection under the Endangered Species Act. At the time of the listing, the USFWS determined that designation of critical habitat was not prudent for the species due to the threat of illegal collection (U.S. Fish and Wildlife Service 1993). Protection for plants under the ESA is somewhat limited when they occur on private land. The Arizona Native Plant Law protects the species as a "Highly Safeguarded Species" requiring a permit for collection and salvage. The species is included in Appendix II of CITES, which requires that a permit be obtained for export from the country of origin.

Corridor needs: No specific corridor needs are known. Dispersal corridors may be necessary for the successful establishment of new populations of the species; however, characteristics of appropriate corridors are unknown and long-distance dispersal mechanisms are unknown. McDonald (2005) indicated that the Pima pineapple cactus plants need to be within approximately 600 m of each other in order to facilitate effective pollination and that plants that are located at distances greater than that from one another become reproductively isolated.

Dispersal requirements: Dispersal mechanisms are currently unknown, though dispersal may be aided by jackrabbits. Dispersal can take place through the movements of both vegetative and seed propagules. However, suitable habitat must be available for new populations to become established. Because little is known regarding specific habitat requirements for this species, potential dispersal routes and establishment sites are

impossible to assess without further research. Protection of habitats that are characteristic for this species and within the known range, to the extent possible, will help to ensure a range of future management options.

Key relationships: Pima pineapple cactus is found primarily in Lower Sonoran Desert Scrub and Semi-desert Grassland dominated by white-thorn acacia (*Acacia constricta*), velvet mesquite (*Prosopis velutina*), thread snakeweed (*Gutierrezia microcephala*), triangle-leaf bursage (*Ambrosia deltoidea*), and various other cacti and grasses (Ecosphere Environmental Services Inc. 1992). Roller (1996b) documented the collection and ingestion of fruit by the greater roadrunner (*Geococcyx californianus*) and documented high levels of activity around individual plants by rodents and lagomorphs. These animals may be important for dispersal of seeds, but effective seed dispersal has not been demonstrated, and the seed dispersal mechanism remains unknown. The species appears to be reliant on the ground-nesting bee *Diadasia rinconis* for pollination (McDonald 2005). The potential effects of the recent loss of feral European honeybees and the arrival and establishment of Africanized honeybees on populations of both native plants and their native pollinators are unknown.

Existing monitoring and research programs: Six population monitoring plots were established by contractors funded by the National Fish and Wildlife Foundation in the Altar Valley in 2002 (Routson et al. 2004) and were monitored annually through 2009 (Baker 2010). Additionally, Pima County monitors populations at its two mitigation banks (Madera Highlands and Elephant Head. Powell (2011) resurveyed the population of the cactus at the County's Southeast Regional Park, a population that was originally surveyed in 1998.

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-1): 18,963.

Acres of mitigation habitat within the current portfolio of conservation lands: 19,322.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Pima pineapple cactus:

- Work with experts to maintain and update as necessary a habitat suitability map and Priority Conservation Area map on a publicly accessible website, such as the SDCP Mapguide site, to be used as a reference for where the species is likely to be encountered.
- Land acquisitions in the range of the species, as defined by the PCA, will be reviewed for evidence of occupancy of the species and its habitat as part of the due diligence (pre-closing), unless precluded by the property owner.
- Seek funds or partnerships to conduct surveys on County-controlled lands in areas south of the Sierrita Mountains and west of Interstate 19, in an attempt to verify whether additional population locations exist, and to determine whether additional acres of acquisition may be counted as habitat mitigation under the MSCP.

- Encourage studies and other scientific investigations that are designed to increase knowledge about the species. This may include, but is not limited to, habitat/connectivity requirements, population viability analyses, effectiveness of transplant methodologies, evaluation of population monitoring methodologies, persistence over time in developed areas, etc.
- Place restrictive covenants or conservation easements on the County's fee simple lands within the PCA at Marley Ranch, Rancho Seco, King 98, Canoa, Cienega Creek Natural Preserve, and Diamond Bell Ranch, as described in Chapter 4 of the MSCP. Additional future land acquisitions will also likely include areas of occupancy for the species.
- If necessary and where feasible, acquire additional high-value areas to offset impacts of Covered Activities. Planned future land acquisitions, such as the Marley Ranch Phase 2 acquisition agreement, include areas of likely occupancy for the species.
- Pima County shall either utilize mitigation credits from County conservation banks or other non-County operated conservation banks to offset impacts of Covered Activities, or assure that the 1:1 species habitat mitigation ratio is met with allocations of other mitigation lands.
- Pima County will continue to protect, manage and monitor lands in its conservation bank for this species at Madera Highlands (Altar Valley) and Elephant Head (Santa Cruz Valley) as required under the conservation easements. Management plans and master plans for County-owned open space lands in the PCA will include attempts to avoid or minimize impacts to the species on those lands that Pima County owns due to such activities as fire management, and ground-disturbing activities such as new trails or ranch infrastructure.
- Pima County will continue to apply avoidance and minimization measures, as described in Chapter 4.
- Continue to work with the Altar Valley Conservation Alliance to promote conservation activities throughout the valley.
- Participate in the recovery planning with the USFWS and assist them in developing a new monitoring protocol.
- At County mitigation banks and long-term monitoring plots, Pima County will note the collection and/or destruction of tagged individuals during periodic surveys. These data, along with data collected by others in the region, can be used by the USFWS to investigate the effects of collecting on this species.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

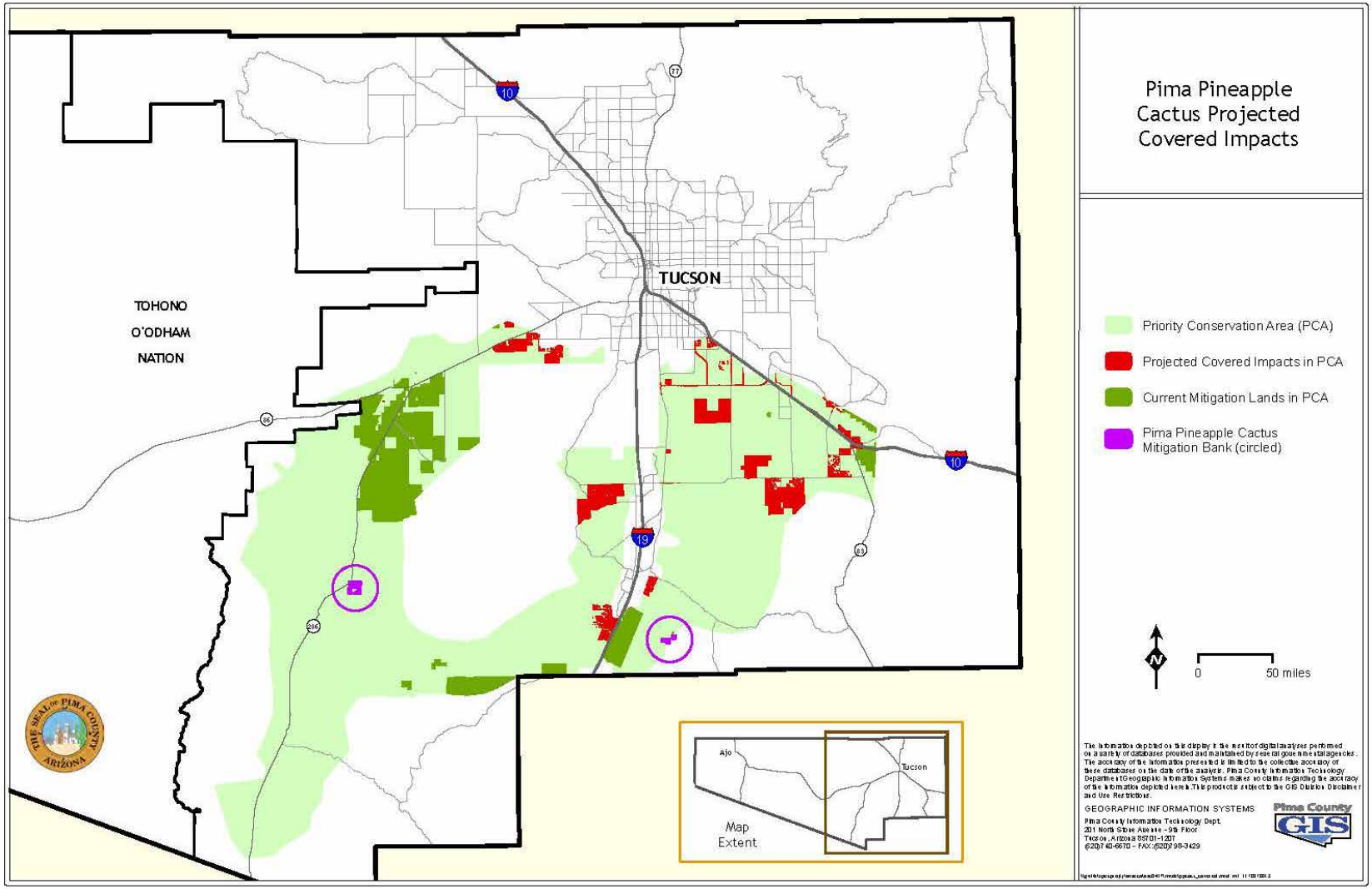


Figure A-1. Map of projected impacts and mitigation for the Pima pineapple cactus.

Needle-spined pineapple cactus (*Echinomastus erectocentrus* var. *erectocentrus*)

Conservation Status

Endangered Species Act Status: None, but former Federal Candidate 2 species.

State: Arizona Native Plant Law, Salvage Restricted.

Other: USFWS Species of Concern; U.S. Forest Service Sensitive.

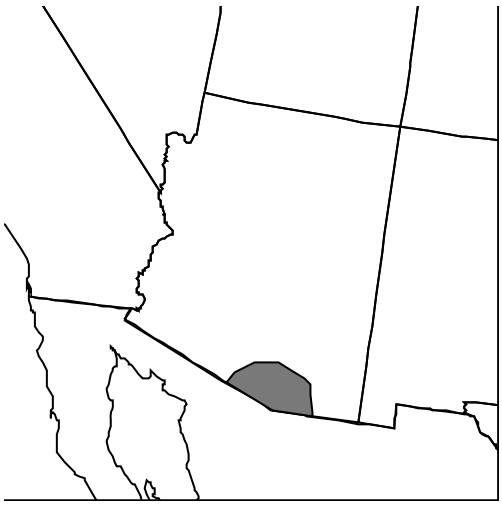
Rankings: G3, S3.

Description

The needle-spined pineapple cactus is a succulent perennial that is 4 to 6 inches (10-15 cm) tall (although occasionally 12 to 15 inches [30-37 cm] tall) and 3 to 5 inches (7.5-13 cm) wide. The plant has tubercles that are about 0.25 inch (0.6 cm) long and are borne on longitudinal ridges. There are 1 or 2 central spines, distinguishing this variety from *E. e. acunensis*, which has 2 or 3 central spines. The central spines are 0.5 to 0.86 inch (1.2-2.2 cm) long, pointed upward, and have reddish brown tips. The radial spines number 11 to 15 per cluster, and are about 0.5 or 0.63 inch (1 to 1.5 cm) long and are white to red-tinged. The flowers are pink, 1.5 inches (3.8 cm) long and 1.5 to 1.8 inches (3.8-4.5 cm) wide, and have bright red stigma lobes. The fruit is green when young and tan when dry and is 0.4 inch (1.0 cm) long and 0.3 inch (0.8 cm) wide.

Distribution and Trend

Benson (1969) described the range as "Southeastern Arizona from southeastern Pima County to western Cochise County." However, his map (p. 190) shows three localities in eastern Pinal County and 1 in eastern Cochise County. The species primarily occurs in Pima and Cochise counties, south and east of Tucson and in southeastern Pinal County near the San Pedro River (Arizona Game and Fish Department 2009a). This species is scattered in a few apparently disjunct populations. Recent search efforts by Baker (Baker 2000; Baker 2005a, 2006, 2007) have revealed >1,000 individuals southeast of Tucson. Large areas of the potential range between known locations



have never been searched adequately to find this species, so the expansion of its known range is likely. Population trends of the needle-spined pineapple cactus are unknown at present.

The needle-spined pineapple cactus has been confirmed on a number of County-owned and managed properties near Vail, including the Bar-V Ranch, Cienega Creek Natural Preserve, McKenzie Ranch, and Colossal Cave Mountain Park.

Habitat Requirements

The needle-spined pineapple cactus has been found on alluvial fans and hills on southern and western exposures, generally from 3,000 to 4,600 feet elevation (915-1403 meters) (Arizona Game and Fish Department 2009a). Substrates consist of alluvial soils with rock and gravel over sandstone conglomerate, and limestone outcrops. It appears *E. e. erectocentrus* may grow over a wider range of substrates than the subspecies *E. e. acuñensis,* which was listed in 2013 and occurs in western Pima County outside of projected Covered Activities.

Current and Potential Threats

Illegal collection for the cactus trade and urbanization are management factors of concern for the needle-spined pineapple cactus (Arizona Game and Fish Department 2009a). Road development, overgrazing, and off-road vehicle use may also impact this species. There are no known records of potential damage to needle-spined pineapple cactus by insects, herbivores, or competition with non-native species. It is possible that invasive non-native grasses such as Lehmann lovegrass and red brome could create conditions that would foster fires that may be detrimental to this species, but no known studies demonstrate this.

Threat mechanism: Speculation includes loss or degradation of habitat by livestock trampling, off road vehicle use, and poaching. However, these potential threats have not been clearly documented (Arizona Game and Fish Department 2009a).

Management Needs

General: Probably the most pressing management need for protection of this species is acquisition of more information about the species through further research. In particular, additional surveys need to be conducted to better delimit the range (e.g., Baker 2005b, 2006), demographic studies should be initiated to determine if existing populations are stable, and studies of the reproductive biology are needed to allow effective management. Resolution of taxonomic uncertainty, with general agreement as to the appropriate name and taxonomic status of this entity would be helpful.

Current protective measures: The Arizona Native Plant Law protects the species as "Salvage Restricted" requiring a permit for collection. *Echinomastus erectocentrus* was originally listed in Appendix II of CITES in 1975, and later uplisted to Appendix I in 1983; thus requiring that a permit be obtained for export from the country of origin. Evidently the only recent legal exports were seeds grown for cultivation (U.S. Fish and Wildlife Service 2000b).

Corridor needs: No specific corridor needs are known. Dispersal corridors may be necessary for the successful establishment of new populations and maintenance of existing populations of the species; however, characteristics of appropriate corridors are not known. Known distribution suggests that populations are naturally isolated from each other.

Key relationships: The needle-spined pineapple cactus inhabits the Arizona Upland Subdivision of the Sonoran Desert Scrub and Semi-desert Grassland with species such as the creosote, ocotillo, and prickly pear cactus. There is no known information concerning pollinators or the seed dispersers of this subspecies, which might provide important information about the life cycle requirements and limited range of this cactus. Some herbivores and frugivores likely consume the flowers and fruits, and some animals may disperse seeds; however, documentation is lacking.

Existing monitoring and research programs: No known monitoring efforts or studies are currently under way.

Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-2): 852

Acres of mitigation habitat within the current portfolio of conservation lands: 8,654

Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the needle-spined pineapple cactus:

- Include measures to avoid and minimize impacts to the species in management and master plans in County-controlled mitigation lands within the PCA.
- Pima County will continue to apply avoidance, minimization and mitigation measures as described in Chapter 4.
- Explore partnerships with developers and ranchers to jointly achieve conservation of this species.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.
- Encourage and support studies and research to better understand the status and life history requirements of the needle-spined pineapple cactus.

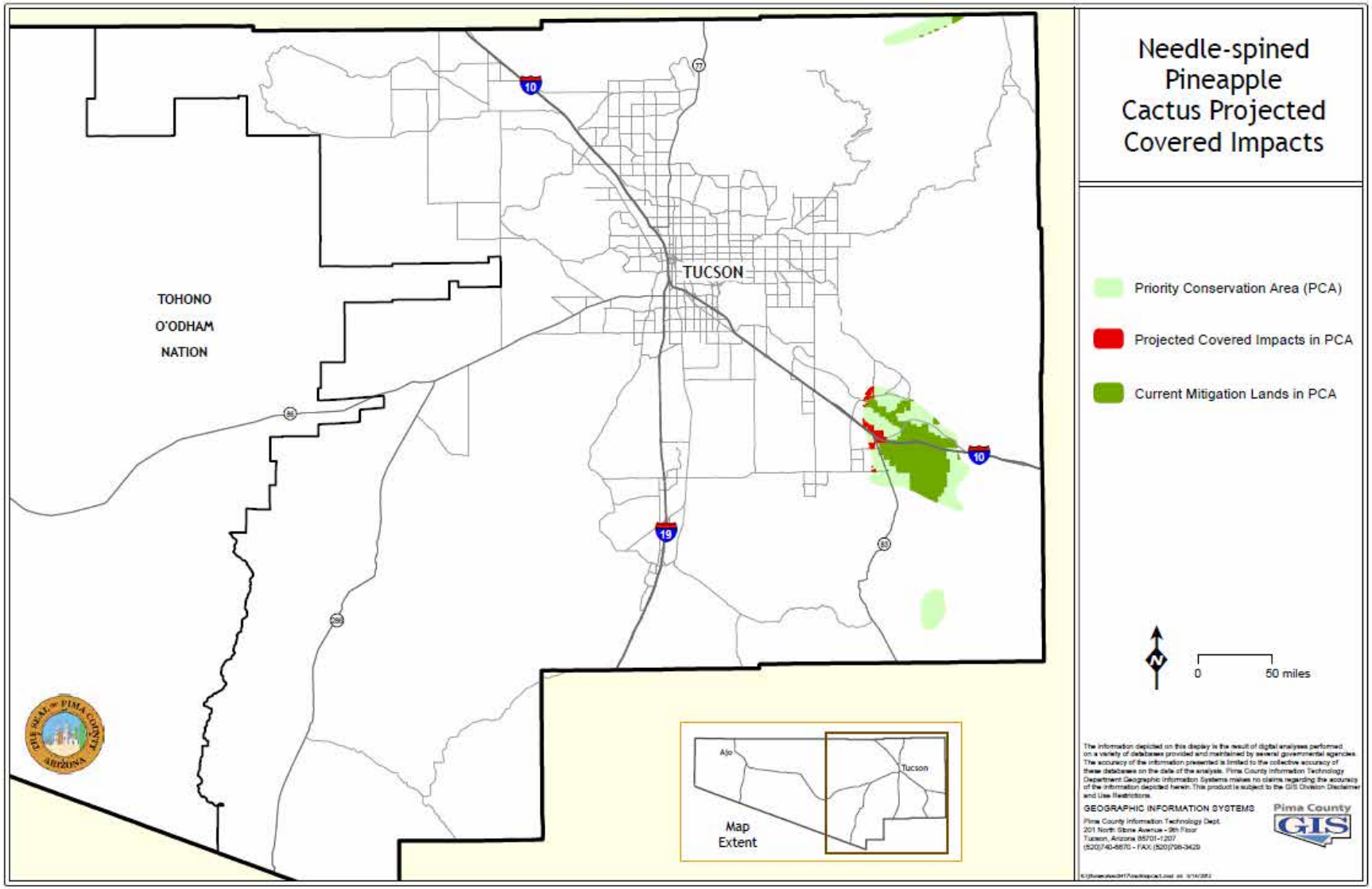


Figure A-2. Map of projected impacts and mitigation for the needle-spined pineapple cactus.

Huachuca water umbel (*Lilaeopsis schaffneriana* ssp. *recurva*)

Conservation Status

Endangered Species Act Status: Listed as Endangered by the USFWS in 1997. Critical habitat designated in 1999 (U.S. Fish and Wildlife Service 1999a).

State: Highly Safeguarded.

Other: U.S. Forest Service Sensitive Species.

Rankings: G4, S2

Description

The Huachuca water umbel is an herbaceous semi-aquatic perennial with tiny 3- to 10-flowered umbels that arise from nodes of creeping shallow (0.4-0.8 inches [1.0-2.0 cm]) underground rhizomes which run along the bottom of still ponds and shallow streamsides. Cylindrical hollow leaves are pale green in color and are typically borne 2 or 3 per node, having septa at irregular intervals. Leaves are generally 0.04-0.12 inches (1.0-3.0 mm) in diameter, however, length varies depending on microhabitat. When growing above water in wet soil near streams, stems are often 1.2-2.0 inches (3.0-5.0 cm) tall (too weak to support leaves) but may be up to 8.0 inches tall (20.0 cm). Inflorescence peduncles are typically 0.4-2.8 inches (1.0-7.0 cm) long and always shorter than leaves. Flowers are 0.04-0.08 inches (1.0-2.0 mm) wide with tiny maroon-tinted petals and are borne below leaves. Fruits are globose, 0.06-0.08 inches (1.5-2.0 mm) in diameter, and slightly longer than wide.

Distribution and Trend

The Huachuca water umbel was historically found in Pima County: Tucson, along the Santa Cruz River; Cochise County: Huachuca Mountains, San Pedro area, Saint David (extirpated), San Bernardino Valley/Black Draw; Santa Cruz County: Sonoita Creek, Canelo Hills/Turkey Creek, San Rafael Valley. This species has been extirpated from a significant portion of its historical range. There are 20 historic locations in Tucson where the species is now extirpated due to unsuitable habitat.

The current distribution of the species is in Arizona and Sonora, Mexico. Fifty one sites are believed to be currently occupied in 5 watersheds, only the first two of which are primarily located in Arizona: San Pedro

River, Santa Cruz River, Rio Yaqui, Rio Sonora, and Rio Concepcion (U. S. Fish and Wildlife Service 2014b), with most sites between 3,500 and 6,500 feet (1,148-2,133 m) elevation (U.S. Fish and Wildlife Service 1999b). New populations have been discovered in the past decade (primarily in Sonora, Mexico) (U. S. Fish and Wildlife Service 2014b).

Three populations are thought to exist in Pima County: (1) Cienega Creek in Las Cienegas National Conservation Area; (2) Cienega Creek Natural Preserve; and (3) Bingham Cienega Preserve. The species was found in Cienega Creek Natural Preserve in 2001 (Engineering and Environmental Consultants Inc. 2001), but subsequent visits since have failed to detect the species. The species was not present on a 2001 survey of the La Cebadilla Property, but it was thought to be present there previously (Engineering and Environmental Consultants Inc. 2001). Wetland conditions required by the species have not been found at Bingham Cienega Preserve since 2007 and the water umbel's continued persistence here is uncertain. It may be possible to reestablish populations at historic localities in the effluent-dominated portion of the Santa Cruz River and in the portion of the San Pedro River within Pima County.

Huachuca water umbel populations are highly dynamic and expand and contract depending on the presence of "refugia" where this species can escape the effects of scouring floods. This kind of population ebb and flow presents considerable challenges to surveying for this species. Additionally, these population dynamics function best in a watershed that has an unaltered hydrograph and a healthy riparian community stabilizing the stream channel. From these refugia, the species can rapidly expand if conditions are favorable. However, entire patches can be lost due to flooding, particularly in compromised stream channels, or may be greatly reduced due to competition with other plant species (U.S. Fish and Wildlife Service 1997a).

Habitat Requirements

The Huachuca water umbel requires perennial water, gentle stream gradients, small- to medium-sized drainage areas, and mild winters, although it can recover from some levels of freeze-damage. It is usually found in water depths from 2.0 to 6.0 inches (5.0 to 15.0 cm), but occasionally to 10.0 inches (25.0 cm) deep. It grows in submerged sand, mud and/or silt, but usually requires some organic component (Mima Falk, USFWS, personal communication to Ken Kingsley, 1 May 2000). This plant also grows in cienegas (marshy wetlands). Plants may be found in both unshaded and shaded sites (U.S. Fish and Wildlife Service 1999b).

The physical and biological habitat features essential to the conservation of Huachuca water umbel include (U.S. Fish and Wildlife Service 1999b):

- a riparian plant community that is fairly stable over time and not dominated by nonnative plant species,
- a stream channel that is relatively stable, but subject to periodic flooding,
- refugia sites, and
- a substrate that is permanently wet or nearly so, for growth and reproduction of the plant.

Current and Potential Threats

General: Wetland areas are rare and declining in the Sonoran desert region (Hendrickson and Minckley 1984; Pima County 2000b). Historic watershed degradation included impacts associated with livestock grazing, development, and diversion of water. Some of these may continue to deteriorate habitat for this species, or keep it unsuitable for re-establishment. Individual plants or entire populations can be destroyed when flooding is too frequent or intense, although an intermediate level of flooding frequency may reduce competition from other plant species (U.S. Fish and Wildlife Service 1999b).

Existing and potential pest species: Huachuca water umbel populations have declined, perhaps in part due to competition when their habitat is aggressively colonized by other wetland species, both native (e.g., cattails [*Typha* spp.]), and nonnative (e.g., water cress [*Rorippa nasturtium-aquaticum*]). *Arundo donax* is also a nonnative plant species of concern in some areas because it might crowd out the umbel. Crayfish (*Orconectes* spp.) are likely detrimental to this species, because they may consume the plants.

Threat mechanism: Populations are threatened by loss of wetland aquatic habitat that may result from: drawdown of shallow groundwater, alteration of watershed conditions, development, overgrazing and trampling by livestock, diversion of water, and flash flooding. Also, overcrowding by other plants may result in reduction of local populations of this species.

Management Needs

General: Perennial water flow and excessive erosion are key management issues. Huachuca water umbel populations are restricted to wetland areas that are rare in the southwest United States and adjacent Mexico. Protective measures should include procurement of instream flow rights and management of watersheds to reduce flood intensity. Rural and urban development, road building, chaining, agriculture, mining, fire, and other land disturbances that degrade the watershed can also adversely affect Huachuca water umbel.

Current protective measures: Endangered status for this species implements Federal protection under the Endangered Species Act (U.S. Fish and Wildlife Service 1999b). Designation of critical habitat (all of which is located within Santa Cruz and Cochise counties) prohibits destruction or adverse modification of critical habitat by any activity funded, authorized or carried out by any Federal agency. Designation of the San Pedro Conservation Area was accomplished by legislation that states that the BLM is charged with conservation, protection and enhancement of the riparian area, which includes populations of Huachuca water umbel. Management of Las Cienegas National Conservation Area may protect this species there, and surveys conducted in 2011 show robust populations there (Jeff Simms, personal communication to Brian Powell, November 2011). Coronado National Forest monitors all of their known populations and has protective measures such as livestock exclosures in place in critical habitat. Populations on Fort Huachuca are also monitored and recreational use in these areas is excluded. The species shows excellent response to reintroductions, so there is a good

likelihood of reestablishing the species in historically occupied sites if conditions are favorable (Titus and Titus 2008a).

Corridor needs: The species likely disperses vegetatively as well as by seed, so dispersal corridors along rivers are likely critical for this species to become naturally re-established in areas from which it has been extirpated.

Dispersal requirements: Dispersal can take place via the movement of both seed and vegetative propagules along stream corridors; however, suitable habitat, which at present is severely limited, must exist for new populations to become established.

Key relationships: A primary constituent of designated critical habitat for this species includes an aquatic plant community that is relatively stable over time and in which non-native species do not exist or are at a density that has little or no adverse effect on resources available to Huachuca water umbel (U.S. Fish and Wildlife Service 1999b). The health of Huachuca water umbel populations may serve as an indicator of habitat conditions for other sensitive species that occupy the same community, including: Canelo Hills lady's tresses (*Spiranthes delitescens*), Huachuca spring snail (*Pyrgulopis thompsonii*), Gila chub (*Gila intermedia*), Sonora tiger salamander (*Ambystoma tigrinum stebbensii*), Chiricahua leopard frog (*Lithobates chiricahuensis*), and northern Mexican gartersnake (*Thamnophis eques megalops*) (Warren et al. 1991). The pollinator or pollination mechanism of this species is not known. If another species is necessary for pollination, then conservation of that species will be necessary in order to maintain viable populations of Huachuca water umbel.

Existing monitoring and research programs: Titus and Titus (2008b) monitored populations at Bingham Cienega Preserve for two years but that population is thought to be extirpated, though a seed bank may still be present on the site. Site-specific monitoring is ongoing at Fort Huachuca, the San Pedro River Conservation Area, and at Las Cienegas National Conservation Area.

Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-3): 364.

Acres of mitigation habitat within the current portfolio of conservation lands: 4,088.

Impact of Covered Activities on Critical Habitat

Critical habitat for the Huachuca water umbel covers areas in Santa Cruz and Cochise counties (U.S. Fish and Wildlife Service 1999a). No critical habitat occurs in Pima County or the Permit Area; the County's obligations under the Section 10 permit will not affect critical habitat for this species.

Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Huachuca water umbel:

- Pima County will work with the USFWS to reestablish populations where conditions are shown to be appropriate; Pima County will monitor the outcome of that work;
- Though the umbel has been surveyed at other potential sites on County preserve lands, Pima County will investigate any credible observations of this species on other County preserve lands and if presence is confirmed, Pima County will monitor at that site if conditions are appropriate (i.e., there is a chance for long-term establishment of the populations).
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database. Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Protect existing habitat in the County-controlled mitigation lands from invasive species and controllable desiccation, where such efforts have a good chance for success.
- Continue to seek protection of water rights at Cienega Creek Natural Preserve and Bingham Cienega Natural Preserve to maintain and restore habitat.
- Continue to seek opportunities to acquire water rights to protect habitat for any newly detected, natural populations located on Pima County preserves.
- Survey for this species in suitable habitat during inventories of new properties.
- Consider establishing or re-introducing this species at aquatic sites on County-controlled mitigation lands; such activities would be conducted in a manner consistent with the Recovery Plan for this species, should one be completed.
- Aid in the development of a Recovery Plan for this species, should one be initiated.

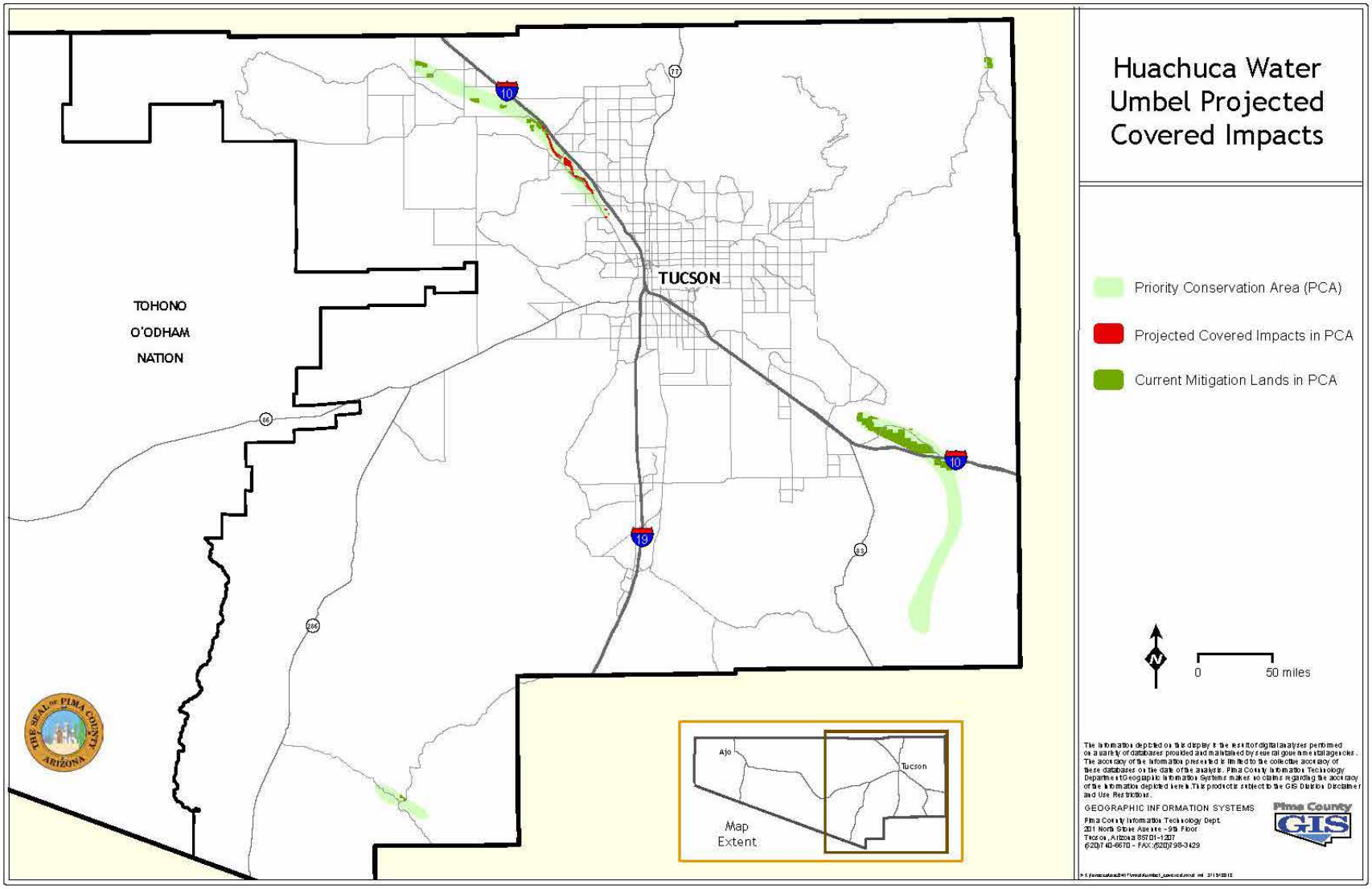


Figure A-3. Map of projected impacts and mitigation for the Huachuca water umbel.

Tumamoc globeberry (*Tumamoca macdougalii*)

Conservation Status

Endangered Species Act Status: None. Species had been listed as endangered, but was delisted because it was found to be more abundant and widespread than was thought at the time of listing.

State: Arizona Native Plant Law: Salvage Restricted.

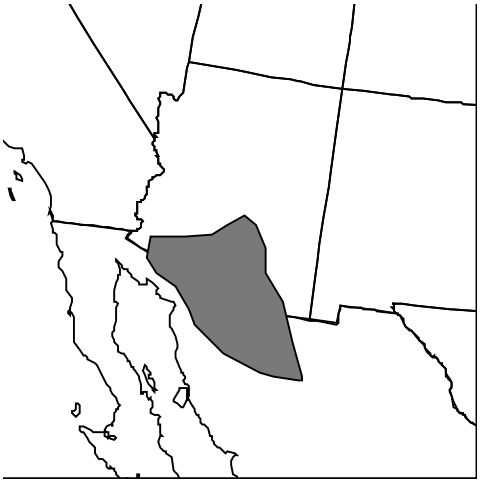
Other: U.S. Forest Service Sensitive Species; Bureau of Land Management Sensitive;

Rankings: G4, S3.

Description

The Tumamoc globeberry is a cryptic perennial dioecious or monoecious vine with grasping tendrils. It arises each summer rainy season from a cluster of tuberous roots that are united into a woody crown with a short stem. The slender annual stems have many nodes. Each node along the stem produces 1 tendril, 1 leaf, 1 male flower raceme, and 1 female flower bud (in monoecious individuals). Leaves vary widely in size and shape. Most are rounded in outline, divided into 3 lobes; these lobes are about 0.8 to 1.6 inches (2.0 to 4.0 cm) long, with secondary lobes. The leaves have tiny pustule-like hairs. The flowers have pale yellow petals that are united below their middle, 0.4 to 0.6 inches (1.0 to1.5 cm) long. Round, green fruit (that give the common name to the plant), about the size of a seedless grape, striped like watermelon when young, develop and turn red after 4 to 5 weeks. They contain 2 to several large seeds, 0.28 to 0.32 inches (7.0-8.0 mm) long that are 4-sided (Arizona Game and Fish Department 2004).

Distribution and Trend



At the time of its discovery, and for many years thereafter, this vine was thought to be very rare and very limited in its distribution. Over time, with acquisition of effective search images and application of extensive and intensive efforts by field crews working primarily for consultants doing surveys for a plant that was initially considered a critically endangered species, the Tumamoc globeberry was found to be more abundant and widespread than had been initially thought.

The range of the Tumamoc globeberry covers approximately 31,000 square miles of Sonoran Desert from just southeast of Guaymas, Sonora, Mexico, to Tucson, Arizona, west to Organ Pipe Cactus National Monument and north to Pinal County, Arizona. The species' range in Pima County covers much of the County, with the highest concentrations of the species found west of I-10 and east of

the Tohono O'Odham Nation (Reichenbacher 1990; Rondeau et al. 1996), but some populations also exist west to Organ Pipe Cactus National Monument (cited in Schmidt et al. 2007). Frank Reichenbacher maintains long-term monitoring sites at Sabino Canyon, Tumamoc Hill, and the Tucson Mountains. Bureau of Reclamation maintains long-term monitoring sites in the Avra Valley. Additional surveys for this species will likely increase its known range in Pima County.

Reichenbacher (2009) reported on monitoring results of three populations in eastern Pima County, with the original surveys starting in the mid-1980s through the mid-1990s (Tumamoc Hill, Tucson Mountain, and Sabino Canyon). All three populations have declined by >85%.

The Tumamoc globeberry has been confirmed on a number of County-owned and managed properties west of Tucson, including Tucson Mountain Park, Tumamoc, and King 98. It is very likely to occur on Rancho Fundoshi in Bear Canyon, but a single survey in 2010 did not detect the species.

Habitat Requirements

The species is capable of occupying a wide range of habitats from halophytic coastal scrub communities on clayey saline hardpans only a few hundred feed from the Gulf of California shoreline to rocky loamy soils derived from weathered granite at nearly 3,000 ft. elevation in south central Arizona (Arizona Game and Fish Department 2004). Southeast of Guaymas, it occurs in a halophytic coastal scrub community on extremely salty hardpans; at Kino Bay it occurs in coastal scrub on salty sand of old barrier dunes; in Tucson it is found on hot, dry, south-facing slopes of basalt and along desert washes. The largest population known is found in creosotebush desert scrub on gravelly loams primarily derived from weathered granites. Biotic communities in which it has been found include Arizona Upland and Lower Colorado Valley, Plains of Sonora and Central Gulf Coast subdivisions of Sonoran Desert Scrub Biotic Community; and the Sinaloan Thornscrub Biotic Community (Arizona Game and Fish Department 2004).

Habitat trends in planning area: Large areas of potentially suitable habitat are found within the species' range, which has not been adequately surveyed. Much of the species' range in the United States is on protected land or land that is not likely to be developed. However, some development has occurred within the species range, and habitat has been lost.

Current and Potential Threats

General: Threats include urbanization, farming, overgrazing, recreation, habitat conversion, javelina (eating tubers), off-road vehicle use, and pesticides (Arizona Game and Fish Department 2004). According to the Arizona Game and Fish Department (2004), the main factors affecting survival are thought to be:

1) Intensity and seasonal distribution of summer precipitation;
2) Intensity, duration, and seasonal distribution of droughts;
3) Date and intensity of first hard frost;

4) Local predation pressure, varying from minor stem clipping to partial or complete root excavation; and
5) Invasive plants such as buffelgrass.
6) Anthropogenic habitat alteration.

Existing and potential pest species: Javelina consume the roots and may destroy the plants in the process. A leaf-mining insect is known to consume some leaf tissue. Rabbits clip growing stems.

Threat mechanism: Physical destruction of plants and failure to reproduce are thought to be the dominant threat mechanisms.

Management Needs

General: Maintenance of at least some of the range of this species in relatively pristine condition is probably necessary for its survival.

Current protective measures: Large areas that are known to be within the species range and that are known to have the species present are under management control of a variety of government agencies. Some preserves (e.g., Bureau of Reclamation CAP preserve) have been created and surrounded with fences to keep out javelina. Many plants were transplanted from the CAP right of way, placed in preserves, and monitored for a number of years (Reichenbacher and Perrill 1991). Monitoring is very difficult, confounded by the difficulties of relocating plants once discovered, of distinguishing them from neighbors only a few millimeters away, and of accounting for dormant plants.

Corridor needs: None are known.

Key relationships: The pollinator(s) have not been identified yet but are believed to be one or more moth species because the plant flowers at night. The highly clumped distribution pattern that local populations are found in suggests that seeds are inefficiently dispersed. Some obscure environmental parameter may also be responsible, but this seems unlikely. Several species of birds have been mentioned as consumers of the fruits (Arizona Game and Fish Department 2004), but their effectiveness as seed dispersers has not been demonstrated. It is believed that nurse plants are necessary to provide support for the delicate vine and provide a means of displaying mature fruits to potential seed dispersers. Nurse plants may also moderate soil conditions, enabling the globeberry to grow in a wide variety of soil types.

Migratory requirements: None are known. Seed dispersal agents may be a limiting factor for at least some populations.

Existing monitoring and research programs: Frank Reichenbacher (Reichenbacher 1990; Reichenbacher and Perrill 1991; Reichenbacher 2008, 2009) has been a leading force in monitoring populations of the species and all of his monitoring plots are in eastern Pima County.

MSCP Projected Modeled Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-4): 15,706.

Acres of modeled habitat within the current portfolio of conservation lands: 21,266.

Pima County's MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Tumamoc globeberry:

- Evaluate newly discovered populations within the County preserve system for presence of threats and protective measures to be taken.
- Minimize impacts by participating in buffelgrass management efforts within the Sonoran desertscrub vegetation community.
- Work with the City of Tucson and Bureau of Reclamation to conserve suitable habitat in the Avra Valley.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

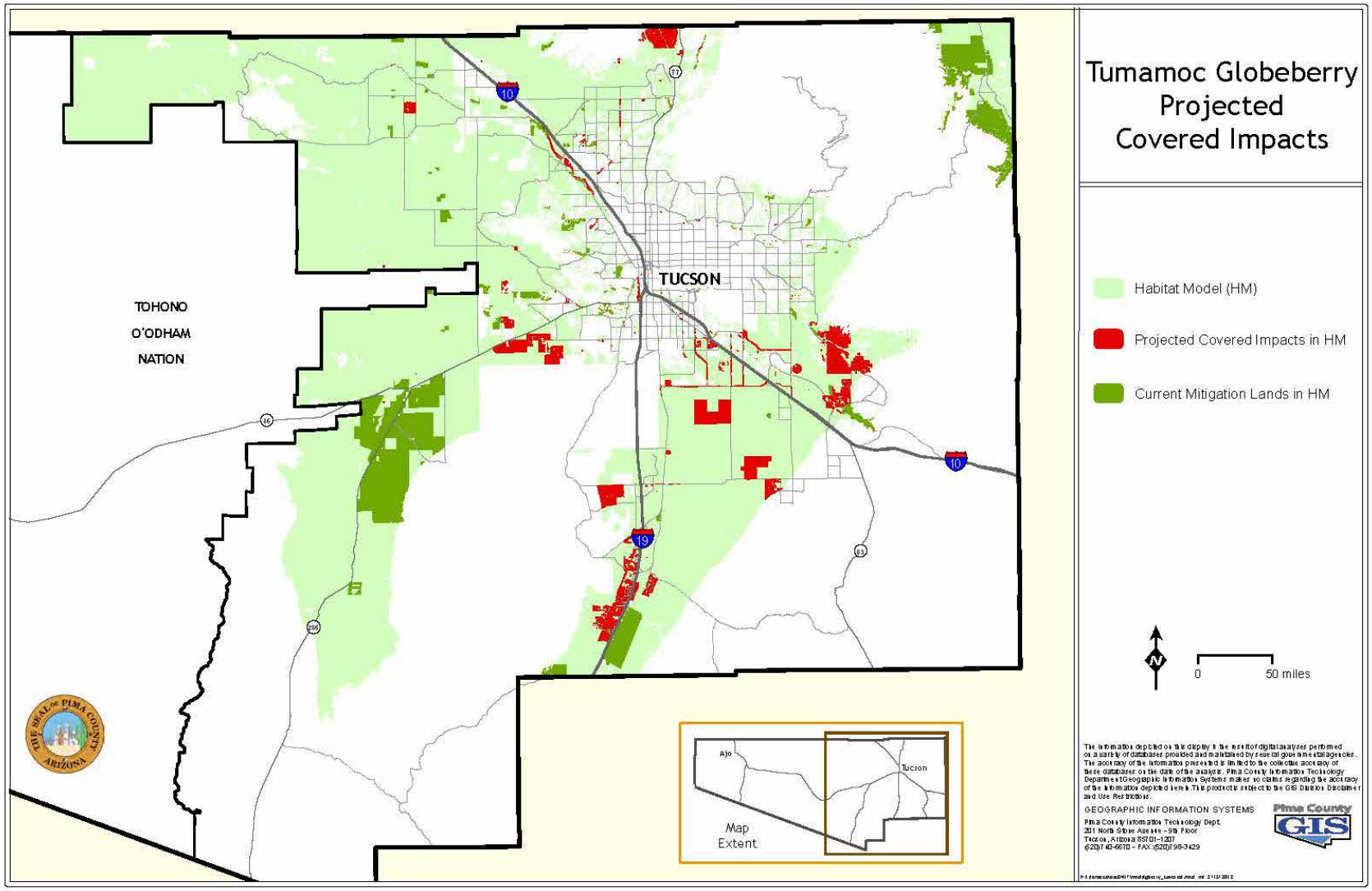


Figure A-4. Map of projected impacts and mitigation for the Tumamoc globeberry.

Mammals

Lesser long-nosed bat (*Leptonycteris curasoae yerbabuena*)

Conservation Status

Endangered Species Act Status: Listed as Endangered in 1988 .

State: Wildlife of Special Concern in Arizona.

Other: U.S. Forest Service Sensitive Species; Threatened in Mexico. "Red" Priority Species by Western Bat Working Group.

Rankings: G3, S2.

Description

The lesser long-nosed bat is a medium-sized bat, is grayish to reddish brown and has an elongated snout. This bat has a nose-leaf, no tail, and an interfemoral membrane that is reduced to a narrow band along each hind leg; this species has large eyes and reduced ears compared to other bats in Arizona (Arizona Game and Fish Department 2003e). It is easily confused with the Mexican long-tongued bat, which has a visible tail enclosed in the interfemoral membrane. Structural adaptations of the mouth of lesser long-nosed bat are geared towards procuring nectar and pollen, their primary food source. The tongue is long and tipped with brush-like papillae that facilitate nectar lapping and the teeth are modified, having lost the cutting and crushing cusps essential to successfully foraging on insects.

Distribution and Trend

The lesser long-nosed bat has been found in southern Arizona from the Picacho Mountains southwest to the Agua Dulce Mountains and southeast to the Chiricahua Mountains. In southwestern New Mexico this species is also found in the Animas, Big Hatchet, and Peloncillo Mountains, and south from Arizona and New Mexico throughout the drier parts of Mexico, including Baja California. Occasionally, individuals have been reported outside of this range, for example there are records of individuals from the Phoenix area and the Bill Williams River during July and August. It is a seasonal resident in Arizona, usually arriving in early April and departing in mid-to-late September. However, it has been seen visiting hummingbird feeders in Tucson in January and February in recent years. It apparently resides in New Mexico only from mid-July to early September (USFWS 1995).

In Pima County, the lesser long-nosed bat is found in the spring and summer. Most of the currently known roost sites are inactive mine adits. In eastern Pima County, roosts are found in the Santa Catalina, Rincon, Whetstone, and Santa Rita mountains (Davis and Sidner 1992; Arizona Game and Fish Department 2003e; Swann and Powell 2006; WestLand Resources Inc 2009), though they are apparently not found in abundance on the east and north sides of the Santa Catalina Mountains due to the lack of *Agave palmeri* there (Ronnie Sidner, *personal communication* to Brian Powell, October 2011).

The species has been recorded in a number of locations in western Arizona including Cabeza Prieta National Wildlife Refuge and Organ Pipe Cactus National Monument (Cockrum 1981; Cockrum and Petryszyn 1986; Petryszyn and Cockrum 1990). Monitoring efforts associated with the Town of Marana's and the City of Tucson's Habitat Conservation Plans indicate that the lesser long-nosed bat forages in the exurban areas of Tucson and avoids the densely populated areas (Arizona Game and Fish Department, *unpublished data*). As of February 2014, there are no known roost sites on Pima County preserves but future surveys may document previously unknown roost sites. However, based on the species' extensive foraging movements across suitable habitat (including foraging at hummingbird feeders in some ex-urban areas), the species is thought to occur in all Pima County-owned and managed properties except perhaps those in the San Pedro River Valley. A maternity roost of this species once occurred in Colossal Cave Mountain Park and efforts have been made to restore the suitability of this roost for the lesser long-nosed bat (U.S. Fish and Wildlife Service 1995b).

In their 5-year review, the U. S. Fish and Wildlife Service (2005b) summarized the results of comments made to inform that review by noting: "Nearly all of the LLNB experts and researchers who provided input to this 5-year review indicated that they felt that the number of lesser long-nosed bats at most of the roost sites in both the United States and Mexico are stable or increasing. Specifically, Dr. Medellín indicated that the roosts they are monitoring in Mexico show stable or increasing numbers, but he provided no specific numbers for these roosts (Medellín 2005). Two of the 12 individuals providing input to this 5-year review expressed concern about roost numbers (McCasland 2005; Howell 2007). Their concerns were related to ongoing threats and to the fact that increases at certain roosts may not indicate overall population increases."

Habitat Requirements

The lesser long-nosed bat is known from semi-desert grasslands and Sonoran Desert Scrub, Arizona Upland Subdivision at elevations below 3,500 feet from April until July up to Madrean Evergreen Woodland (oak transition regions) at elevations up to 5,500 feet from July until late September/early October (U.S. Fish and Wildlife Service 2005b). In Arizona there appears to be both sexual and seasonal differences in the range of the lesser long-nosed bat. During the early part of their stay (late April to late July) pregnant females congregate at traditional roost sites, give birth, and raise their young at lower elevations (below about 3500 ft (1068 m)) within the range of columnar cacti. Males and perhaps nonreproductive females may be found at this time in roosts in the eastern part of the state. By late July, most females and young have dispersed from the

maternity colonies and some have moved to higher elevations (up to about 5500 ft (1678 m)) where they are found feeding on agave flowers. By late September or October, all of these bats migrate south to Mexico, although exactly where is not known (Arizona Game and Fish Department 2003a).

Current and Potential Threats

The primary threat to the species is from roost disturbance because the number of roosts is small and because so many individuals gather at a single roost (U.S. Fish and Wildlife Service 2005b). Other threats include the increase in border activity and specifically the use of caves by illegal immigrants and drug traffickers, recreation and caving, loss of habitat to development, loss of key foraging resources because of changes in species composition and loss of food plants (columnar cacti and agaves), and roost deterioration (U.S. Fish and Wildlife Service 2005b).

There is no known information on existing or potential harm to the lesser long-nosed bat by pest species. Major bat predators include snakes in roosts, carnivores at roost entrances, and owls while the bats are foraging. Unlike many other bats, however, the lesser long-nosed bat is not lunar-phobic (i.e., it does not reduce its foraging activity during the bright time of the lunar month), which suggests that it does not suffer strong selection pressure from nocturnal aerial predators (U.S. Fish and Wildlife Service 1995b).

Management Needs

Management "needs" and recovery actions are detailed in the Recovery Plan (U.S. Fish and Wildlife Service 1995b). In summary, these are:

- Continue protecting roost sites and evaluate the need for and implement protection for food plants.
- Monitor all major roosts in Arizona, New Mexico, and Mexico once a year.
- Continue surveying for additional roosts in the U.S. and Mexico.
- Develop and conduct a public education and information campaign in Arizona, New Mexico, and Mexico on the beneficial aspects of bats in general and the lesser long-nosed bat specifically.
- Conduct critical research on population census techniques, physical requirements for roosts, foraging ranges of roosts, reproduction and mating systems and other life history and habitat questions.

Current protective measures: Two laws provide some measure of protection at cave roosts, subject to enforcement capability. The Federal Cave Protection Act of 1988 prohibits persons from activities that "destroy, disturb, deface, mar, alter, remove, or harm any significant cave or alters free movement of any animal or plant life into or out of any significant cave located on Federal lands, or enters a significant cave with the intent of committing any act described …". The Arizona Revised Statute (ARS) §13-3702 makes it a class 2 misdemeanor to "deface or damage petroglyphs, pictographs, caves, or caverns." Activities covered under ARS §13-3702 include "kill, harm, or disturb plant or animal life found in any cave or cavern, except for safety reasons." Of course, the effectiveness of these laws in protecting bat roosts is related to enforcement efforts,

which are currently minimal. Protective measures such as gating may actually lead to abandonment (U.S. Fish and Wildlife Service 2005b), so guidelines need to be developed to ensure that gates are appropriate for lesser long-nosed bats.

Corridor and migratory needs: Because lesser long-nosed bats migrate seasonally between the southwestern United States and Mexico, it is assumed that they utilize migration corridors, and that some quality of the corridor is necessary for this species. Specific corridors are not known, and may vary from year to year, or between fall and spring migrations, but the northward migration is thought to be in relation to the distribution and abundance of saguaros, agaves, and other food plants. Some roosts for day and night use must be present within the migration corridor, and populations of forage plants along migration routes are necessary.

Key relationships: This species is a known pollinator of several agave species and columnar cacti, upon which it depends for food. It is often used as an example of mutualism, although, the importance of this species in pollinating plant species with which it is associated in Arizona is not clear because they also exist outside of the known range of lesser long-nosed bat (Cockrum and Petryszyn 1991; U.S. Fish and Wildlife Service 1995b; Ober and Steidl 2004).

Existing monitoring and research programs: Long-term monitoring projects for this species have increased in the last decades. Sidner (2005) has been monitoring the species at the Fort Huachuca military reservation since 1990 and efforts at the Organ Pipe Cactus National Monument have been ongoing since 1995 (Organ Pipe Cactus National Monument 2006b). Since 2001, the Arizona Game and Fish Department has been coordinating exit counts at a number of sites in Arizona (Arizona Game and Fish Department, *unpublished data*).

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-5): 15,978.

Acres of PCA habitat within the current portfolio of conservation lands: 85,501.

Determination of Incidental Take

Pima County anticipates that take of individual lesser long-nosed bats will be low and extremely difficult to detect because of the nocturnal nature of the species; their cryptic coloration; and large permit area. However, incidental take in the form of harm, harassment, possible roost disruption, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from collisions with or crushing of forage plants by vehicles and equipment, land clearing, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as subsequent erosion, invasive species, and light pollution. Therefore, we will use acres of PCA habitat impacted by covered activities (see Table 3.3 in the MSCP) as a surrogate for the incidental take of the lesser long-nosed bat. Effects to habitat can result in the following impacts to lesser long-nosed bats: abandonment of young due to noise, activity, light, etc.; injury or death of young if they are abandoned or fall in flight; being forced into suboptimal habitat; increased predation; starvation and reduced

reproductive output due to reduced habitat quality and increased competition; loss of day and night roosts, etc.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the lesser long-nosed bat:

- Protect known roosts and foraging habitats of this species on County-controlled mitigation lands using appropriate means.
- Investigate the purchase of valid mining claims for mines with known roosts; look into opportunities for creating roost preserves and install bat-friendly exit gates, where appropriate and economically feasible.
- Restrict county activities within 1 kilometer of known roosts during May to September if this can be accomplished without disclosure of roost locations.
- Evaluate known roosts of this species on County preserves for conditions and needs for structural stabilization. Where appropriate, such stabilization will be carried out using techniques that minimize disturbance and alteration of conditions and whenever possible will occur when bats are not present (e.g., October-April).
- Pima County will apply avoidance, minimization and mitigation measures as described in Chapter 4.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

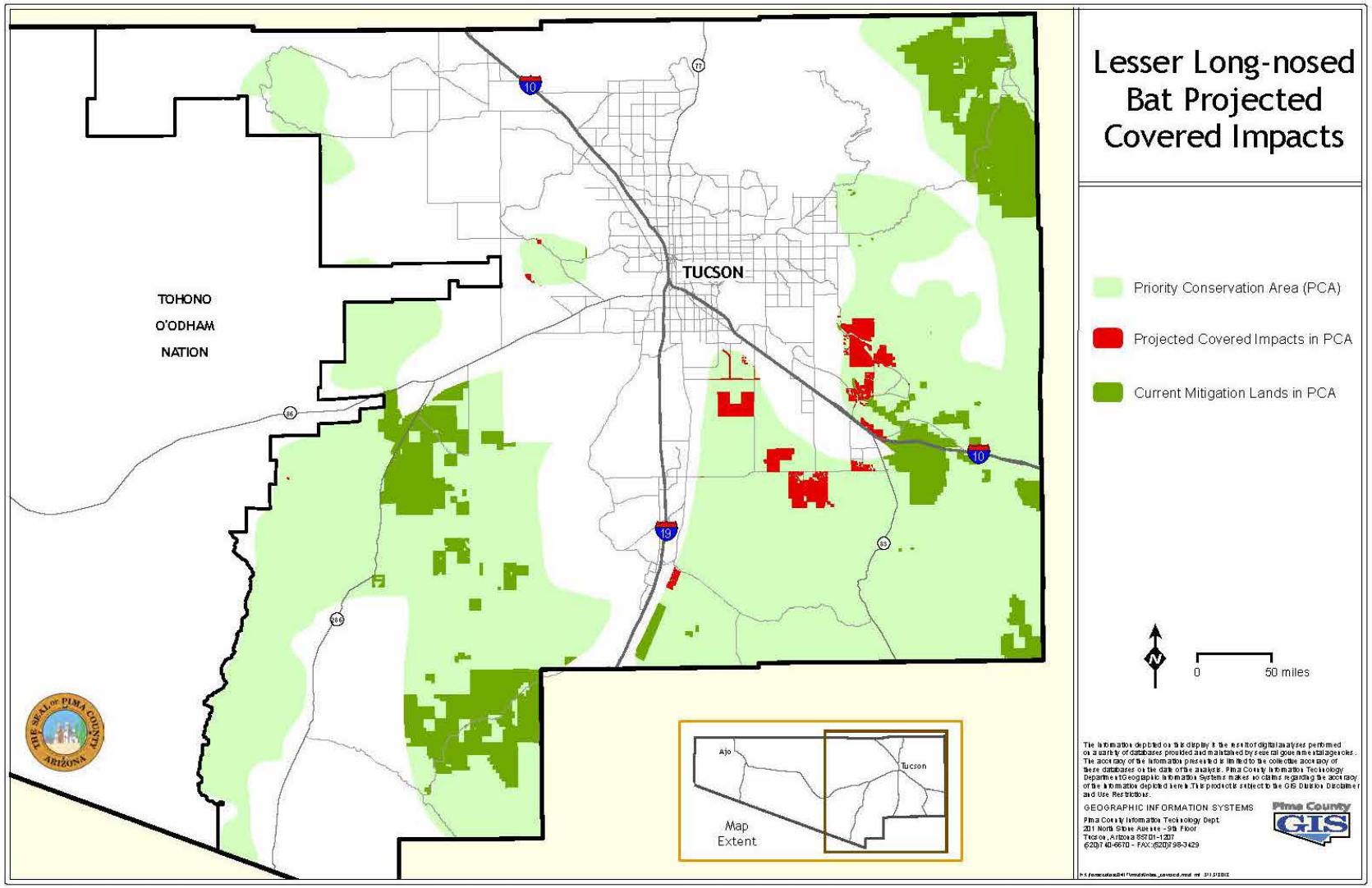


Figure A-5. Map of projected impacts and mitigation for the lesser long-nosed bat.

Mexican Long-tongued Bat (*Choeronycteris mexicana*)

Conservation Status

Endangered Species Act Status: None.

State: Wildlife of Species Concern in Arizona.

Other: USFWS Species of Concern; California Species of Special Concern, U.S. Forest Service Sensitive Species. "Red" Priority Species by Western Bat Working Group.

Rankings: G2, S1.

Description

The Mexican long-tongued bat has a long and slender nose, with a leaf-like structure that is broad at the base, pointed at the tip, and about 0.2 inches (5.0 mm) high. The forearm is 1.68-1.92 inches (42.0-48.0 mm) long, and the hind foot is 0.44-0.56 inches (11.0-14.0 mm) long. The tail is approximately 1/3 inch (10 mm) in length, about 1/3 the length of the interfemoral membrane. Dorsal pelage varies from buffy brown to dark grayish brown, palest on shoulders; the venter is paler, and the short ears are pale brownish gray. The tongue is long and extendable. The upper incisors are small, and do not fill the space between the canines. There are no permanent lower incisors, but 1 to 4 deciduous teeth may persist in adults (Arizona Game and Fish Department 2006b).

Distribution and Trend

This species is known from Venezuela northward through Central America and Mexico to southeastern Arizona, southwestern New Mexico, and San Diego, California (Barbour and Davis 1969). Only adult females migrate into the United States, but juvenile bats of both sexes wander widely after they leave the maternity roost (Arizona Game and Fish Department 2006b).

The Mexican long-tongued bat is found throughout Pima County, particularly in the eastern portion (Hoffmeister 1986). Roost sites have been found in the Santa Catalina, Rincon, Baboquivari, and Santa Rita mountains and lower Cienega Creek (Don Carter, unpublished data; Cryan and Bogan 2003; Arizona Game and Fish Department 2006b; WestLand Resources Inc 2009). Individuals have been netted at Rincon Creek (Arizona Game and Fish Department 2006b; Swann and Powell 2006) and in Organ Pipe Cactus National Monument (Organ Pipe Cactus National Monument 1999, 2006a). Work by Wolf and Shaw (*unpublished*

data) at hummingbird feeders in and around Tucson found Mexican long-tongued bats throughout the Tucson Basin, particularly along the Pantano, Rillito, and Agua Caliente washes and Tanque Verde Creek. Ronnie Sidner has studied the species extensively at the Fort Huachuca Military Reservation (Cochise County; *unpublished data*). Populations in Arizona appear to be highly variable (Arizona Game and Fish Department 2006b) and there is no evidence of a positive or negative trend.

The Mexican long-nosed bat has been confirmed to roost at the Cienega Creek Natural Preserve, but is thought to forage on most County-owned and managed properties.

Habitat Requirements

The Mexican long-tongued bat is known from canyons of mixed oak-conifer forests in mountain ranges surrounded by desert (Arizona Game and Fish Department 2006b). It requires caves, inactive mines, or unoccupied buildings to use as both day and night roosts. Most roost sites are located near a water source and near areas of riparian vegetation (Cryan and Bogan 2003). Carter and Peachy (1996) studied roost sites in the Cienega Creek Natural Preserve and most sites were located immediately adjacent to the creek. The roost sites consisted of pocketed, eroded clay soil holes such as sink holes, or soil piping caves.

Long-tongued bats feed on nectar and pollen, also probably ingesting insects found in the flowers (Hevly 1979). Food plants include paniculate agaves and occasionally columnar cacti (Hevly 1979). These bats have also been observed feeding at hummingbird feeders on the edges of urban Tucson (Arizona Game and Fish Department 2006b). On a population level, the value of this resource has not been determined.

Current and Potential Threats

More potential roosts sites are available now than before mining occurred in the mountain ranges occupied by this species, yet both natural caves and mine roost sites are threatened by human disturbance, destruction, mining activities, mine closures, and border activities. This species is extremely sensitive to disturbance at roost sites, and may abandon roosts if disturbed; the females taking babies with them and subjecting them to additional mortality factors (Arroyo-Cabrales et al. 1987). In addition to threats at mine sites, loss of forage plants (agave and saguaro flower nectar and pollen) and loss of riparian vegetation may also impact the species (Arizona Game and Fish Department 2006b). There are no known records of existing or potential harm to the Mexican long-tongued bat by predators or introduced pest species.

Management and Information Needs

Mexican long-tongued bats are very wary of humans and are easily disturbed. Human disturbance to roost sites should be restricted. Surveys for this species may be difficult because it roosts in small (5-15 individuals) colonies. The development of improved survey methods could greatly increase knowledge of population trends. Studies to determine food habits, range, population densities, and migration and roosting patterns are also needed (Arizona Game and Fish Department 2003a).

Current protective measures: Two laws provide some measure of protection at cave roosts, subject to enforcement capability. The Federal Cave Protection Act of 1988 prohibits persons from activities that "destroy, disturb, deface, mar, alter, remove, or harm any significant cave or alters free movement of any animal or plant life into or out of any significant cave located on Federal lands, or enters a significant cave with the intent of committing any act described …". The Arizona Revised Statute (ARS) §13-3702 makes it a class 2 misdemeanor to "deface or damage petroglyphs, pictographs, caves, or caverns." Activities covered under ARS §13-3702 include "kill, harm, or disturb plant or animal life found in any cave or cavern, except for safety reasons." The effectiveness of these laws in protecting bat roosts is related to enforcement efforts, which are currently minimal. Protective measures such as gating may actually lead to abandonment (U.S. Fish and Wildlife Service 2005b), so guidelines need to be developed to ensure that gates do not negatively impact bats. Pima County's Natural Resources, Parks, and Recreation department has stabilized soil pipe caves at the Cienega Creek Preserves with some success, so restoration of roosting habitat is possible.

Corridor and migratory needs: Because Mexican long-tongued bats migrate seasonally between the southwestern United States and central Mexico, it is assumed that they utilize migration corridors, and that some quality of the corridor is necessary for this species, but there is no specific information known that supports conclusions regarding corridor needs. Specific migratory requirements are not known. It is presumed that food and shelter along the migration route are necessary.

Key relationships: The Mexican long-tongued bat is found in canyons of mixed oak-conifer forests, at elevations ranging from 4,000 to 6,000 feet, in mountain ranges surrounded by desert (Arizona Game and Fish Department 2006b). The presence of flowering agave during the summer months appears to be critical for this species.

Existing monitoring and research programs: No long-term monitoring of the species has been conducted, though according to Cryan and Bogan (2003), there is no evidence to conclude that populations in Arizona and New Mexico have increased or decreased. Trend monitoring may be difficult given the dispersed roost characteristic of the species.

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-6): 5,735.

Acres of mitigation habitat within the current portfolio of conservation lands: 52,925.

Determination of Incidental Take

Pima County anticipates that take of individual Mexican long-tongued bats will be low and extremely difficult to detect because of the nocturnal nature of the species; their cryptic coloration; and the large permit area. However, incidental take in the form of harm, harassment, potential roost disruption, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from collisions with or crushing of foraging plants by vehicles and equipment, land clearing, habitat fragmentation, increased human activity, and indirect impacts such as subsequent

erosion, invasive species, and light pollution. Therefore, we will use acres of PCA habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of the Mexican long-tongued bat. Effects to habitat can result in the following impacts to Mexican long-tongued bats: abandonment of young due to noise, activity, light, etc; injury or death if they fall in flight; being forced into suboptimal habitat; increased predation; starvation and reduced reproductive output due to reduced habitat quality and increased competition; and loss of day and night roosts, etc.

Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Mexican long-tongued bat:

- Evaluate known roosts of this species on County preserves for conditions and needs for structural stabilization. Where appropriate, such stabilization will be carried out using techniques that will minimize disturbance and alteration of conditions. Install bat-friendly exit gates, where appropriate and feasible.
- Emphasize management for this species within Cienega Creek Natural Preserve and Colossal Cave Mountain Park.
- Pima County will apply avoidance, minimization, and mitigation measures as described in Chapter 4.
- Encourage the purchase and installation of new lighting within the cave tour portion of Colossal Cave Mountain Park that reduces stress on bats and promotes higher abundance and occupancy.
- Continue to maintain USFWS-funded soil piping project at Cienega Creek Natural Preserve, as budget and site conditions allow.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

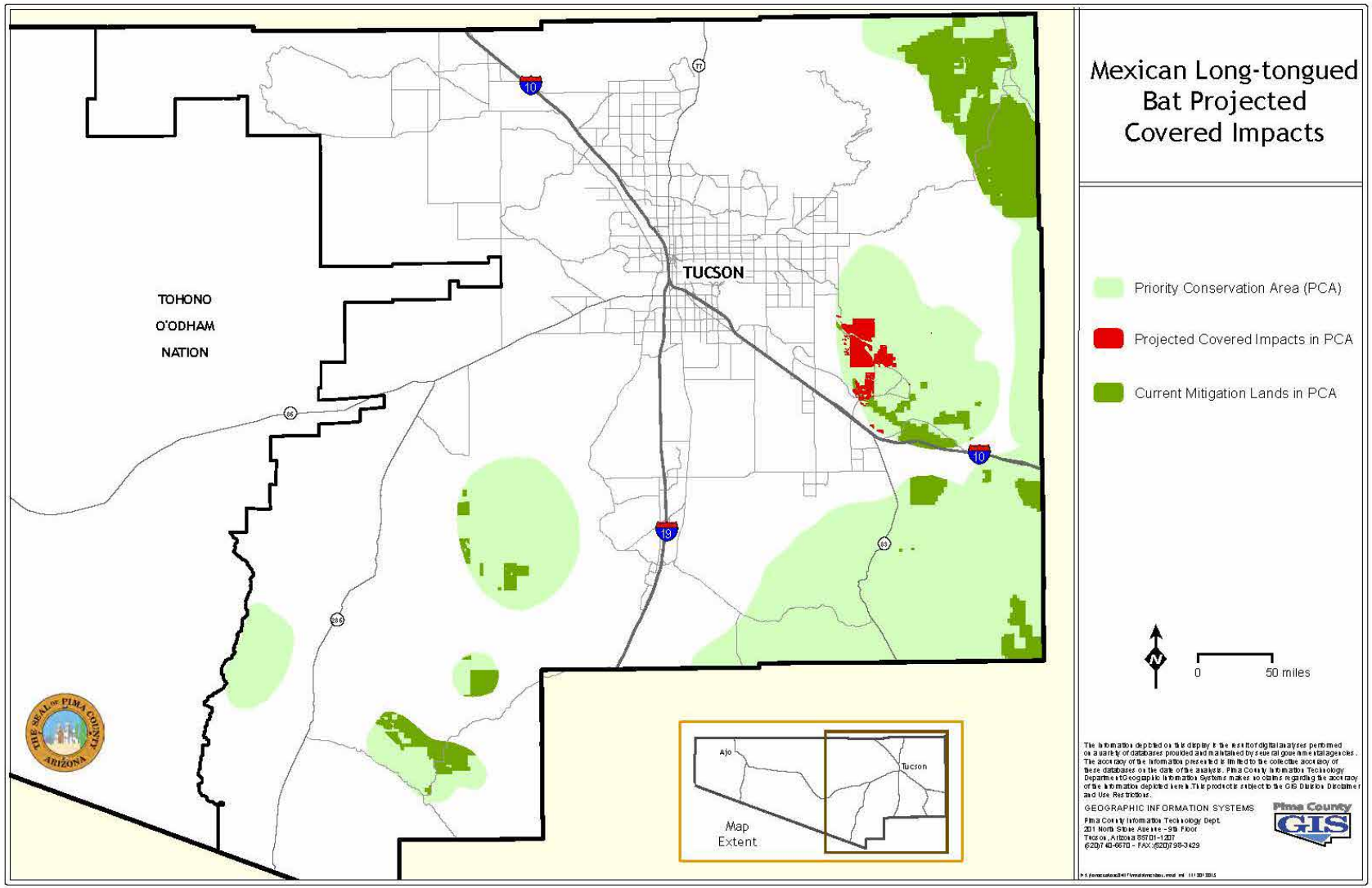


Figure A-6. Map of projected impacts and mitigation for the Mexican long-tongued bat.

Western red bat (*Lasiurus blossevillii*)

Conservation Status

Endangered Species Act Status: None.

State: Species of Special Concern in Arizona.

Other: U.S. Forest Service Sensitive Species; "Red" Priority Species by Western Bat Working Group.

Rankings: G5, S2.

Description

The western red bat is a medium-sized bat, forearm 1.5 to 1.7 inches (38 to 43 mm) long, weight 0.25 to 0.5 ounces (7 to 15 g); wings long, narrow, and pointed, wingspan 11 to 13 inches (290-332 mm), ears short and rounded, 0.3 to 0.5 inches (11-13 mm) in length; interfemoral membrane (uropatagium) is completely furred on the dorsal surface. Color ranges from bright orange to yellow-brown with white-tipped hairs; whitish patches near the shoulder; and wing membranes are black. Males are usually more brightly colored than females (Arizona Game and Fish Department 2003d).

Distribution and Trend

The total range of the western red bat extends from extreme southern Canada through the United States and west of the Great Plains south to Panama and South America. Apparently it is only a summer resident in the southwestern United States (Barbour and Davis 1969; Shump and Shump 1982; Arizona Game and Fish Department 2003c) and it winters northward to Sonora and coastal California (Findley et al. 1975). It is presumed to be found throughout Pima County, including the Santa Rita Experimental Range, Empire Gulch, SE of the Baboquivari Mountains, Santa Catalina Mountains including Sabino Canyon, Buenos Aires National Wildlife Refuge (Arizona Game and Fish Department 2003c), Rincon Creek (Swann and Powell 2006), and Colossal Cave Mountain Park. As of 2003 there have been <20 documented occurrences of the bat in Pima County (Arizona Game and Fish Department 2003a). There have been no confirmed observations of western red bats on County-owned and managed properties, though they are likely to be found at the Cienega Creek Natural Preserve and other sites with large cottonwood and willow trees.

There is no trend data for this species, but anecdotal evidence suggests that it may be less common in recent decades (Arizona Game and Fish Department 2003c). Declines—if they have occurred—may be attributable to loss of riparian gallery forests which are important for roosting and foraging habitat.

Habitat Requirements

The western red bat inhabits broadleaf riparian deciduous forests and woodlands. Cottonwood distribution throughout the range is thought to determine this species' ability to complete its annual migration (Pierson et al. 1999; Arizona Game and Fish Department 2003c). The species often roosts alone (Arizona Game and Fish Department 2003c). Additionally, this species has been found roosting in fruit orchards (Arizona Game and Fish Department 2003a).

Current and Potential Threats

General: Current threats to this species are based on habitat loss and degradation of riparian areas and other broadleaf deciduous forests and woodlands (Arizona Game and Fish Department 2003c).

Existing and potential pest species: There are no known records of existing or potential harm to the western red bat by predators or introduced pest species.

Threat mechanism: Current threats include habitat loss and degradation of riparian and other broad-leaf deciduous forests and woodlands from water withdrawal, and the destruction of stream banks and accelerated erosion related to grazing, dam construction, water diversions, aquifer pumping, and pasture and cropland conversion (Arizona Game and Fish Department 2003c). Toxic chemicals may also negatively impact local populations of this and other bat species (Clark 1988).

Management Needs

General: Adequate management strategies include developing efficient survey methods that address population status, life history, and roost selection, and protecting broad-leaf deciduous riparian areas. Additionally, land acquisition and land owner education programs (most riparian habitat is privately owned) would also effectively bolster management efforts for this species (Arizona Game and Fish Department 2003c). Restoration and protection of gallery cottonwood and willow forests would also benefit this species.

Current protective measures: No protective measures are known to currently exist specifically for this species except that all bats are protected by State wildlife regulations against direct take. Pima County has a floodplain ordinance that prevents, minimizes or mitigates some destruction of habitat for this species. The Federal Clean Water Act, in its Section 404, may also protect some of the habitat of this species.

Corridor needs and migratory requirements: Because western red bats migrate seasonally between the southwestern United States and South America and, in Arizona, occur primarily in riparian regions, it is assumed that they travel along riparian corridors

and that some level of quality and connectivity of riparian corridors is necessary for this species.

Key relationships: This species is found in broadleaf riparian deciduous forests and woodland sites. The western red bat is associated with cottonwood and sycamore trees (Arizona Game and Fish Department 2003c). Recent observations of western red bats at riparian restoration sites along the lower Colorado River provides some evidence for the importance of protecting and enhancing broadleaf deciduous forests in Arizona (Calvert and Neiswenter 2012).

Existing monitoring and research programs: No monitoring programs exist for this species, most likely because of the difficulty in locating individuals to enumerate.

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-7): 178.

Acres of mitigation habitat within the current portfolio of conservation lands: 21,441.

Determination of Incidental Take

Pima County anticipates that take of individual western red bats will be low and extremely difficult to detect because of the nocturnal nature of the species; their cryptic coloration; and the large permit area. However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, roost site loss, loss of open water, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as subsequent erosion, invasive species, and light. Therefore, we will use acres of PCA habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of the western red bat. Effects to habitat can result in the following impacts to western red bats: abandonment of young due to noise, activity, light pollution, etc; injury or death if they fall in flight; being forced into suboptimal habitat; increased predation; starvation and reduced reproductive output due to reduced habitat quality and increased competition; and loss of day and night roosts, etc.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the western red bat:

- Pima County has implemented the Pima County Floodplain Ordinance to minimize loss of habitat for this species, as described in Chapter 4.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

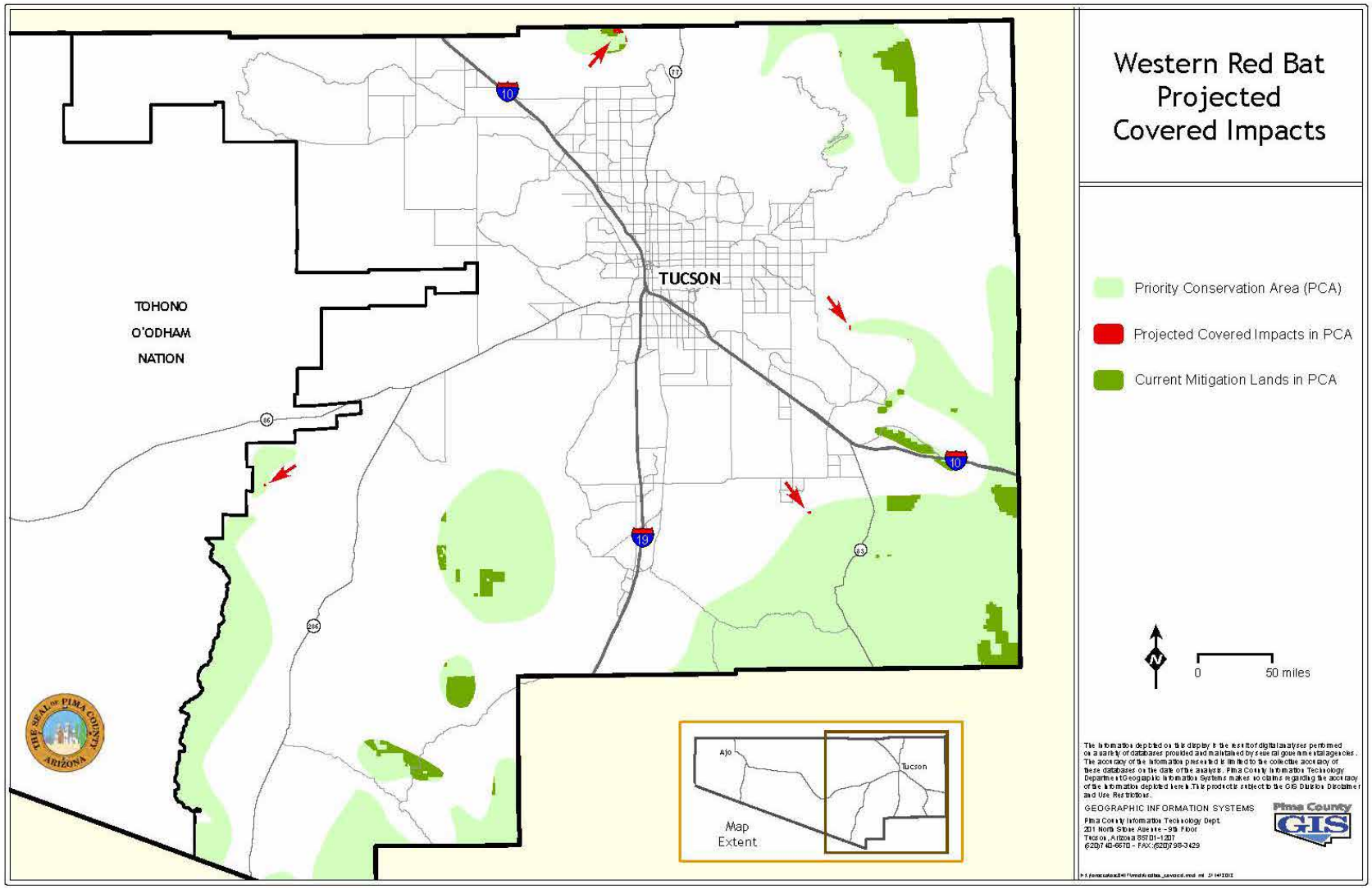


Figure A-7. Map of projected impacts and mitigation for the western red bat.

Western yellow bat (*Lasiurus xanthinus*)

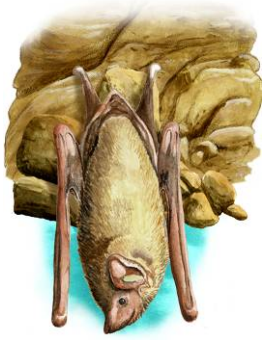
Conservation Status

Endangered Species Act Status: None.

State: Wildlife of Special Concern in Arizona.

Other: U.S. Forest Service Sensitive Species. "Red" Priority Species by Western Bat Working Group.

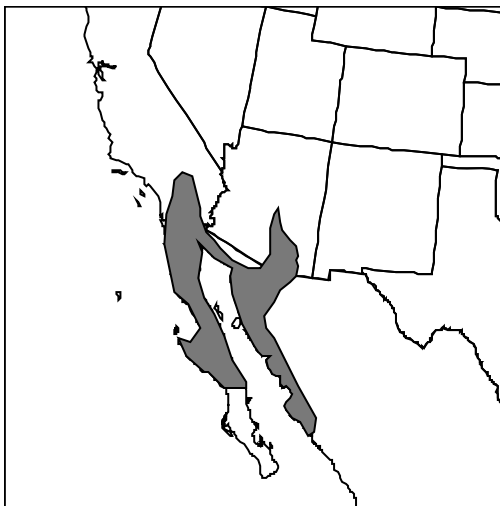
Rankings: G5, S1



Description

The western yellow bat has an average wingspread of 13 to 14 inches (32-35 cm), and an average body length of 2.5 to 3 inches (6.25 to 7.5 cm) (Noel and Johnson 1993). Its fur is the yellowish color of the dead palm fronds in which it is often found.

Distribution and Trend



The historic range of this species is not well known and, in Arizona it was not known until recently (Noel and Johnson 1993). This is a tropical species that barely enters the United States in southern Arizona, southern California, Texas, and New Mexico, and ranges south to Uruguay and Argentina (Noel and Johnson 1993). There are very few records of this species in the U.S. and existing records are primarily in urban areas (Noel and Johnson 1993; Arizona Game and Fish Department 2003d). Most records of western yellow bats from Arizona are from urban Tucson and Phoenix, where they are associated with planted fan palms (Hoffmeister 1986; Arizona Game and Fish Department 2003d). Also, it has been found in recent years in Sasabe, Sabino Canyon, and the Galiuro Mountains (Graham County). The species is said to be encountered by tree trimmers in urban Tucson. There have been no confirmed observations of western yellow bats on County-owned and managed properties, though they are likely to be found at the Cienega Creek Natural Preserve and other sites with large cottonwood and willow trees.

Population trends are not known, although records of this species appear to be increasing (Noel and Johnson 1993; Fahey 1997), this may be a result of better observation and reporting. It is also possible that this species has declined along the

Santa Cruz River and Rillito Wash as a result of historic loss of riparian woodland, and that the population has shifted to palm trees in the absence of riparian deciduous trees.

Habitat Requirements

This species is likely to be found primarily in association with planted fan palms (*Washingtonia filifera* and *W. robusta*) in residential and park areas up to 6,000 feet (Arizona Game and Fish Department 2003c). It is also found in riparian deciduous forests and woodlands (Jason et al. 2006) and one individual in Texas was found roosting in yucca (Higginbotham et al. 2000). Individuals have been found roosting about 15 feet above the ground in a hackberry (*Celtis reticulata*) and sycamores (*Platanus wrightii*) (Arizona Game and Fish Department 2003d). It is known to occur in association with Washington fan palms at Yuma, and in broad-leaved riparian areas along the Bill Williams River (Hoffmeister 1986; Arizona Game and Fish Department 2003d).

Current and Potential Threats

General: Loss and degradation of riparian woodlands due to trampling of stream banks and increased erosion associated with grazing, construction of dams, water diversions, aquifer pumping, and pasture and cropland conversion, burning and removal of palm groves, and pruning of urban palm trees (Arizona Game and Fish Department 2003d).

Existing and potential pest species: None are known.

Threat mechanism: Loss of roost sites resulting from historic loss of riparian deciduous woodland and ongoing palm frond removal and trimming in more developed areas.

Management Needs

General: Management guidelines for halting or reducing tree trimming would probably benefit this species. Adequate management strategies include developing efficient survey methods that address population status, life history, and roost selection, and protecting broad-leaf deciduous riparian areas. Additionally, land acquisition and land owner education programs (most riparian habitat is privately owned) would also effectively bolster management efforts for this species.

Current protective measures: No protective measures are known to currently exist specifically for this species except that all bats are protected by State wildlife regulations against direct take. Pima County has a floodplain ordinance that prevents, minimizes or mitigates some destruction of habitat for this species. The Federal Clean Water Act, in its Section 404, may also protect some of the habitat of this species.

Corridor and migratory needs: Because western yellow bats migrate seasonally between the southwestern United States and South America and, in Arizona, occur primarily in riparian regions, it is assumed that they travel along riparian corridors and that some level of quality of the riparian corridors is necessary for this species.

Key relationships: This species appears to be dependent upon fan palms and riparian deciduous woodland tree species (cottonwoods and willows) for roost sites (Spencer et al. 1988).

Existing monitoring and research programs: No information is currently known regarding existing monitoring and research programs for this species.

MSCP Projected Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-8): 48.

Acres of PCA habitat within the current portfolio of conservation lands: 13,276.

Determination of Incidental Take

Pima County anticipates that take of individual western yellow bats will be low and extremely difficult to detect because of the nocturnal nature of the species; their cryptic coloration; and the large permit area. However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, roost site loss, loss of open water, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as subsequent erosion, invasive species, and light. Therefore, Pima County will use acres of PCA habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of western yellow bats. Negative effects to habitat can result in the following impacts to western yellow bats: abandonment of young due to noise, activity, light pollution, etc; injury or death if they fall in flight; being forced into suboptimal habitat; increased predation; starvation and reduced reproductive output due to reduced habitat quality and increased competition; and loss of day and night roosts, etc.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the western yellow bat:

- Implement the Pima County Floodplain Ordinance to minimize loss of habitat as described in Chapter 4.
- Because this species is thought to be associated with untrimmed palm trees within the urban environment, Pima County will support public education about the importance of leaving palm trees untrimmed (or only conducting minimal trimming in the case of a safety issue), and may support a small project to map the location of palm tree resources.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.
- Conduct tree maintenance at Agua Caliente Park in such a way as to promote and protect potential roost sites, where these efforts do not interfere with other park goals.

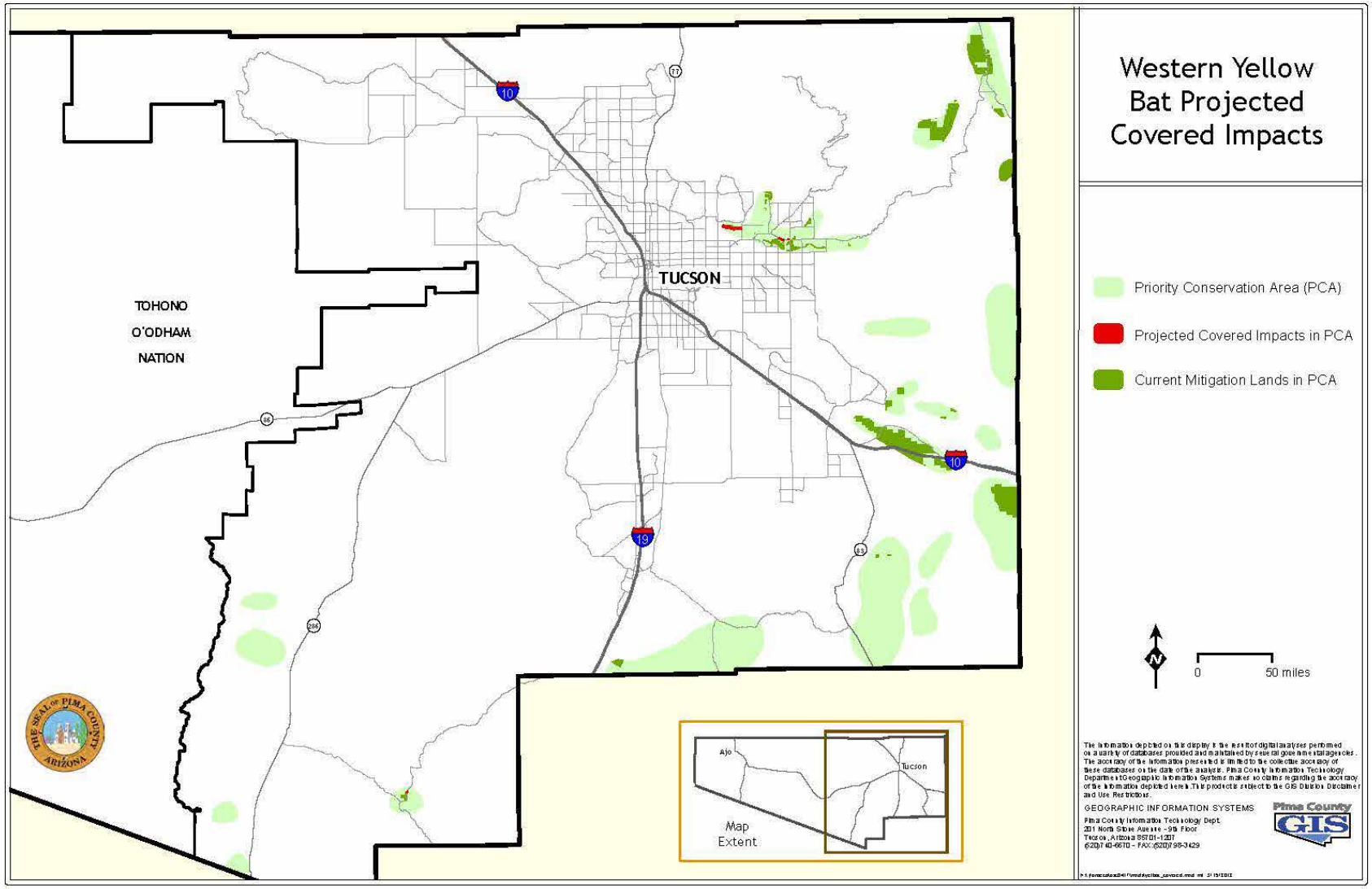


Figure A-8. Map of projected impacts and mitigation for the western yellow bat.

California leaf-nosed bat (*Macrotus californicus)*

Conservation Status

Endangered Species Act Status: None. Former FWS Category 2 Candidate.

State: Wildlife Species of Special Concern in Arizona.

Other: USFWS Species of Concern; U.S. Forest Service Sensitive Species; "Red" Priority Species by Western Bat Working Group.

Rankings: G4; S3,S4.

Description

The California leaf-nosed bat is a bat with an erect, lanceolate nose-leaf. The ears are large, 1.16 to 1.52 inches (29.0-38.0 mm) long, and joined together near the base. The tail extends free past the edge of the uropatagium for 0.2-0.4 inches (5.0 to 10.0 mm). The forearm measures 1.88 to 2.25 inches (47.0-55.0 mm), and the wingspan is about 13.5 inches (35 cm). The color is grey (Arizona Game and Fish Department 2001f).

Distribution and Trend

This species is known from southern California, southern Nevada, across the southwestern half of Arizona (with one report from northwestern Mohave County) and southward to the southern tip of Baja California, northern Sinaloa, and southwestern Chihuahua, Mexico (Arizona Game and Fish Department 2001f). The historic range of *M. californicus* does not include New Mexico. In Arizona, the species is known to occur in the Sonoran desert scrub from south of the Mogollon Plateau. At some roosts, this species is a year-round resident; the winter range for *M. californicus* is nearly the same as the summer range (Arizona Game and Fish Department 2003a). Because this species does not hibernate, the identification and protection of winter roost sites with appropriate conditions is crucial to the conservation of this species. This species does not always use the same roost sites in the summer and winter due to different requirements as the seasons change.

In Pima County, this is one of the most common species of bats to find in caves, mines, and rock shelters throughout the County, especially low elevation ranges including in Organ Pipe Cactus National Monument (Cockrum 1981; Cockrum and Petryszyn 1986;

Petryszyn and Cockrum 1990) and mountain ranges near Tucson including the Tucson Mountains (Swann and Powell 2007), and Waterman, Silverbell, Santa Catalina, Rincon, Sierrita, and Baboquivari mountains (Arizona Game and Fish Department 2001f). There is one known roost site of the California leaf-nosed bat on County-owned and managed properties (in Tucson Mountain Park), but this number is likely to be higher due to the difficulty of roost site detection.

Population trends are poorly known, but concerns have been expressed regarding roost abandonment and reduced population densities as a result of disturbances by both recreationists and scientists at a number of well-known and accessible roost sites (Arizona Game and Fish Department 2003a), as well as impacts associated with border activities.

Habitat Requirements

The California leaf-nosed bat is known from caves, mines, and rock shelters, mostly in Sonoran Desert Scrub (Arizona Game and Fish Department 2001f). Day roosts in mines usually occur within approximately 80 feet of the entrance and the bats prefer areas with abundant ceiling and flying space. In the colder areas of the range, roosts are chosen with temperatures equal to or exceeding 80 degrees Fahrenheit; the roosts are usually approximately 80 to 100 feet or more from the back of the entrance (Noel and Johnson 1993; Arizona Game and Fish Department 2001f). Night roost sites can include open buildings, cellars, bridges, and porches. Winter and summer roost sites can differ, with an apparent requirement for winter roost sites that maintain warmer temperatures needed by this non-hibernating, non-migrating species. The species forages over large distances.

Current and Potential Threats

General: The most important threat potentially affecting this species is usually considered to be human disturbance to roosts (Arizona Game and Fish Department 2001f), though habitat conversion and pesticide use are also a concern.

Existing and potential pest species: There are no known records of existing or potential harm to the California leaf-nosed bat by predators or introduced pest species. Though they roost colonially, they are unlikely to be impacted by white-nosed syndrome because they do not hibernate.

Threat mechanism: This species depends for its survival on the roosts it uses, especially when nursing young and during the winter. Disturbance may cause the bats to desert their roost and likely perish unless they can find another suitable roost (Arizona Game and Fish Department 2003a). Also, destruction or modification of the roost may make it unusable to the bats.

Management Needs

General: Restricting human disturbances to roosts is a key management priority for this species. In addition, studies to determine home range, foraging areas and distances, and local and seasonal movement will augment current understanding of this species.

Review of historical studies of roost sites and disturbance are also necessary to fully comprehend the management needs of this species (Arizona Game and Fish Department 2001f). Within the species' range, surveys for—and protection of—roosts may be appropriate. California leaf-nosed bats have been shown to accept properly designed gates at roost sites (Arizona Game and Fish Department 2003a).

Current protective measures: Two laws provide some measure of protection at cave roosts, subject to enforcement capability. The Federal Cave Protection Act of 1988 prohibits persons from activities that "destroy, disturb, deface, mar, alter, remove, or harm any significant cave or alters free movement of any animal or plant life into or out of any significant cave located on Federal lands, or enters a significant cave with the intent of committing any act described …". The Arizona Revised Statute (ARS) §13-3702 makes it a class 2 misdemeanor to "deface or damage petroglyphs, pictographs, caves, or caverns." Activities covered under ARS §13-3702 include "kill, harm, or disturb plant or animal life found in any cave or cavern, except for safety reasons." Of course, the effectiveness of these laws in protecting bat roosts is related to enforcement efforts, which are currently minimal. If done improperly, protective measures such as gating may actually lead to abandonment (U.S. Fish and Wildlife Service 2005b), so guidelines need to be developed.

Corridor and migratory needs: As this is not a migratory species, no known migration corridor needs exist for this species. However, some evidence indicates that this species forages primarily along desert washes, and so foraging corridors may be a need. It is not unusual for California leaf-nosed bats to move between roost sites, and some roosts are used more during some seasons than at others.

Key relationships: The California leaf-nosed bat is found primarily in Sonoran Desert Scrub, both major divisions, at elevations below 4,000 feet, most occurring at elevations below 2,500 feet (Arizona Game and Fish Department 2001f).

Existing monitoring and research programs: No known monitoring or on-going research efforts are taking place for this species.

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-9): 111.

Acres of mitigation habitat within the current portfolio of conservation lands: 12,202.

Determination of Incidental Take

Pima County anticipates that take of individual California leaf-nosed bats will be low and extremely difficult to detect because of the nocturnal nature of the species; their cryptic coloration; and the large permit area. However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, roost site loss (very low probability), loss of open water, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as subsequent erosion, invasive species, and light. Therefore, Pima County will use acres of PCA habitat impacted by

covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of California leaf-nosed bats. Negative effects to habitat can result in the following impacts to California leaf-nosed bats: abandonment of young due to noise, activity, light pollution, etc; injury or death if they fall in flight; being forced into suboptimal habitat; increased predation; starvation and reduced reproductive output due to reduced habitat quality and increased competition; and loss of day and night roosts, etc.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the California leaf-nosed bat.

- Protect existing known roosts and foraging habitat from all potentially detrimental activities on County-controlled mitigation lands.
- Investigate the purchase of valid mining claims for mines with known roosts; look into opportunities for creating roost preserves. Each roost will be considered for gating, and where appropriate, proper gates will be installed.
- On County preserves, restrict county activities near known roosts if this can be accomplished without disclosure of roost locations.
- Evaluate known roosts of this species on County-controlled mitigation lands for conditions and needs for structural stabilization. Where appropriate, such stabilization will be carried out using techniques that minimize disturbance and alteration of conditions.
- Encourage the purchase and installation of new lighting within the cave tour portion of Colossal Cave Mountain Park to reduce stress on bats and to promote higher abundance and occupancy.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

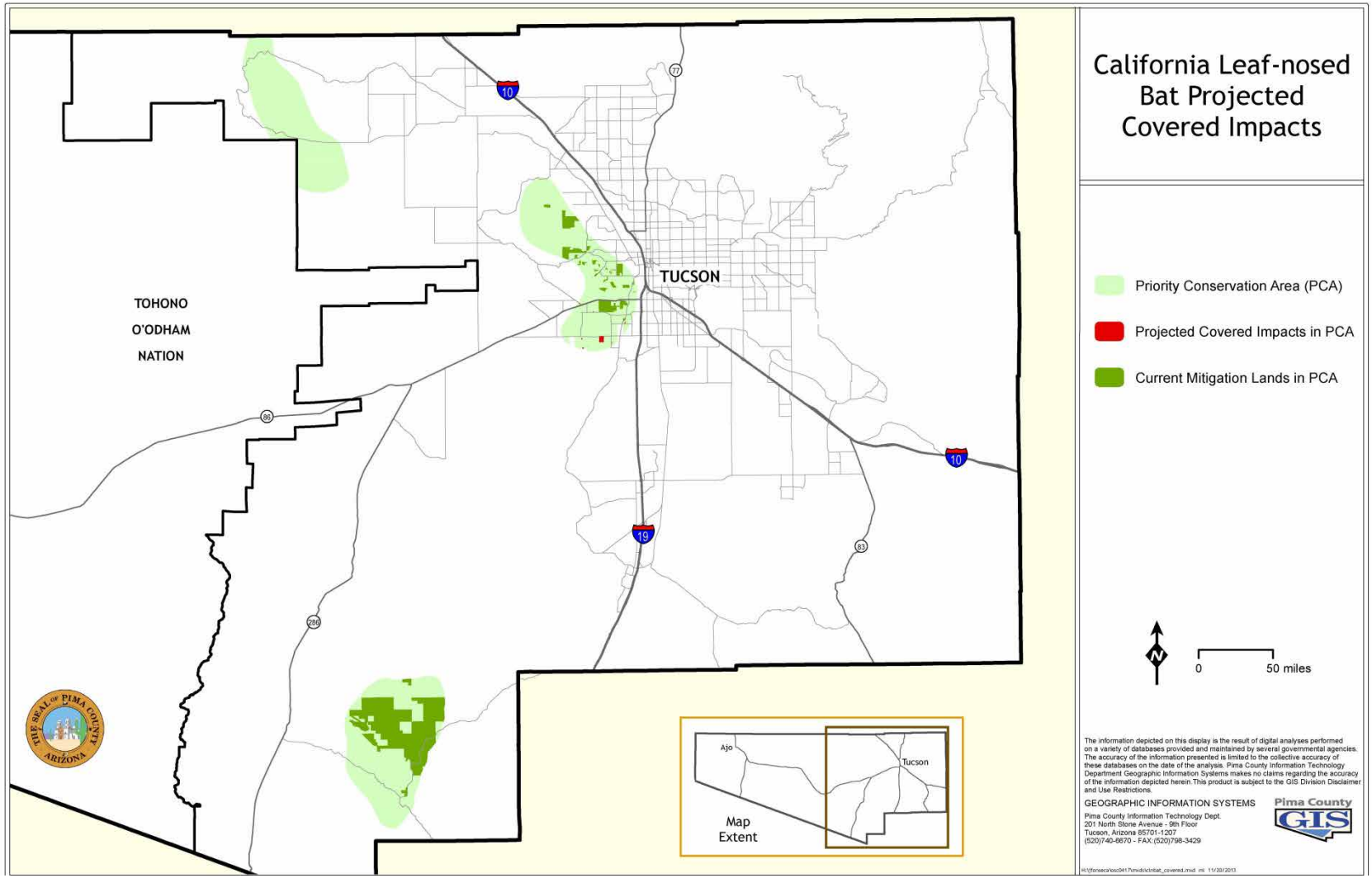


Figure A-9. Map of projected impacts and mitigation for the California leaf-nosed bat.

Pale Townsend's big-eared bat (*Corynorhinus townsendii pallescens*)

Conservation Status

Endangered Species Act Status: None. Former FWS Category 2 candidate.

State: Wildlife of Special Concern in Arizona.

Other: USFWS Species of Concern; "Red" Priority Species by Western Bat Working Group.

Rankings: G4; S3,S4.

Description

The pale Townsend's big-eared bat is a pale yellowish brown, medium-sized bat, the forearm length is 1.56 to 1.88 inches (39.0-47.0 mm), its wingspan averages between 11.5 and 12.5 inches (29 31 cm), and a body length of 2 to 2.5 inches (5 to 7 cm). It has large, hairless ears, 1.2 to 1.6 inches (30.0-39.0 mm) in length. It has a large glandular lump on each side of the nose (Noel and Johnson 1993; Arizona Game and Fish Department 2001h).

Distribution and Trend

This species is known from western North America from southern British Columbia south through the Pacific Northwest and southern California on the west and the Black Hills of South Dakota and West Texas on the east through the Mexican uplands to the Isthmus of Tehuantepec in southern Mexico. Isolated (and presumable relict) populations also exist in the Ozark Mountains of Oklahoma, Missouri, Arkansas, Kentucky, Virginia, and West Virginia (Hoffmeister 1986; Noel and Johnson 1993; Arizona Game and Fish Department 2001h). Pale Townsend's big-eared bat is widespread in Arizona, although it is not considered common anywhere, and is least common in northeastern grasslands and southwestern desert areas (Arizona Game and Fish Department 2003a).

In Pima County, this species is frequently found in small groups in inactive mines and caves, and occasionally in buildings. It has been found across a wide elevational range in Pima County (Arizona Game and Fish Department 2003e). This species has been observed in the Rincon Mountains (Davis and Sidner 1992; Swann and Powell 2006), Tucson Mountains (Swann and Powell 2007), Sierrita Mountains (Snow et al. 1996), Baboquivari Mountains (Hoffmeister 1986), Santa Rita Mountains (Snow et al. 1996;

WestLand Resources Inc 2009), and Organ Pipe Cactus National Monument (Cockrum 1981; Cockrum and Petryszyn 1986). There are likely roosts that are not currently identified in the Tortolita, Tucson, and Silverbell mountains. Within the County's preserve system, there have been confirmed roosts of pale Townsend's big-eared bat at Colossal Cave Mountain Park and at Oracle Ridge (Tetra Tech 2011).

Population trends for pale Townsend's big-eared bats are unclear, though there have been losses or reductions of maternity colonies reported (Arizona Game and Fish Department 2003a).

Habitat Requirements

This species is known to use caves, mines, and buildings (generally abandoned or inactive) through a range of elevations and vegetation communities. It has been found in Sonoran Desert Scrub (both Arizona Upland and Lower Colorado River Valley subdivisions), Madrean Evergreen Woodland (oak woodland, oak/pine, and pinyon/juniper), and coniferous forests in Arizona (Hoffmeister 1986; Noel and Johnson 1993; Arizona Game and Fish Department 2001h). Night roosts may often be in abandoned buildings. In winter, they hibernate in cold caves, lava tubes, and mines mostly in uplands and mountains from the vicinity of the Grand Canyon to the southeastern part of the state (Arizona Game and Fish Department 2001h). The bats prefer to hang from open ceilings at roost sites and do not use cracks or crevices. At maternity roosts these bats apparently prefer dim light near the edge of the lighted zone (Arizona Game and Fish Department 2001h). Winter roosts generally contain fewer individuals (usually singles or small groups and, in Arizona, occasionally as many as 50) than summer roosts (Arizona Game and Fish Department 2003a).

Current and Potential Threats

Disturbance of roosts appears to be the most important threat. Renewed mining, closure and sealing of abandoned mines naturally or for hazard abatement, and, possibly, the use of non-target pesticides are all considered threats (Arizona Game and Fish Department 2001h). A number of roosts have also been discovered in the Santa Rita Mountains at and near to the proposed Rosemont Mine site which, if approved and mining proceeds, will impact these roosts (U.S. Forest Service 2013). Historical alteration in the vegetation community along the Lower Colorado River is considered to have changed the available food supply for this species (U.S. Bureau of Reclamation 2008), and similar conditions have occurred along the Santa Cruz River. Because this species hibernates in cold caves, it is thought to be the only species of bat covered under the County's MSCP that may be susceptible to white-nosed syndrome.

Management Needs

General: Management needs for this species include:

- Development of consistent, effective monitoring methods;
- Surveys to identify important summer and winter roost sites and foraging areas;
- Surveys to locate, census, and monitor maternity colonies;

- Protection of maternity and hibernaculum roosts using bat-friendly gates and weathering zone stabilization;
- Establishing buffer zones to protect maternity roosts from human access during roost occupancy; and mitigation against or prevention of renewed mining activity near significant roosts and foraging areas (Arizona Game and Fish Department 2003a)
- Monitoring for the occurrence of white-nosed syndrome in Pima County and other areas of Arizona to determine if or when it may be present.

Current protective measures: Human access to some sites is limited by policy, procedure, and terrain. Some caves and mines known to have this species have been gated, but the extent to which this has occurred in Pima County is not known.

Corridor and migratory needs: None are known for this species. It does use different roosts in winter and summer, so suitable roosts may be considered migratory requirements.

Key relationships: This species is dependent on caves and mines for roosts, and on moths for food.

Existing monitoring and research programs: No species-specific studies are known to be currently underway in southern Arizona.

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-10): 1,525.

Acres of mitigation habitat within the current portfolio of conservation lands: 26,277.

Determination of Incidental Take

Pima County anticipates that take of individual pale Townsend's big-eared bats will be low and extremely difficult to detect because of the nocturnal nature of the species; their cryptic coloration; and the large permit area. However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, roost site loss (very low probability), loss of open water, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as subsequent erosion, invasive species, and light. Therefore, Pima County will use acres of PCA habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of pale Townsend's big-eared bat. Negative effects to habitat can result in the following impacts to pale Townsend's big-eared bat: abandonment of young due to noise, activity, light pollution, etc.; injury or death if they fall in flight; disturbance while hibernating depletes energy reserves and ability to survive during the winter; being forced into suboptimal habitat; increased predation; starvation and reduced reproductive output due to reduced habitat quality and increased competition; and loss of temporary day and night roosts, etc.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the pale Townsend's big-eared bat:

- Where possible, protect existing known roosts and foraging habitats of this species in County-controlled mitigation lands from all potentially detrimental activities.
- Investigate the purchase of valid mining claims for mines with known roosts; look into opportunities for creating roost preserves. Each roost will be considered for gating, and where appropriate and financially feasible, proper gates will be installed.
- Map and document all known active and inactive mine/adits on county lands.
- On County-controlled mitigation lands, restrict county activities within 1 kilometer of known summer roosts during May to September, and known hibernacula from October to April, if this can be accomplished without disclosure of roost locations.
- Evaluate known roosts of this species, including buildings, on County-controlled mitigation lands for conditions and needs for structural stabilization. Where appropriate, such stabilization will be carried out using techniques that minimize disturbance and alteration of conditions.
- Implement white-nosed syndrome prevention protocol during all roost visits.
- Encourage the purchase and installation of new lighting within the cave tour portion of Colossal Cave Mountain Park to reduce stress on bats and to promote higher abundance and occupancy.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

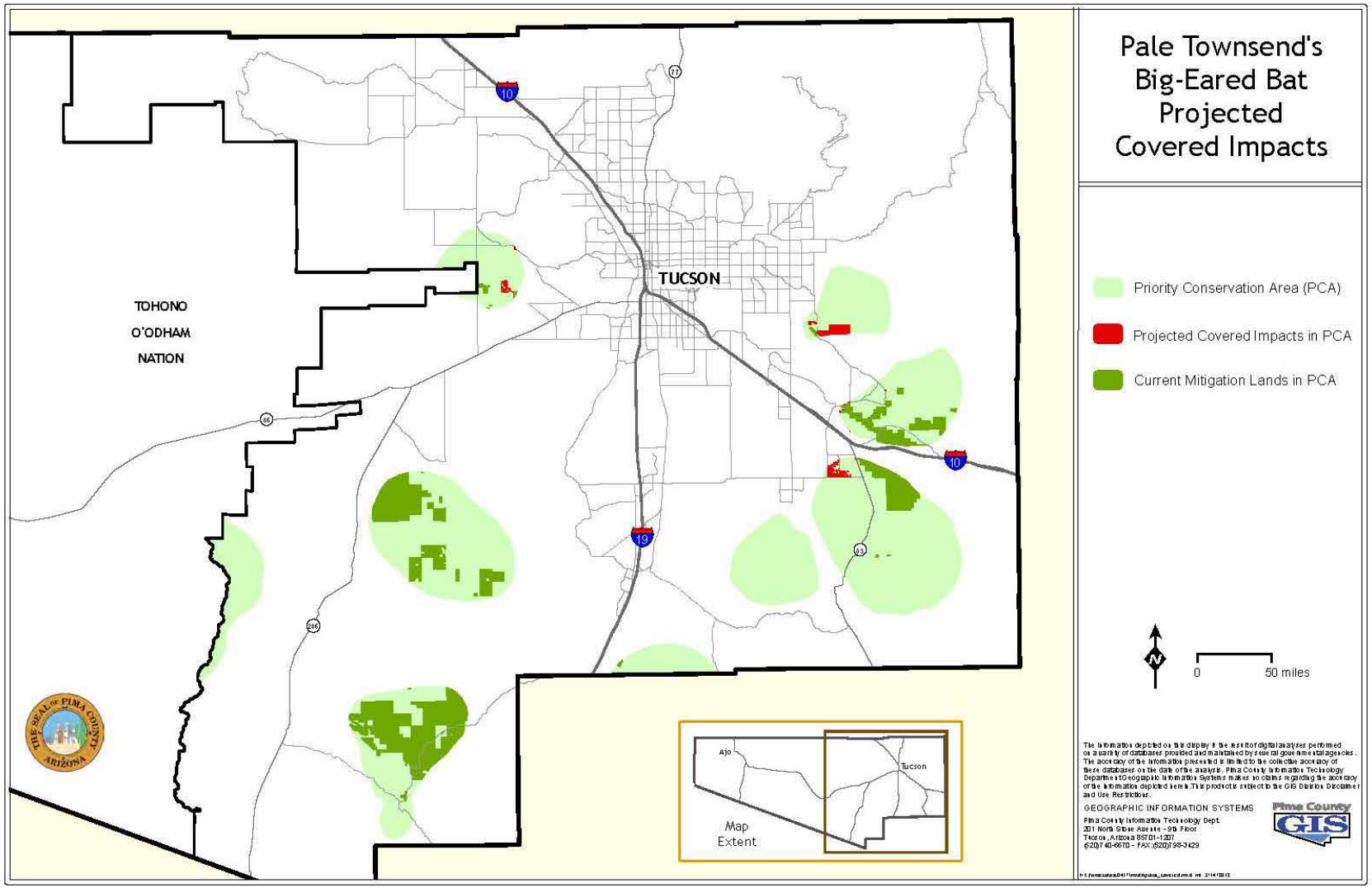


Figure A-10. Map of projected impacts and mitigation for the pale Townsend's big-eared bat.

Merriam's mouse (*Peromyscus merriami*)

Conservation Status

Endangered Species Act Status: None.

State: Wildlife of Special Concern in Arizona.

Other: None.

Rankings: G5, S3.

Description

Merriam's mouse has a pale gray body, faintly washed with tawny; the belly is cream-colored, and the tail is long, thinly haired and bicolored. There are 4 mammae. The head and body are 3.8 to 4.0 inches (97 to 102 mm) long, and the tail is 4.0 to 4.8 inches (102 to 122 mm) long (Burt and Grossenheider 1976). Merriam's mouse is very similar to the Cactus mouse (*P. eremicus*), and differs in having a slightly larger size, a ventrally curving baculum (as opposed to the dorsally curving baculum of *P. eremicus*) and a longer hind foot (Hoffmeister 1986).

Distribution and Trend

Merriam's mouse was found in the large mesquite forests along rivers throughout Pinal, Pima, and Santa Cruz counties in Arizona and into Sonora, Mexico (Arnold 1940). In Arizona it has been found in the south-central part of the state, from just north of Florence at the north, southeast of Tucson to the east, and Quitobaquito to the west (Hoffmeister 1986; Arizona Game and Fish Department 2001g).

Most areas where Merriam's mice were historically present have been altered and recent records are lacking as to whether the species persists in these areas. These areas include the Santa Cruz River area (San Xavier) before the mesquite bosques were removed in the early part of the twentieth century for firewood (Phillips et al. 1964), and at Wilmot Station southeast of Tucson where they were formerly taken in large numbers (Biota Information System of New Mexico 2008f). It now occurs in isolated pockets throughout the County, including at Organ Pipe Cactus National Monument (Petryszyn and Russ 1996) and in a number of sites in eastern Pima County including the Tucson Mountains, Cienega Creek, the northwest foothills of the Santa Rita Mountains, and the Altar Valley (Kingsley 2006). Hoffmeister (1986) reports the species from historical Ft. Lowell, Sabino Canyon, Baboquivari Mountains, and near Arivaca. There have been no confirmed observations of Merriam's mouse on County-owned and

managed properties, though they are likely to be found at the Cienega Creek Natural Preserve and Canoa Ranch, as well as other sites with large mesquite trees.

Habitat Requirements

Merriam's mice are known primarily from heavy, forest-like stands of mesquite (bosques). They have also been found in thick stands of mesquite, cholla, prickly pear, palo verde, and grasses (Hoffmeister 1986). There is no information on the specific home range needs of this species.

Current and Potential Threats

General: The greatest threat to Merriam's mouse is loss and degradation of mesquite-forest habitat.

Existing and potential pest species: There are no identified pest species. However, near human habitation, domestic cats may impact this species, and house mice may compete with it.

Threat mechanism: Loss of habitat through cutting of firewood or clearing for grazing or other development. Groundwater depletion in many places resulted in loss of formerly lush riparian areas with a reduction in large mesquites and dense vegetation. Re-establishment and regeneration of suitable habitat for this species may be precluded by groundwater depletion.

Management Needs

General: Preservation of existing mesquite bosques and re-establishment of mesquite bosque habitat may benefit the Merriam's mouse, if it persists or can be reintroduced.

Current protective measures: The Merriam's mouse has been designated as a Species of Special Concern by the State of Arizona (Arizona Game and Fish Department 2006c). This status affords no specific protection. Some of its potential habitat lies within protected areas, where mesquite collecting and habitat destruction may be regulated.

Corridor and migratory needs: There is no known information on corridor or dispersal needs. It is possible that this species requires large contiguous mesquite bosques along river corridors for its long-term survival, but this has not been demonstrated. The species does not migrate.

Key relationships: Merriam's mouse associated with large mesquite trees. It may also require a mixture of other plants such as cacti, trees, and grasses.

Existing monitoring and research programs: There are no known monitoring and research programs for this species. A long-term program of trapping for small mammals is continuing at Organ Pipe Cactus National Monument (Organ Pipe Cactus National Monument 2006b).

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-11): 330.

Acres of mitigation habitat within the current portfolio of conservation lands: 9,301.

Determination of Incidental Take

Pima County anticipates that incidental take of Merriam's mouse will be difficult to detect because of the large Permit Area; its cryptic coloration; the species is secretive by nature (it lives in burrows); the species has a small body size; losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); the species occur in habitats that make detections difficult; and natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the habitat of the Merriam's mouse that results from land clearing, burrow destruction, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as subsequent erosion, invasive species, light pollution, etc. Therefore, Pima County will use acres of PCA habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of Merriam's mouse. Effects to habitat can result in the following impacts to Merriam's mouse: direct impacts to burrows; abandonment of nests or burrows due to noise, activity, light, etc.; injury or death of young if they are abandoned or are forced from burrows; being forced into suboptimal habitat or already-occupied habitat; increased predation; increased occurrence of non-native competitors and predators; increased erosion and sedimentation affecting life history requirements; starvation and reduced reproductive output due to reduced habitat quality and increased competition; effects to stream flow resulting in flooding of habitat; inability of individuals to find mates; habitat fragmentation preventing or reducing the ability of species to move, disperse, or migrate to meet life history needs; spread of diseases that can result in mortality or reduce health and productivity; etc.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Merriam's mouse.

- Implement the Pima County Floodplain Ordinance to minimize loss of habitat, as described in Chapter 4.
- Restore mesquite bosque and associated communities, where feasible.
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations to benefit the species.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

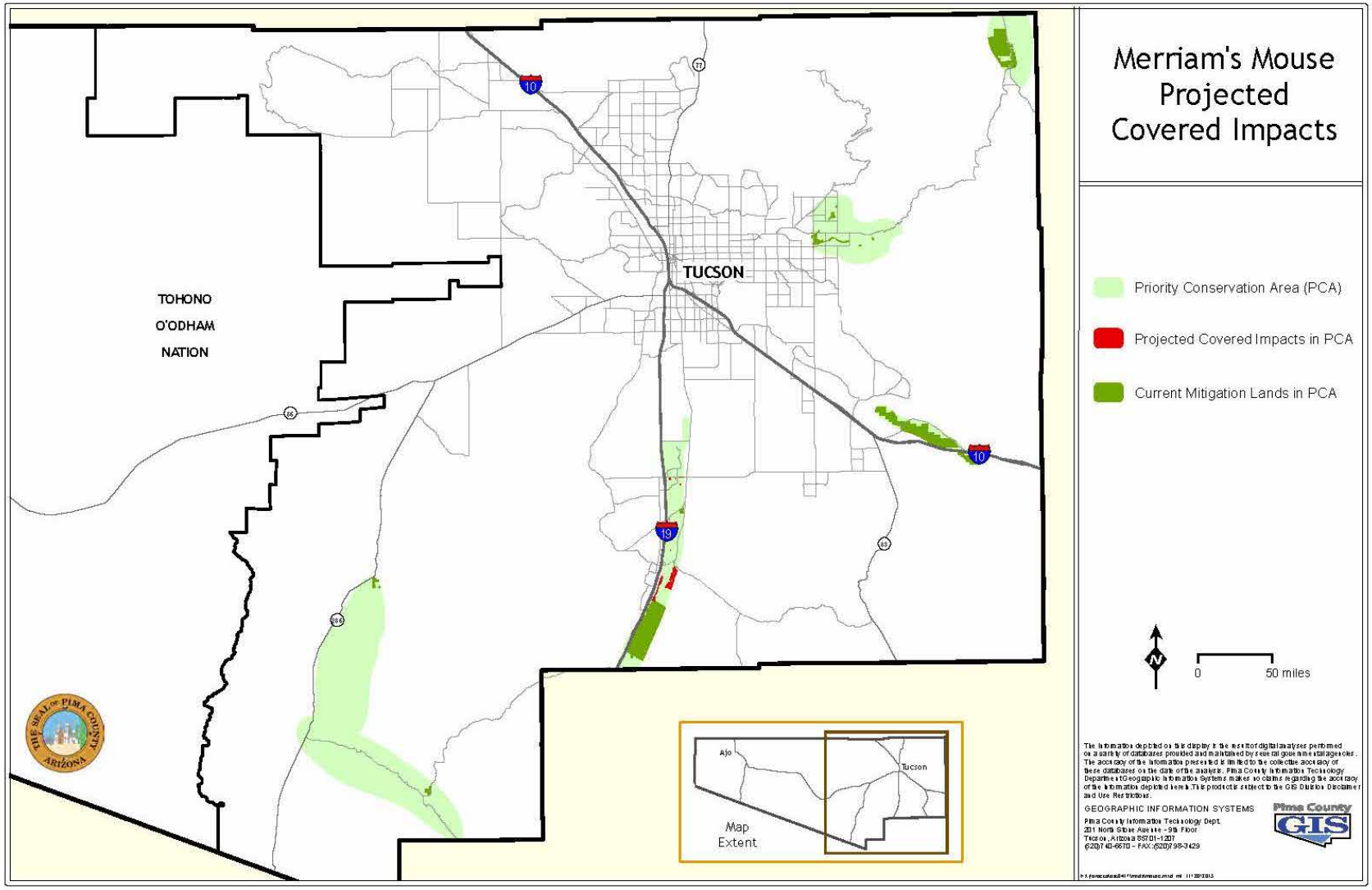


Figure A-11. Map of projected impacts and mitigation for the Merriam's mouse.

Birds

Western burrowing owl (*Athene cunicularia hypugaea*)

Conservation Status

Endangered Species Act Status: None.

State: None.

Other: Nine states have listed the species as endangered, threatened, or of special concern. Migratory bird under the Migratory Bird Treaty Act.

Rankings: G4, S4.

Description

The western burrowing owl is a small owl that measures from 7.5 to 10 inches (19 to 25 cm) in length and weighs about 5 ounces (150 g). The legs are long and sparsely feathered below the tibiotarsal joint. It has a round head with no ear tufts and a distinct oval facial ruff, framed by a broad, buffy white eyebrow-to-malar stripe on the interior part. The iris is usually bright lemon yellow. The wings are relatively long and rounded, with 10 brown and buffy white barred rectrices. The dorsum is brown; back, scapulars and crown are profusely spotted with buffy white. The throat and undertail coverts are white; and the remainder of underparts of adults are buffy white with broad barring on both sides. Females are generally darker than males overall, particularly in worn plumage (Haug et al. 1993).

Distribution and Trend

The historic range of the western burrowing owl includes Arizona, California, Colorado, Idaho, Iowa, Kansas, Louisiana, Minnesota, Montana, North Dakota, Nebraska, New Mexico, Nevada, Oklahoma, Oregon, South Dakota, Texas, Washington, Wyoming, Canada, and Mexico. Migratory populations breed in North America and may winter as far south as Guatemala or El Salvador (Biota Information System of New Mexico 2008b).

In Arizona, the western burrowing owl has a widespread but sporadic nesting distribution (Arizona Game and Fish Department 2001b; Corman and Wise-Gervais 2005). In western Pima County they breed on and near to the Barry M. Goldwater Range (Corman and Wise-Gervais 2005) and have been observed at Organ Pipe Cactus National Monument (Groschupf et al. 1988). Western burrowing owls have been well studied in eastern

Pima County (Brown and Mannan 2002). They are found primarily in three areas of the County: (1) in the Altar Valley north to the Santa Cruz River in Marana; (2) along the Santa Cruz River, primarily south of downtown Tucson to the Santa Cruz County line, and (3) in and around the Davis-Monthan Air Force Base (Estabrook 1998; Arizona Game and Fish Department 2001b; Alanen 2003; Corman and Wise-Gervais 2005; Garcia and Conway 2007; Town of Marana 2009; Tucson Bird Count 2012). On County owned and managed properties, they have been found along the Santa Cruz River, at the Kino Ecosystem Restoration area, Canoa Ranch, and Southeast Regional Park.

Burrowing owls have declined in abundance throughout most of their range (Haug et al. 1993; Brown and Mannan 2002; Klute et al. 2003; Tucson Bird Count 2012). In the western states, 54% of 24 jurisdictions reported burrowing owl populations decreasing, and there were no reported increases (U.S. Bureau of Reclamation 2008).

Habitat Requirements

Within their geographic range, burrowing owls inhabit open areas such as grasslands, pastures, coastal dunes, desert scrub, and the edges of agricultural fields. They also inhabit golf courses, airports, cemeteries, vacant lots, and road embankments, wherever there is sufficient friable soil for a nesting burrow (Haug et al. 1993; Estabrook 1998; Bartok and Conway 2010). Agricultural areas such as fields and croplands often provide optimal habitat for burrowing owls, as do moderately grazed areas (Moulton et al. 2006). Urban development in these areas may result in a loss of habitat as well as mortality on roadways (Klute et al. 2003).

Current and Potential Threats

General: The primary threat to the species appears to be habitat loss from housing development and agriculture; shrub encroachment; and fire spread via invasive plants fuel loads (especially grasses) (Klute et al. 2003). Predation is also a major cause of mortality in burrowing owls. The dominant mammalian predators of burrowing owls are badgers (*Taxidea taxis*); other predators include opossums (*Didelphis virginiana*), weasels (*Mustela* spp.), skunks (*Mephitis* spp.), gopher snakes (*Pituophis catenifer*) and domestic dogs and cats, and squirrels (Arrowood et al. 2001). Avian predators include Swainson's hawks (*Buteo swainsonii*), ferruginous hawks (*B. regalis*), merlins (*Falco columbarius*), prairie falcons (*F. mexicanus*), peregrine falcons (*F. peregrinus*), great horned owls (*Bubo virginianus*), red-tailed hawks (*B. jamaicensis*) and Cooper's hawks (*Accipiter cooperii*) (Haug et al. 1993). Other observed causes of mortality include human disturbance or burrow destruction through agricultural and construction activities, collisions with vehicles (the owls habitually sit and hunt on roads at night), and toxic chemicals such as insecticides and strychnine-laced grains (often dispersed for rodent and insect pest control in agricultural areas where birds nest). Also, a decline in the population of burrowing mammals may adversely affect owls by way of a reduced number of burrows (Haug et al. 1993).

Existing and potential pest species: Burrowing owls have been reported suffering from body parasites such as lice (*Colpocephalum pectinatum*), sticktight fleas (*Echidnophaga gallinacea*), and human fleas (*Pulex irritans*). Several species of nest arthropods and

fleas have been found in burrows (Haug et al. 1993). Many species of predators (listed above) are known to prey on burrowing owls.

Threat mechanism: Threats include loss of habitat through urban development in agricultural or rural areas; direct toxicity or loss of prey resulting from use of insecticides or rodenticides for pest management purposes in areas where western burrowing owls breed; reduction in nest sites resulting from decreases in burrowing mammal population; and direct mortality from vehicular collisions and loss of artificial and natural burrows.

Management Needs

General: Management measures that have been proposed for western burrowing owls include protecting burrowing mammal populations to provide nesting habitat for burrowing owls; creating artificial burrows where natural burrows are destroyed or limited; providing artificial perches where perch sites limited for hunting and predator observation; and managing vegetation for foraging habitat through fire or grazing (City of Tucson Burrowing Owl Working Group 2007). Pima County populations are especially important since there has been a decrease in populations within Pima County as well as others throughout Arizona lowlands (Brown and Mannan 2002; Klute et al. 2003).

Current protective measures: This species is protected under the Migratory Bird Treaty Act. The Migratory Bird Treaty Act makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird, including feathers, parts, nests, or eggs. Violations of the Migratory Bird Treaty Act are considered criminal offenses and can result in significant fines and imprisonment.

Corridor and migratory needs: No specific information is known for corridor needs for this species. Most populations of the species are migratory to some extent and this appears to be the case for Arizona populations (Haug et al. 1993), although some populations in Arizona also appear to be resident, non-migratory populations.

Key relationships: The western burrowing owl nests in desert valleys and grasslands and is often found in association with prairie dog colonies, which only occur on a few small and isolated sites in Pima County (Las Cienega National Conservation Area). In Pima County, this species may also depend on round-tailed ground squirrels, badgers, artificial holes, and soil piping for burrows.

Existing monitoring and research programs: Considerable attention has been paid to this species, especially in the last 10 years and numerous research and monitoring efforts throughout its range have been undertaken (Klute et al. 2003), including in Pima County (Estabrook and Mannan 1998, Garcia and Conway 2007).

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-12): 1,392.

Acres of mitigation habitat within the current portfolio of conservation lands: 2,879.

Determination of Incidental Take

Pima County anticipates that incidental take of western burrowing owls will be difficult to detect because of the large Permit Area; losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); and natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, burrow destruction, habitat fragmentation, increased human activity, collisions with vehicles and equipment, and indirect impacts such as subsequent erosion, invasive species, light, etc. Therefore, Pima County will use acres of PCA habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of western burrowing owls. Effects to habitat can result in the following impacts to western burrowing owls: collisions with and crushing by vehicles and equipment; direct impacts to nests and burrows; abandonment of nests or burrows due to noise, activity, light, etc; injury or death of nestlings or young if they are abandoned or fall or are forced from nests or burrows; being forced into suboptimal habitat or already-occupied habitat; increased predation; increased occurrence of predators; starvation and reduced reproductive output due to reduced habitat quality and increased competition; effects to stream flow that might result in flooding of burrows.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the western burrowing owl:

- Pima County will continue to apply avoidance and minimization measures as described in Chapter 4;
- Pima County will place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4.
- Offer to collaborate with the Town of Marana and City of Tucson HCPs to develop management strategies for the protection of this species.
- Collaborate with Federal partners and conservation groups (e.g., Tucson Audubon Society) to develop guidelines for successful implementation of artificial burrows.
- On County-controlled mitigation lands, enact a 100-m buffer "restricted activity zone" around known nests during the nesting period. Allow only short duration "pass through" activities.
- Request clearance surveys prior to CIP projects constructed in Priority Conservation Areas.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

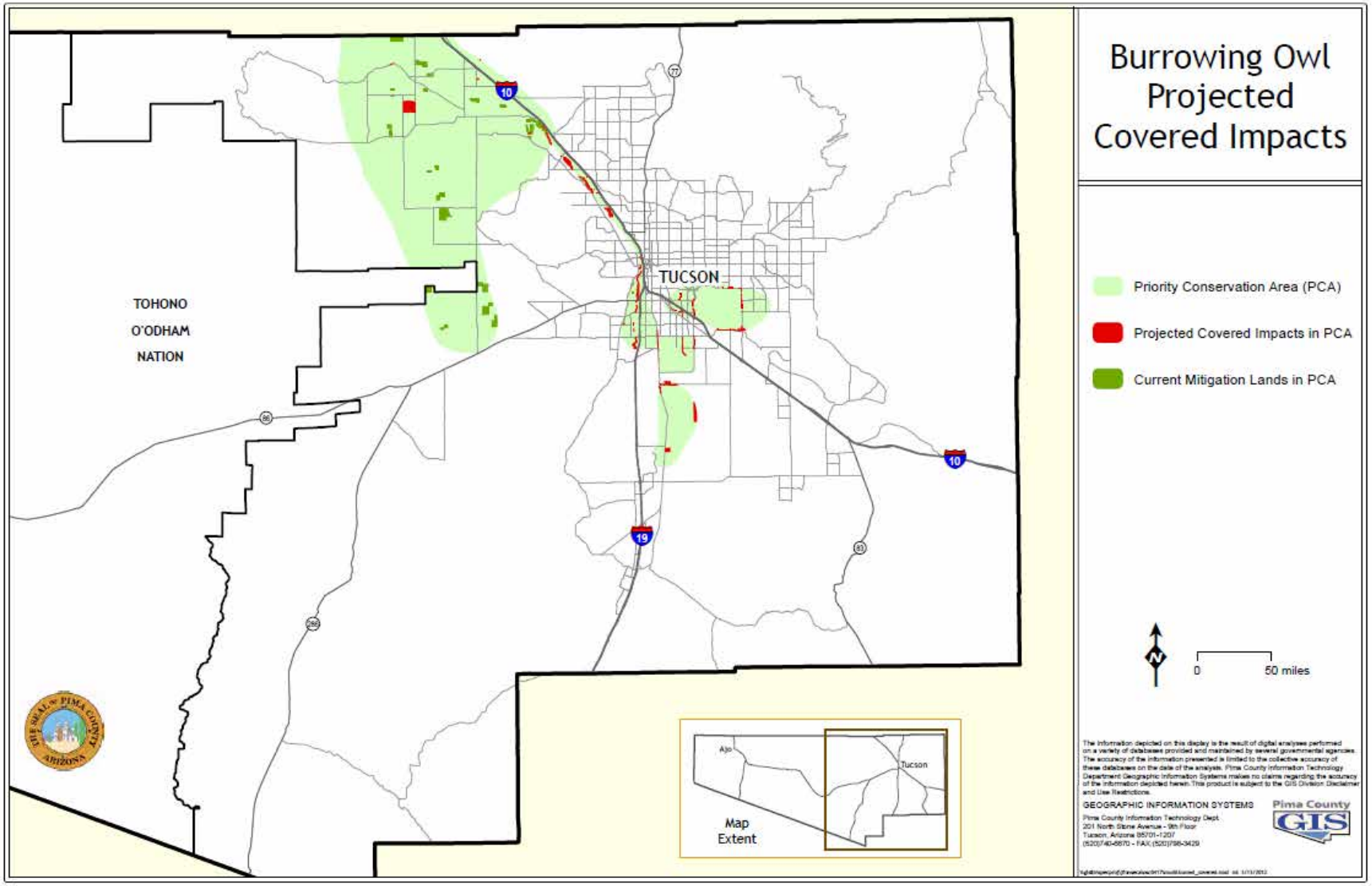


Figure A-12. Map of projected impacts and mitigation for the western burrowing owl.

Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*)

Conservation Status

Endangered Species Act Status: No current protected status, but it was listed as Endangered until 2006. FWS produced a negative 12-month Finding in 2011 related to a 2007 petition to relist (U.S. Fish and Wildlife Service 2011). The 12-month Finding is currently under litigation.

State: Wildlife Species of Special Concern in Arizona.

Other: U.S. Forest Service Region 3 Sensitive Species

Rankings: G5, S1.

Description

The cactus ferruginous pygmy-owl is a small bird, averaging 6.5 inches (16.5 cm) in length and weighing 2.5 ounces (70 g). The owl is gray-brown or rufous (reddish) brown in color. The head is small, compared to some other owls, and it lacks ear tufts. The eyes are yellow. The crown is finely streaked with flecks of buff. The tail is relatively long compared to those of other owls. There are subtle differences in coloration and size between the sexes (females are larger than males), and juveniles have somewhat different plumage from adults (Cartron and Finch 2000).

Distribution and Trend

The historical distribution and decline of the species was described by Johnson et al. (2000). Evidence suggests that the species is at the edge of its range in Arizona, and that most of its range is in Mexico, Central, and South America. The exact limits of distribution of each subspecies are not clearly resolved. Most evidence indicates that the species was historically found primarily, if not exclusively, in riparian areas, including xeroriparian washes. Most current locations occur in Sonoran desertscrub, semi-desert grasslands, and the drainages within those communities. Baseline information is limited, and most of the early bird studies were fairly concentrated along rivers. It is possible, although not certain, that the species occurred primarily along rivers and may have also occupied desert scrub. Records of the species extend along the southern Arizona river valleys, as far north as New River, north of Phoenix, west to Agua Caliente on the Gila River, and east to (possibly) the

confluence of the San Francisco and Gila Rivers. At one time, it was considered common in the Phoenix area.

The current distribution and abundance in Pima County is unknown and the population in southern Arizona and northern Sonora, Mexico has been declining for approximately 10 years. In 1999, a total of 78 individual owls were detected in Arizona in the Organ Pipe Cactus National Monument, Tohono O'odham Nation, Altar Valley, northwest Tucson and the Tortolita Mountains, and the Roskruge Mountains (Richardson et al. 2000). The owls are thought to currently persist in three areas of Pima County: the Tohono O'odham Nation, the Altar Valley, and in Organ Pipe Cactus National Monument. Monitoring has taken place in the Altar Valley of Sonora, Mexico since 2000 where a documented decline in occupancy and abundance has been noted in most years (Flesch and Steidl 2006; Flesch 2008a; Flesch 2008b). In recent years, the only observation of the species on County-owned and managed lands was on Old Hayhook Ranch in the Altar Valley.

Habitat Requirements

Cactus ferruginous pygmy-owls are found in a mix of dense thicket or woodland vegetation types in the Sonoran Desert, requiring saguaros or trees that are large enough for nesting cavities. A variety of multilayered vegetation cover and canopy cover are important to provide habitat for the owl's prey. Most of the known pygmy-owls detected since 1993 were found in an area that is a mixture of private, State, and BLM lands. Residential development within occupied areas ranges from scattered ranches on hundreds of acres to six residences per acre. Livestock grazing and recreational use occur in the area (Richardson et al. 2000). Other areas that are relatively more pristine, with fewer human residences and less intensive human activities have fewer or even no records of cactus ferruginous pygmy-owls.

Current and Potential Threats

General: Threats were defined as historic loss of riparian habitat, and current threats are usually summarized as "development" and "other potential impacts." The species was listed as endangered because of historical and current evidence suggesting a significant population decline had occurred in Arizona and that the owl was nearly extirpated. Loss and alteration of the owl's habitat was identified as the primary threat to the remaining population (U.S. Fish and Wildlife Service 1997b). Specific causes of human-related deaths of individual owls are not well known, but were speculated to include casualties caused by pest control, pollution, collision with cars, TV towers, glass windows, electrocution by power lines, and cat predation (Abbate et al. 2000).

Existing and potential pest species: There has been some speculation that the introduced house sparrow and European starling may compete for nest cavities with cactus ferruginous pygmy-owls, but this has not been substantiated (Cartron et al. 2000). Several species of native birds have also been mentioned as potential competitors for nest cavities and raiders of prey caches (Cartron et al. 2000). Nest parasites may also be a problem for this species (Proudfoot et al. 2005).

Threat mechanism: Historical habitat losses, current habitat losses and alterations, reduction in prey density, and competition have all been mentioned as threats. Also, the possibility of natural fluctuations of a species at the edge of its range has been raised (Johnson et al. 2000). Drought and predation play a role in reduced cactus ferruginous pygmy-owl productivity. There is an inherent risk of extinction in small populations due to stochastic variation in demographic parameters, sex ratios, genetic diversity, environmental conditions and disease (Cartron et al. 2000).

Management Needs

General: Scientific understanding of management needs is lacking. Specific recommendations have been made to increase and intensify surveys and to centralize information. Specifically called for are conducting surveys within a range of housing development patterns as well as sites with other types of human activities to clarify the extent of human activities that are compatible with the occurrence of cactus ferruginous pygmy-owls (Richardson et al. 2000; Cartron et al. 2000).

Current protective measures: Since the delisting of the species, there are no protective measures beyond what might be afforded by the Migratory Bird Treaty Act.

Corridor and migratory needs: None are positively known. It has been speculated that loss of more-or-less continuous riparian corridors may have been the cause of the species decline in Arizona. Although it has been stated that the species is not migratory (U.S. Fish and Wildlife Service 1997b), habitat connectivity is needed to facilitate dispersal and is important in maintaining populations of cactus ferruginous pygmy-owls which generally function as metapopulations.

Key relationships: This species often uses former woodpecker nest sites (e.g., Gila woodpecker and gilded flicker) for nest holes in Arizona (Cartron et al. 2000).

Existing monitoring and research programs: Since the species was delisted, the number of surveys and monitoring efforts has declined significantly in Arizona. Glenn Proudfoot continues to conduct long term monitoring of pygmy-owls in Texas. The longest-running effort in Mexico is by Aaron Flesch in northern Sonora, Mexico (Flesch 2008a; Flesch 2008b).

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-13): 7,394.

Acres of mitigation habitat within the current portfolio of conservation lands: 43,248.

Determination of Incidental Take

Pima County anticipates that incidental take of cactus ferruginous pygmy owl will be difficult to detect because of the large Permit Area; the species' very small population size; and its nocturnal and crepuscular activity patterns. However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect

impacts such as invasive species, light, etc. Therefore, Pima County will use acres of PCA habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of cactus ferruginous pygmy-owls. Effects to habitat can result in the following impacts to cactus ferruginous pygmy-owls: collisions with and crushing by vehicles and equipment; direct impacts to nests; abandonment of nests due to noise, activity, light, etc.; increased occurrence of non-native competitors and predators; injury or death of nestlings or young if they are abandoned or fall or are forced from nests; being forced into suboptimal habitat or already-occupied habitat; increased predation; inability of individuals to find mates; and starvation and reduced reproductive output due to reduced habitat quality and increased competition.

MSCP Management and Conservation Commitments

Pima County has spent considerable resources on this species by funding surveys, research (genetic work), telemetry, and habitat analysis studies. Pima County will continue this commitment by working with the USFWS to develop a set of Permit coverage conditions for this species. Pima County will pursue additional management actions and conservation commitments for the cactus ferruginous pygmy-owl:

- Pima County will apply avoidance and minimization measures as described in Chapter 4;
- Place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4;
- Support and participate in research experiments and other scientific efforts to benefit and increase knowledge of this species in collaboration with the USFWS, AGFD, and other partners.
- Implement the Floodplain Ordinance to minimize loss of habitat, as described in Chapter 4.
- Facilitate the release of captive-bred birds on Pima County lands, if such a program is carried out.
- If possible, work with citizen's group to build and install nest boxes on County-owned or managed properties that the USFWS deems appropriate for such use.
- On County-owned lands, enact a 250 m buffer "restricted activity zone" around known nests during the nesting period. Allow only short duration "pass through" activities.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

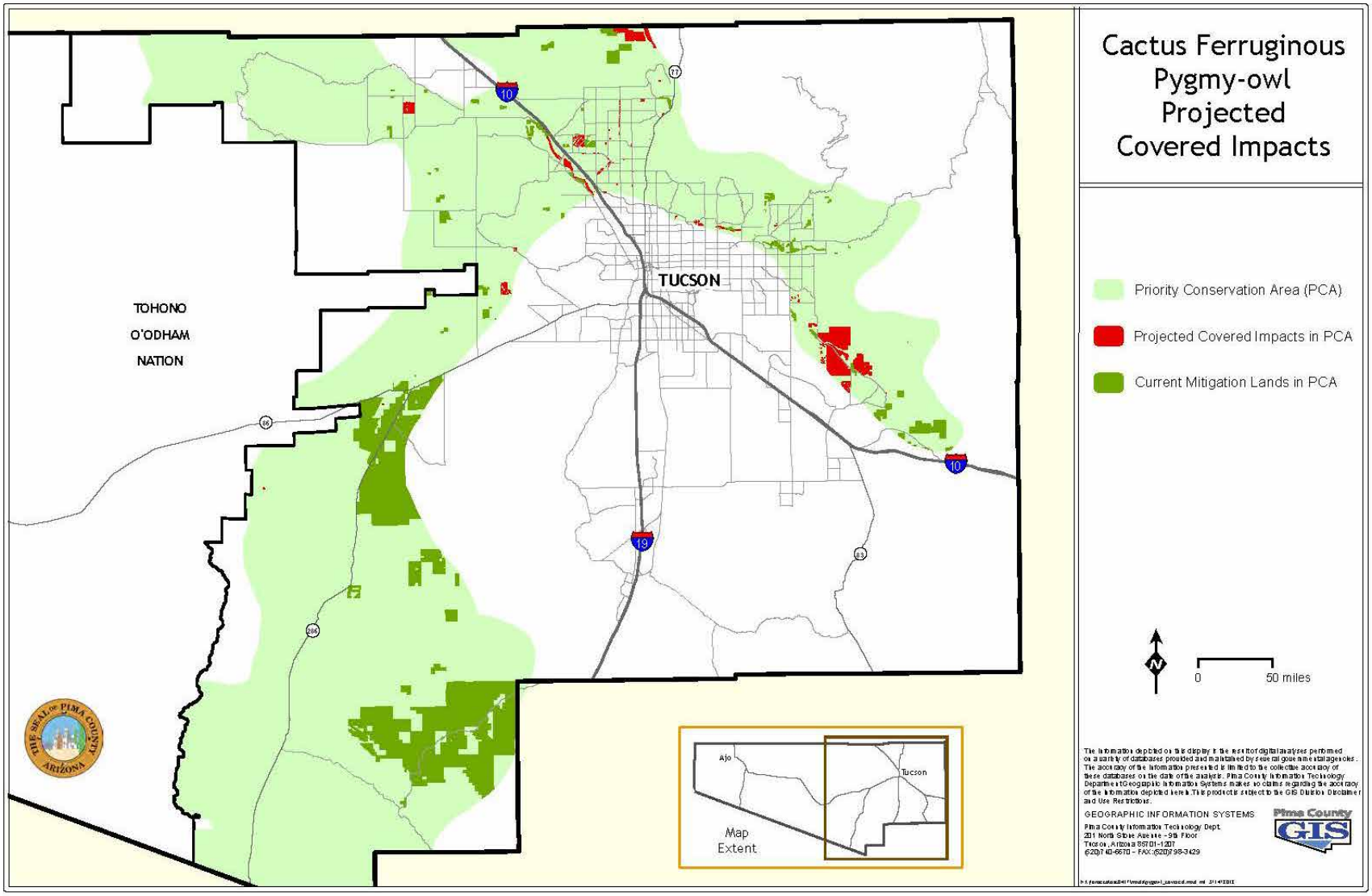


Figure A-13. Map of projected impacts and mitigation for the cactus ferruginous pygmy-owl.

Rufous-winged sparrow (*Aimophila carpalis*)

Conservation Status

Endangered Species Act Status: None.

State: None.

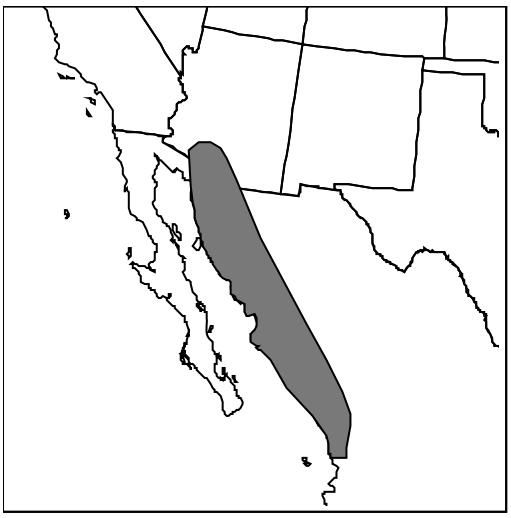
Other: Migratory bird under the Migratory Bird Treaty Act.

Rankings: G4, S3.

Description

The rufous-winged sparrow is a small (5.1-5.5 inches [13-14 cm], 15 g), distinctly marked sparrow. The adult has a gray head with black moustachial and malar stripes, narrow rufous postocular stripe, and rufous crown streaked with gray, often with a vague gray median stripe; grayish brown back streaked with dark brown; unstreaked pale gray underparts; dark brown wing-feathers edged buffy brown or rufous (on tertials), with two indistinct buffy white wing-bars, and rufous lesser wing-coverts (often concealed). The tail is long and rounded, and the bill is distinctly bicolored, with the lower mandible orange-pink and the upper mandible dusky (except along cutting edges, which are the same color as the lower mandible). The sexes are similar, and the adult plumages remain similar throughout the year. The juvenile plumage is similar but buffier, with distinct spotting or streaking on underparts, head streaked brown, less distinct facial pattern, and an all dark bill (Lowther et al. 1999).

Distribution and Trend



The rufous-winged sparrow is a year-round resident from south-central Arizona (Pinal County) south along the Pacific slope of Mexico through central Sonora to central Sinaloa. In Arizona, it is a resident in central and southern portions of eastern Pinal County (Red Rock, Oracle Junction), and northern portion of the San Pedro River near Winkelman (Lowther et al. 1999). The rufous-winged sparrow is found in the eastern two-thirds of Pima County including the Santa Cruz and Avra valleys, and the foothills of the major mountain ranges of eastern Pima County (Phillips et al. 1964; Lowther et al. 1999; Corman and Wise-Gervais 2005; Powell 2006, 2007a; Tucson Bird Count 2012). Arizona Breeding Bird Atlas records indicate that this species is fairly widespread in appropriate habitat in Pima County, and that there are no specific concentrations that should be deemed especially significant. There have been observations of rufous-winged sparrows on numerous County owned and managed properties including Rancho Seco, Sopori Ranch, Colossal Cave Mountain Park,

Tucson Mountain Park, Canoa Ranch, Catalina Regional Park, Diamond Bell Ranch, Lord's Ranch, Marley Ranch, and Cienega Creek Natural Preserve.

Comparing historical distribution to current distribution shows a species that is highly variable. Rufous-winged sparrows were found by Bendire near old Fort Lowell, Tucson, in "the early part of June," 1872. By 1884, the species had disappeared from the area. It was considered by the American Ornithologist's Union to be extirpated in Arizona due to overgrazing. The species reappeared, or was rediscovered, in the Tucson area in 1936 and has been recorded locally with some consistency since then (Phillips et al. 1964; Lowther et al. 1999), and is now fairly common and widespread (Corman and Wise-Gervais 2005).

Habitat Requirements

According to results from the Arizona Breeding Bird Atlas (Corman and Wise-Gervais 2005), habitats in which this species was recorded and the proportion of the 64 records that were from each habitat are Arizona Upland Biome (73 percent), Lower Colorado River Biome (1.5 percent), Semidesert Grassland (6 percent), Sonora Savanna Grassland (3 percent), Urban/Agricultural (parks) (1.5 percent), Sonoran Riparian Deciduous Forest and Woodlands (3 percent), and Sonoran Riparian Scrubland (8 percent). Several records were from residential, rural, and park situations, indicating that this species may not be excluded by some level of human use and modification of the landscape.

Rufous-winged sparrows use flat or gently hilly Sonoran desert scrub and Sinaloan thorn scrub, characterized by scattered spiny trees and shrubs. This species apparently does not use the steeper hillsides. Grasses are essential components of the species' habitat. Hackberry (*Celtis* sp.), cholla species (*Opuntia* spp.), and paloverde (*Cercidium microphyllum*) almost invariably are present (Lowther et al. 1999). Territories typically include some wash (riparian) habitat. Areas near Tucson, where the species has been found, include swales of tobosa grass, desert (dry) washes, riparian (flowing water) areas, farmland (brush and cleared areas along irrigation ditches) and deep-soil sites (spaced mesquite trees with many clumps of sacaton grass). Small numbers occur in oak savannahs at higher elevations.

Current and Potential Threats

General: Loss of grassland habitat as a result of overgrazing and urban development is believed to have had the greatest effect on populations (Latta et al. 1999). Overgrazing in the desert habitats was alleged to have caused the local extirpation of the species in the 1880s from at least part of its range (Phillips et al. 1964). Apparent recovery of this species over the past 50 years may be related, at least in part, to improved grazing management.

Existing and potential pest species: Parasitism by brown-headed cowbirds was noted in as many as one-half of monitored nests at the time of the rufous-winged sparrow's discovery, but has been reported infrequently since then. A study conducted in 1969 found rates of brood parasitism to be 7 cowbird eggs reared out of 90 sparrow nests (Lowther et al. 1999).

Threat mechanism: Loss of habitat through urban development, overgrazing, and invasive species.

Management Needs

General: Arizona Partners in Flight (a state, Federal, and private partnership for conservation of native land birds) developed a conservation plan for key breeding, winter and resident birds. In that plan, the rufous-winged sparrow is recognized as a "priority species" and serves as one of the representative species for Lowland Grassland Priority Habitat (Latta et al. 1999). Specific management needs, beyond protection of habitat from direct impacts of development and overgrazing, are not currently known.

Current protective measures: This species is protected under the Migratory Bird Treaty Act. The Migratory Bird Treaty Act makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird, including feathers, parts, nests, or eggs. Violations of the Migratory Bird Treaty Act are considered criminal offenses and can result in significant fines and imprisonment.

Corridor needs: No information is available to support conclusions or conjecture with regard to corridor needs.

Key relationships: Rufous-winged sparrows require flat or gently hilly desert grasslands with scattered trees or shrubs and grass of various species. They require seeds and arthropods for food. During hot hours in spring and summer, they forage in the deep shade portion of shrubs. When flushed by humans, rufous-winged sparrows generally fly to spiny shrubs or cacti (Lowther et al. 1999). More specific habitat relationships have not been demonstrated. This species is an occasional host of the brown-headed cowbird. There is no information on the kinds of predators that are likely to impact this species. Population fluctuations and survivorship appear to be closely tied to the amount and timing of rainfall (Lowther et al. 1999).

Migratory requirements: Rufous-winged sparrows are not migratory, although individuals may move a short distance in winter months in search of food (Lowther et al. 1999).

Existing monitoring and research programs: No species-specific monitoring or research is currently known.

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-14): 19,108.

Acres of mitigation habitat within the current portfolio of conservation lands: 37,361.

Determination of Incidental Take

Pima County anticipates that incidental take of rufous-winged sparrows will be difficult to detect because of the large Permit Area; the species' small body size; losses may be masked by normal seasonal fluctuations in numbers and other causes (predation,

migration, starvation, etc.); natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as invasive species, light, etc. Therefore, Pima County will use acres of PCA habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of rufous-winged sparrows. Effects to habitat can result in the following impacts to rufous-winged sparrows: collision with vehicles and equipment; direct impacts to nests; abandonment of nests due to noise, activity, light pollution, etc.; increased occurrence of non-native competitors and predators; injury or death of nestlings or young if they are abandoned or fall or are forced from nests; being forced into suboptimal habitat or already-occupied habitat; increased predation; and starvation and reduced reproductive output due to reduced habitat quality and increased competition.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the rufous-winged sparrow:

- Pima County will apply avoidance, minimization and mitigation measures as described in Chapter 4.
- Monitor grazing on Pima County lease lands for range health and avoid over-grazing on all County-controlled mitigation lands, as indicated in Chapter 5. Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

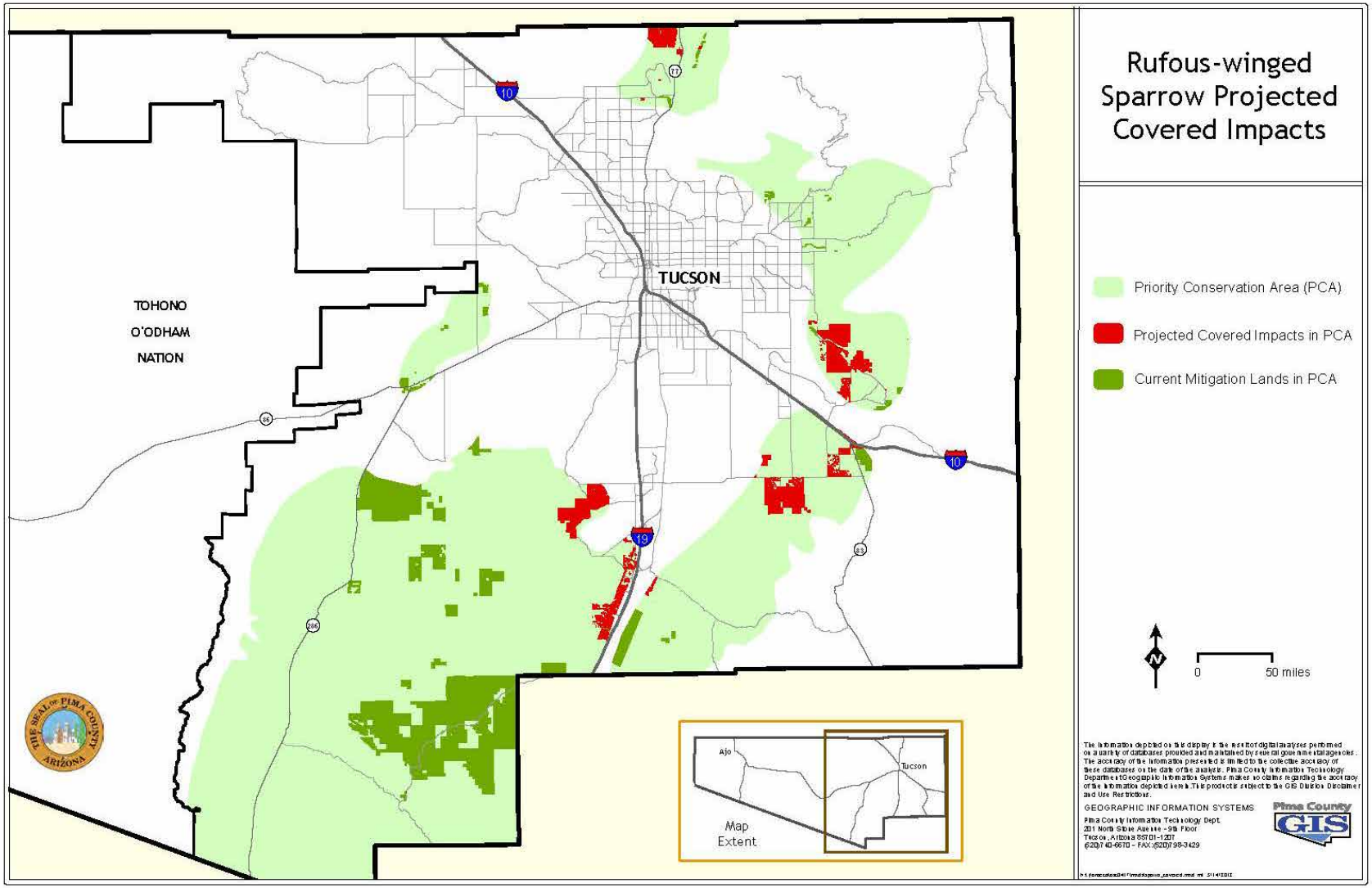


Figure A-14. Map of projected impacts and mitigation for the rufous-winged sparrow.

Swainson's hawk (*Buteo swainsoni*)

Conservation Status

Endangered Species Act Status: Former FWS Candidate.

State: Arizona Wildlife Species of Special Concern.

Other: USFWS Species of Concern; Migratory species; U.S. Forest Service Sensitive Species; restricted from international trade by CITES.

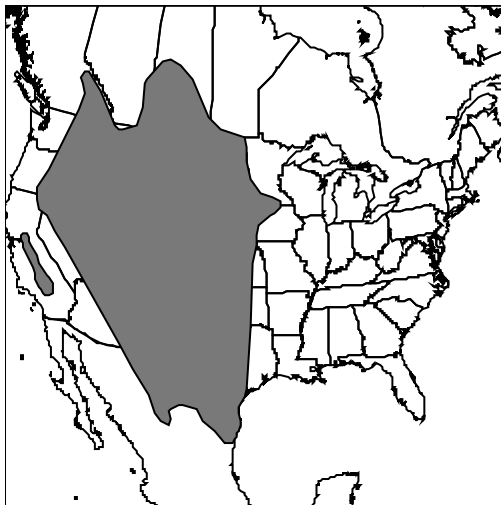
Rankings: G5, S3.

Description

The Swainson's hawk is a large, slim-winged, long-tailed Buteo. There coloration is highly variable (Glinski and Hall 1998). The only color patterns that seem consistent are the two-toned underwing, with the leading edge appearing lighter than the trailing edge, and the white patch on the throat and forehead. The species is adapted for hunting in the open country and has more pointed wings and a longer tail than the more familiar red-tailed hawk. In a soar, the bird somewhat resembles a Peregrine Falcon with its long pointed wings, but when it is gliding, the wings are crooked like those of an Osprey. When soaring, the wings are held in a dihedral. Total length of males is 19 to 20 inches (48 to 51 cm) and of females is 20 to 22 inches (51 to 56 cm), and the wingspan is 47 to 57 inches (119 to 144 cm).

Distribution and Trends

Swainson's hawks breed throughout most of the western U.S., from northern Mexico to Alaska (The National Geographic Society 1987; England et al. 1997). They are very rare fall visitors to the eastern U.S., and they winter primarily in South America (England et al. 1997). In Arizona, this species breeds throughout the state in suitable open grassland habitats and open desert scrub that sustains a grassland component (Glinski and Hall 1998; Corman and Wise-Gervais 2005).



The Swainson's hawk is a common breeder in semi-desert grasslands of southeastern Arizona, particularly east of Pima County (Corman and Wise-Gervais 2005). In Pima County it is an uncommon breeder in the Altar Valley and other isolated pockets of semi-desert grasslands such as in the foothills of the Santa Rita, Santa Catalina and Las Guijas Mountains and near the Pantano Wash

(Nishida et al. 2001; Hobbs 2004; Corman and Wise-Gervais 2005). In Pima County-owned and managed lands, the Swainson's hawk has been observed at the Sands Ranch, Clyne Ranch, Bar-V, Rancho Seco, and Diamond Bell Ranch.

Although the nesting range has remained relatively stable, Swainson's hawks have suffered major declines in certain portions of their range, especially in California, Oregon, and Nevada (England et al. 1997; Arizona Game and Fish Department 2001c). In Arizona, data are inadequate to determine trends (Bednarz 1988).

Habitat Requirements

Migrating Swainson's hawks are frequently seen in agricultural fields where they forage (Glinski and Hall 1998). They often can be seen resting on utility poles and fence posts. The importance of Arizona's watercourses to migrating hawks is uncertain, although migrating Swainson's hawks are regularly sighted in the valleys of the Gila and Santa Cruz rivers, from central Arizona south to Mexico (Glinski and Hall 1998). They are rarely seen in urban or suburban developed areas, woodlands, forests, or dense scrublands.

Swainson's hawks forage in open stands of grass-dominated vegetation, sparse shrub-lands, and small open woodlands. In many parts of their range today, they have adapted well to foraging in agricultural areas (e.g., wheat and alfalfa), but cannot forage in most perennial crops or in annual crops that grow much higher than native grasses, making prey more difficult to find (England et al. 1997).

Although Swainson's Hawk will nest in almost any tree of suitable size, in Arizona and adjacent Mexico, vegetation used for nesting include: catclaw acacia (*Acacia greggii*), cholla cactus (*Opuntia* sp.), mesquite (*Prosopis glandulosa*), desert willow (*Chilopsis linearis*), Joshua tree (*Yucca brevifolia*), creosotebush (*Larrea tridentata*), paloverde (*Cercidium* sp.), ironwood (*Olneya tesota*), and saguaro (*Carnegiea gigantea*) (Glinski and Hall 1998).

Current and Potential Threats

General: Habitat loss, degradation, fragmentation, and use of pesticides are likely contributors to the decline of this species (Arizona Game and Fish Department 2001c). Throughout their Arizona range, Swainson's hawks must contend with habitat loss through a continually expanding human population and associated development and recreation activities (Arizona Game and Fish Department 2001c).

Existing and potential pest species: No information is available regarding predation of adults; however, predation of nestlings or fledglings by American crows, great horned owls, golden eagles, and predatory mammals has been documented (England et al. 1997).

Threat mechanism: Use of pesticides in areas of wintering hawk concentrations may significantly affect some North American breeding populations. Pesticides also reduce prey on wintering grounds and most likely impact the breeding grounds as well, depending on the setting. Direct mortality is caused by shooting, as the species is

sometimes erroneously perceived as a pest, and it is often an easy target because it habitually perches on utility poles and fence posts along roads in open country.

Management Needs

General: The health of this species on its wintering grounds in South America remains uncertain (Glinski and Hall 1998). On the breeding grounds, research is needed to learn why populations and productivity have declined, especially in areas where apparently suitable habitat remains unoccupied (England et al. 1987).

Current protective measures: The Swainson's hawk does not receive any special Federal or state protection, although it is generally protected by provisions of the Migratory Bird Treaty Act of 1918 (Glinski and Hall 1998). The Migratory Bird Treaty Act makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird, including feathers, parts, nests, or eggs. Violations of the Migratory Bird Treaty Act are considered criminal offenses and can result in significant fines and imprisonment.

Corridor needs: During migration, Swainson's hawks rest and feed in grasslands and harvested fields, especially where grasshoppers are numerous, and often they perch on fence posts and telephone and power poles (England et al. 1997).

Dispersal requirements: No specific dispersal requirements for this species are known.

Key relationships: Because the Swainson's hawk is an extremely versatile predator, no clear dependence on any particular prey species is noted, but their prey base while in Arizona is likely rodents, rabbits, and reptiles. It is also versatile in selection of nest sites, so is not dependent on any particular tree species. However, it is closely tied to grasslands, if not dependent on them. Agricultural fields are also important resources for this species and impacts from pesticides can have a substantial impact on populations, especially on the wintering grounds.

Existing monitoring and research programs: No ongoing research and monitoring projects are known.

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-15): 10,981.

Acres of mitigation habitat within the current portfolio of conservation lands: 56,457.

Determination of Incidental Take

Pima County anticipates that incidental take of Swainson's hawk will be difficult to detect because of the large Permit Area; the remote location of most individuals; losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harass, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as invasive species, etc. Therefore, Pima County will use acres of PCA habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of Swainson's hawks. Effects to habitat can result in the following impacts to Swainson's hawk: collisions with vehicles and equipment; direct impacts to nests; abandonment of nests due to noise, activity, light, etc.; increased occurrence of non-native predators; injury or death of nestlings or young if they are abandoned or fall or are forced from nests; being forced into suboptimal habitat or already-occupied habitat; increased predation; and starvation and reduced reproductive output due to reduced habitat quality and increased competition.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Swainson's hawk:

- Pima County will apply avoidance, minimization and mitigation measures as described in Chapter 4;
- Continue to prioritize protection and acquisition of high-quality habitat;
- Where feasible, restore semi-desert grasslands by introducing prescribed fire and other methods to reduce shrub cover.
- Enact a 400 m buffer "restricted activity zone" around known nest sites on County-controlled mitigation lands during the nesting period. Allow only short duration "pass through" activities.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

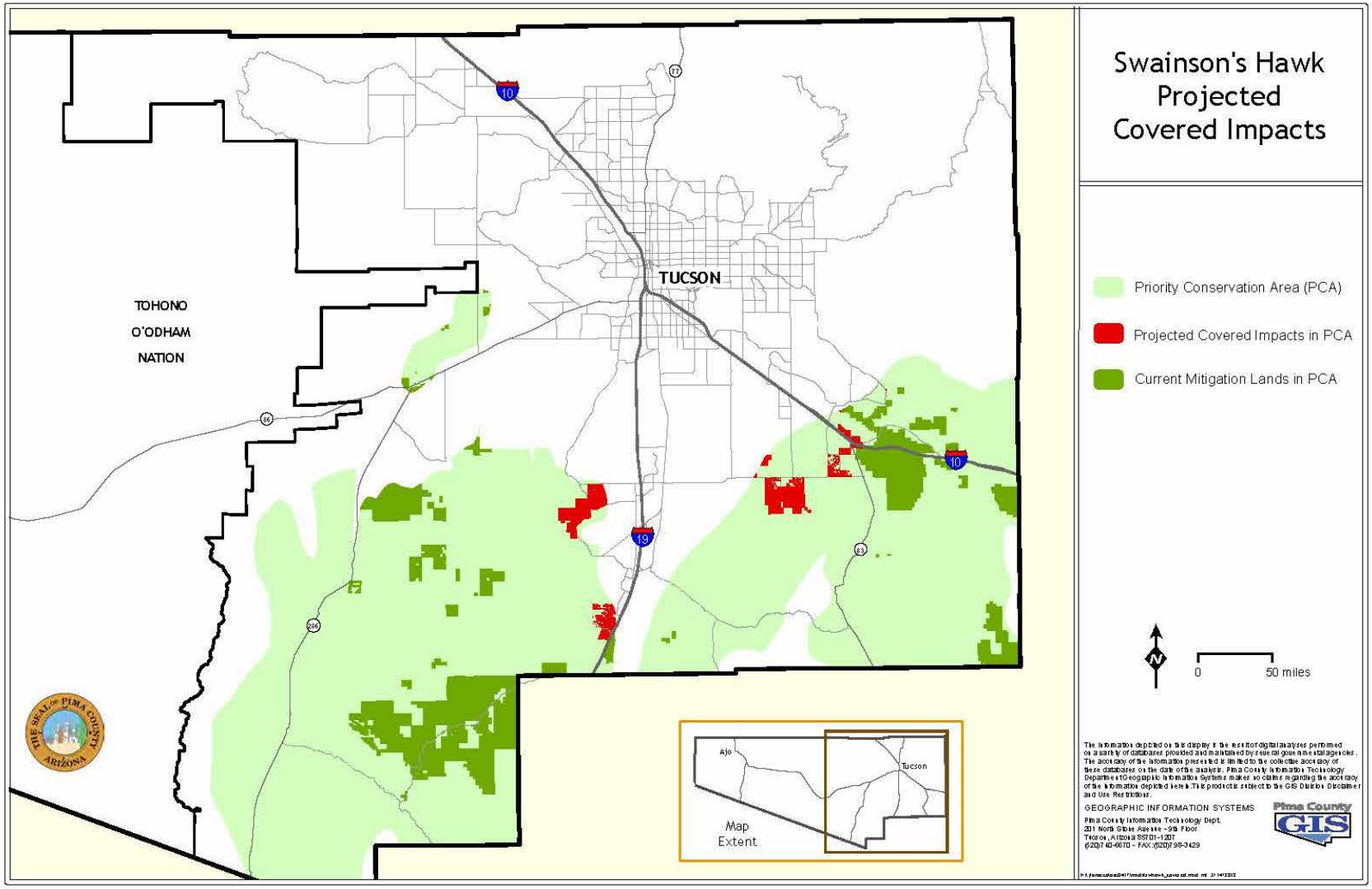


Figure A-15. Map of projected impacts and mitigation for the Swainson's hawk.

Yellow-billed cuckoo (*Coccyzus americanus*)

Conservation Status

Endangered Species Act Status: Determination of threatened status under the ESA was finalized in 2014 (U.S. Fish and Wildlife Service 2014a). Critical habitat is under review (U.S. Fish and Wildlife Service 2014b).

State: Wildlife of Special Concern in Arizona.

Other: Listed as a migratory bird under the Migratory Bird Treaty Act; U.S. Forest Service Sensitive Species.

Rankings: G5, S3.

Description

The yellow-billed cuckoo is a 10- to 12-inch (26 to 30 cm) long slender bird with relatively short, dark legs. The plumage is grayish brown on top and white below. The primary feathers on the wings are rufous (orange-brown) in color and there is a bold black-and-white pattern under the tail. The mandible of the bill is yellow. The plumage of both sexes is similar. Juveniles, which hold juvenile plumage well into the fall, have a much paler pattern on the tail and the bill may show little to no yellow (Arizona Game and Fish Department 2003b).

Distribution and Trend

In the western U.S., the species now occurs in small and isolated pockets in California, Arizona, New Mexico, Utah, Idaho, Montana, and Wyoming. The species was extirpated in British Columbia in the 1920s, Washington in the 1930s, and Oregon in the 1940s, and in the Sacramento Valley, California, where it was originally a common breeding bird, now less than 1% of the original breeding habitat remains (Laymon and Halterman 1987). In Arizona, the species was a common summer resident in the (chiefly lower) Sonoran zones of southern, central, and western Arizona; scarce in the north-central part of the state, and very rare in the northeast (Phillips et al. 1964).

In Arizona, the yellow-billed cuckoo now nests primarily in the central and southern parts of the state. It has been extirpated from most lower elevation localities, especially the Colorado River valley (Biota Information System of New Mexico 2008d) and most of the Santa Cruz River in Pima County (Corman and Magill 2000). The yellow-billed

cuckoo breeds in eastern Pima County in cottonwood/willow forests. It has been found nesting at Cienega Creek (Empire Ranch, and Cienega Creek Natural Preserve), Arivaca Creek, Buehman Canyon, and several sites in the Altar Valley (Corman and Magill 2000; Arizona Game and Fish Department 2003b) including confirmed nesting in Brown Canyon in the Baboquivari Mountains (B. Powell, *unpublished data*). There was a high density of nesting pairs along the Santa Cruz River in Santa Cruz County in 2000 (Powell 2000) and again in 2009 (Krebbs and Moss 2009). Yellow-billed cuckoos have been recorded in the pecan groves in Green Valley and Sahuarita (Kingsley 1989). They have been recorded as rare transients in the Rincon Mountain District of Saguaro National Park, but no breeding has been reported in Rincon Creek, the most likely habitat for the species in the park (Powell 2004, 2006). Recent unconfirmed breeding in eastern Pima County includes areas along the Santa Cruz River north of Tucson in 2005 (Crawford 2005) and along Tanque Verde Creek in 2002 (Sage Landscape Architecture and Environmental Inc 2003). In Pima County-owned and managed lands, the Yellow-billed cuckoo has been recently observed at the Cienega Creek Natural Preserve and Buehman Canyon.

Habitat Requirements

The yellow-billed cuckoo uses cottonwood and willow groves almost exclusively for migrating and breeding, though they occasionally use mesquite bosque and even oak woodlands, while avoiding saltcedar (*Tamarix* spp.; Rosenberg et al. 1991; Hughes 1999). They prefer large trees for nesting, seeming to prefer to nest near the tops of tall cottonwood and willow trees. Hamilton and Hamilton (1965) suggest nest placement within river bottoms may be due to humidity requirements for successful hatching and rearing of chicks. The cuckoo often forages in open areas, woodlands, orchards and adjacent streams (Hughes 1999), which include stands of smaller mesquite trees and even tamarisk on occasion (Rosenberg et al. 1991). This species may be rarely observed as a transient in desert and urban settings (Arizona Game and Fish Department 2002c).

Current and Potential Threats

General: The primary threat to this species' survival is the continued loss, degradation, and fragmentation of mature cottonwood-willow riparian habitat. Major threats to this habitat type include reclamation, flood control, and irrigation projects; habitat loss due to urbanization and agricultural activities; and the continued invasion of nonnative saltcedar into riparian areas. Exposure to pesticides and other contaminants on wintering and breeding grounds, as well as livestock grazing and off-road vehicle use within riparian habitats, also continue to threaten this species' survival (Laymon and Halterman 1987). As the quality of the habitat decreases through competition with exotic plant species, or inappropriate grazing, the number of yellow-billed cuckoos that can be supported by the available habitat may decrease. There is evidence that pesticide use (DDT) adjacent to the breeding grounds and in the wintering grounds may cause eggshell thinning (Laymon and Halterman 1987).

Existing and potential pest species: Invasive exotic plant species such as saltcedar have altered native riparian habitat and may render it less suitable for the yellow-billed cuckoo.

Threat mechanism: The primary threat to yellow-billed cuckoo habitat is the degradation and fragmentation of riparian woodlands, specifically mature cottonwood-willow riparian habitat, and failure of these to regenerate because of flood management practices. Threats to remaining populations in central and southern Arizona are stated as: degradation and loss of riparian habitat from vegetation clearing, stream diversion, water management, agriculture, urbanization, overgrazing, and recreation (Arizona Game and Fish Department 2002c). Depletion of groundwater has dried many riparian areas and resulted in the loss of riparian vegetation.

Management Needs

General: Management of riparian habitat known to support cuckoo populations is considered necessary. Corman and Magill (2000) summarize the needs of the species as follows: expand survey effort to encompass all major riparian habitat types and include areas within potentially suitable habitat that were not thoroughly surveyed; conduct nest searching and monitoring studies; land management agencies need to promote regeneration of riparian habitat; management activities require cooperation, coordination, and funding.

Current protective measures: The species in Arizona has been listed under the Endangered Species Act as a distinct population segment. This species is also protected under the Migratory Bird Treaty Act. The Migratory Bird Treaty Act makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird, including feathers, parts, nests, or eggs. Violations of the Migratory Bird Treaty Act are considered criminal offenses and can result in significant fines and imprisonment. Pima County has a floodplain ordinance that prevents some destruction of habitat for this species. The Federal Clean Water Act, in its Section 404, may also protect some of the habitat of this species.

Corridor and migratory needs: Contiguous well-developed riparian corridors may be beneficial, but birds may be sighted in and have bred in fragmented riparian habitat. Contiguous corridors to connect isolated breeding areas are probably unnecessary for a highly mobile migratory species such as this, but some degree of connectivity is likely to be beneficial. The migratory habits and routes of this species are poorly known and need further study; however, it is likely that riparian corridors play a role since food sources, such as caterpillars, are found there (Hughes 1999).

Key relationships: Mature cottonwood-willow riparian habitat is utilized by this species for breeding and as a source of primary prey items, particularly caterpillars and cicadas.

Existing monitoring and research programs: Monitoring is ongoing along the Colorado River for the Bureau of Reclamation's Habitat Conservation Plan, and along the San Pedro River at the San Pedro River Conservation Area. The National Park Service

hopes to conduct periodic monitoring at the Tumacacori National Historical Park to follow up on the work of Powell (2000) and Krebbs and Moss (2009).

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-16): 28.

Acres of mitigation habitat within the current portfolio of conservation lands: 9,966.

Determination of Incidental Take

Pima County anticipates that take of the yellow-billed cuckoo will be difficult to detect because of the large Permit Area; the secretive nature of the species; losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as invasive species, etc. Therefore, Pima County will use acres of PCA habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of yellow-billed cuckoos. Effects to habitat can result in the following impacts to yellow-billed cuckoos: collision with vehicles and equipment; direct impacts to nests; abandonment of nests due to noise, activity, light, etc; injury or death of nestlings or young if they are abandoned or fall or are forced from nests; being forced into suboptimal habitat or already-occupied habitat; increased erosion and sedimentation affecting life history requirements; increased predation; and starvation and reduced reproductive output due to reduced habitat quality and increased competition.

Impact of Covered Activities on Proposed Critical Habitat

Critical habitat for the yellow-billed cuckoo was proposed on August 15 2014 (U. S. Fish and Wildlife Service 2014a). Proposed critical habitat encompasses 546,335 acres across the western United States, with three areas in Pima County subject to the proposed designation: San Pedro River, Cienega Creek, and Arivaca Cienega and adjacent areas in the Buenos Aires National Wildlife Refuge. Because of the relatively remote nature of these lands, the number of acres of proposed Critical Habitat that are anticipated to be impacted by Covered Activities is approximately 9 acres. Pima County currently owns or leases approximately 2,000 acres of proposed Critical Habitat as proposed mitigation.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the yellow-billed cuckoo:

- Pima County will apply avoidance, minimization and mitigation measures as described in Chapter 4;

- Continue to prioritize protection and acquisition of high-quality habitat;
- Implement the Pima County Floodplain Ordinance to minimize loss of habitat for this species as described in Chapter 4;
- Seek to protect additional water rights at Cienega Creek Natural Preserve and Buehman Canyon to maintain and restore habitat.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.
- Enact a 400 m buffer "restricted activity zone" around known nests during the nesting period. Allow only short duration "pass through" activities.

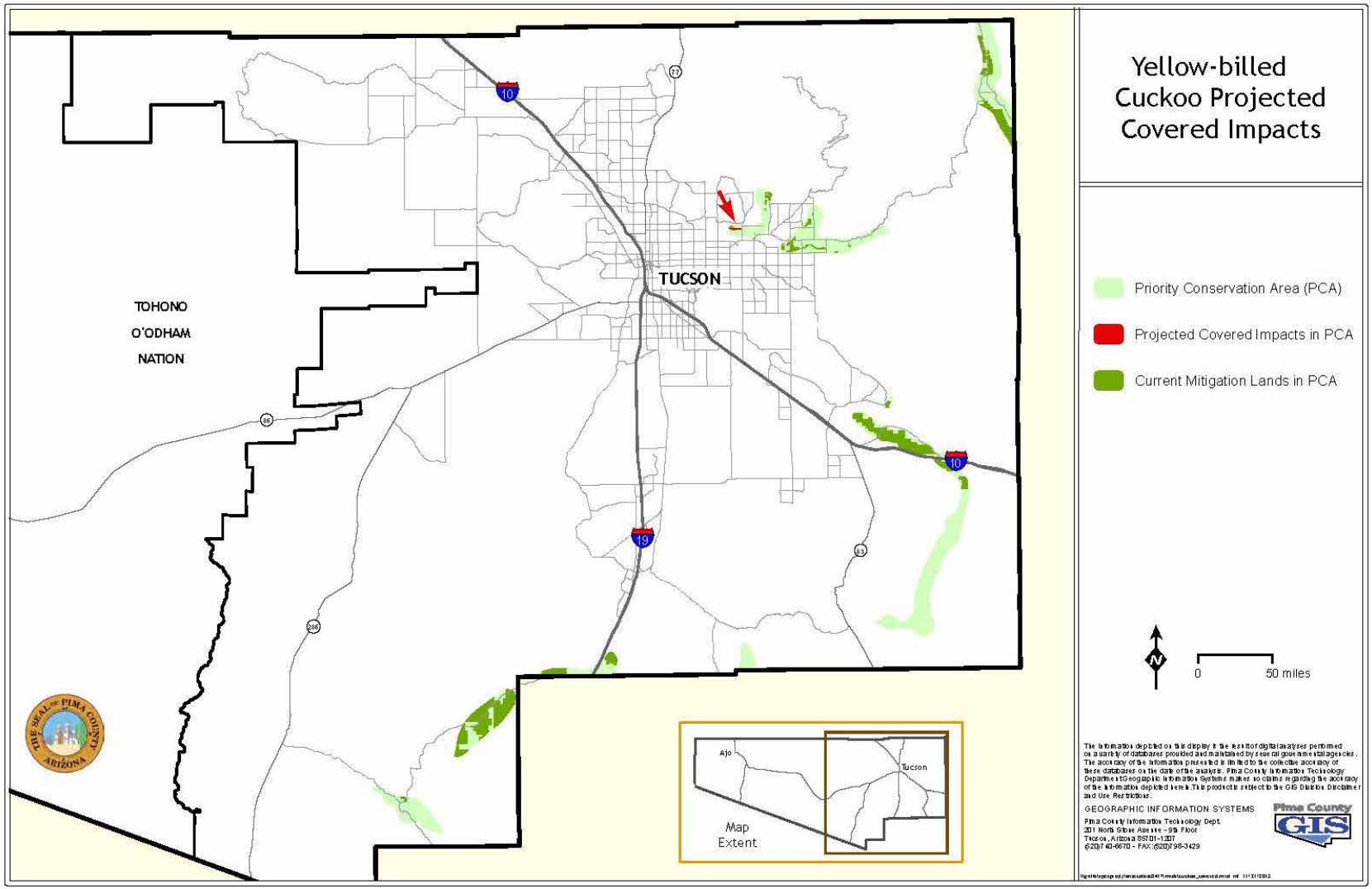


Figure A-16. Map of projected impacts and mitigation for the yellow-billed cuckoo.

Abert's towhee (*Melozone aberti*)

Conservation Status

Endangered Species Act Status: None.

State: None.

Other: Listed as a "migratory bird" under the Migratory Bird Treaty Act.

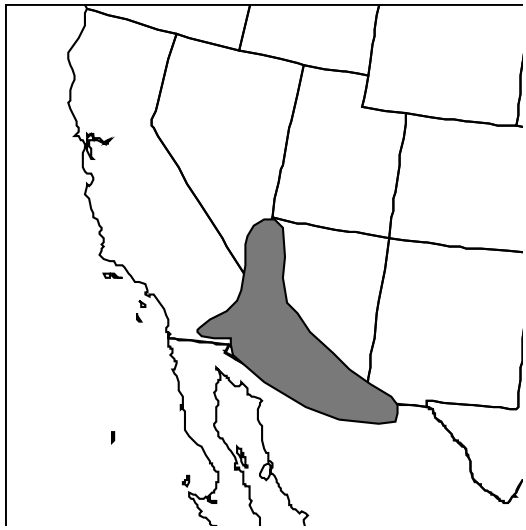
Rankings: G3,G4; S3.

Description

Abert's towhee is a large sparrow with gray-brown upperparts. There is little or no contrast between crown and back. The breast, flanks, and belly are pinkish brown. There is black on the lores, malar region, chin, and extreme anterior forehead surrounding a pale bill, giving the appearance of a black mask around the bill. The male and female plumages are identical (Tweit and Finch 1994).

Distribution and Trend

This species is resident from southeastern California, southern Nevada, southwestern Utah, central Arizona, and southwestern New Mexico south to northeastern Baja California and northern Sonora (Tweit and Finch 1994). In Pima County, Abert's towhees are common along brushy washes and the effluent-dominated portion of the Santa Cruz River, and they may be present in urban backyards, especially those that are along washes. It is common along many of the major washes and rivers of eastern Pima County including the Santa Cruz River, Brawley Wash, Rillito River, Pantano Wash; and Rincon, Cienega, and Arivaca creeks (Tweit and Tweit 1986; Powell 2004; Corman and Wise-Gervais 2005; Powell 2006; Tucson Bird Count 2012). In Pima County-owned and managed lands, the Abert's towhee has been observed at the A7 Ranch, Cienega Creek Natural Preserve, Colossal Cave Mountain Park, Tucson Mountain Park, Santa Cruz River parcels, Canoa Ranch, and Sopori Ranch.



Since the mid-1970s the range of Abert's towhee has expanded from the upper Santa Cruz to Nogales, up Sonoita Creek, up Oak Creek nearly to Sedona, and from the upper San Pedro into Mexico (Corman and Wise-Gervais 2005). The species has also been found utilizing exotic shrubs along irrigation ditches and suburban backyards in Phoenix and Tucson. The range of the species has contracted in other areas, and Abert's towhees have completely disappeared from some

areas of Utah. In Arizona, loss of native riparian habitat has fragmented the species range, and invasive species such as saltcedar (*Tamarisk* sp.) may importantly reduce the density of available nesting habitat (Tweit and Finch 1994). While individuals may use saltcedar-dominated habitats it is not known how conducive these habitats are for population recruitment.

Habitat Requirements

Abert's towhee prefers Sonoran Riparian Deciduous Woodland and Riparian Scrubland, with a dense understory of shrubs. The plant species used for nesting vary considerably, but the species consistently uses very dense vegetation in which to place its nest (Corman and Wise-Gervais 2005). Much of their preferred habitat for nesting has been altered and fragmented, and Abert's towhee is now found in remnants of riparian woodland and scrubland, marshes, and areas with exotic vegetation, including saltcedar in the lower Colorado River valley (Rosenberg et al. 1991) and in mixed exotic-native habitat in the Phoenix, and Tucson areas (Tweit and Finch 1994). They are also found in Sonoran and Chihuahuan Desert Scrub habitats, usually near washes. This species appears to be well adapted to urban development in some areas where wash vegetation has been preserved, such as Tucson (McCaffrey et al. 2012). However, density in urban areas may be less than in natural areas and predation by domestic and feral pets may be an issue.

Current and Potential Threats

General: Much riparian habitat has been lost through the clearing of land for agriculture, development or grazing, or through groundwater depletion that has lowered the water table. Exotic species such as saltcedar have become established in many remaining riparian areas and may have reduced the habitat quality for Abert's towhee. After removal of cattle from the San Pedro Riparian National Conservation Area, spring densities of Abert's towhees in cottonwood-willow habitat almost doubled (Tweit and Finch 1994).

Existing and potential pest species: Cowbirds are sometimes parasites of Abert's towhee nests (Ehrlich et al. 1988). Because Abert's towhee eggs are larger than those of cowbirds, Abert's towhee is probably not a good host for the cowbird (Tweit and Finch 1994). Because cowbirds usually select host nests that contain eggs smaller than their own. Cowbird nestlings do not appear to thrive in Abert's towhee nests, possibly starving to death due to competition from the much larger towhee nest mates (Tweit and Finch 1994).

Threat mechanism: Destruction of riparian habitat through development, agriculture, grazing or groundwater depletion. There have been no known studies performed on the effects of pesticides or other contaminants in areas where Abert's towhees are present (Tweit and Finch 1994).

Management Needs

General: Protection of native riparian habitat is needed for the conservation of Abert's towhee. Management programs that benefit the endangered southwestern willow flycatcher may also benefit Abert's towhee in portions of their sympatric range.

Current protective measures: This species is protected under the Migratory Bird Treaty Act, despite the fact that it is essentially non-migratory. The Migratory Bird Treaty Act makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird, including feathers, parts, nests, or eggs. Violations of the Migratory Bird Treaty Act are considered criminal offenses and can result in significant fines and imprisonment. The Pima County Floodplain Protection ordinance provides guidance to avoid, minimize, or mitigate for damage to riparian habitat that is used by this species. The Federal Clean Water Act, in its Section 404, may also protect some of the habitat of Abert's towhee.

Corridor and migratory needs: There is no known information available on corridor needs of this species. The species is essentially sedentary, although it is classified as a "Migratory Bird" under the Federal Migratory Bird Treaty Act.

Key relationships: Abert's towhee is considered a riparian obligate species (Tweit and Finch 1994), but the specific type of riparian association upon which it is obligate can vary from xeroriparian to hydroriparian. The dependency appears to be more on vegetation density and structure than on species of vegetation or presence of water.

Existing monitoring and research programs: No specific monitoring and research programs for this species are currently known. However this species is one that is frequently observed in studies of riparian birds within its range and is a common bird along washes in the Tucson Basin (Tucson Bird Count 2012).

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-17): 554.

Acres of mitigation habitat within the current portfolio of conservation lands: 10,506.

Determination of Incidental Take

Pima County anticipates that take of the Abert's towhee will be difficult to detect because of the large Permit Area; the secretive nature of the species; its relatively small body size; losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as invasive species, etc. Therefore, Pima County will use acres of PCA habitat impacted by covered activities (as described in

Table 3.3 of the MSCP) as a surrogate for the incidental take of Abert's towhees. Effects to habitat can result in the following impacts to Abert's towhees: collision with vehicles and equipment; increased occurrence of non-native predators; direct impacts to nests; abandonment of nests due to noise, activity, light, etc.; loss of riparian vegetation as breeding, feeding and sheltering habitat; injury or death of nestlings or young if they are abandoned or fall or are forced from nests; being forced into suboptimal habitat or already-occupied habitat; increased erosion and sedimentation affecting life history requirements; increased predation; and starvation and reduced reproductive output due to reduced habitat quality and increased competition.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Abert's towhee:

- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat.
- Identify and pursue opportunities for restoration of mesquite bosques on appropriate portions of the County-controlled mitigation lands.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

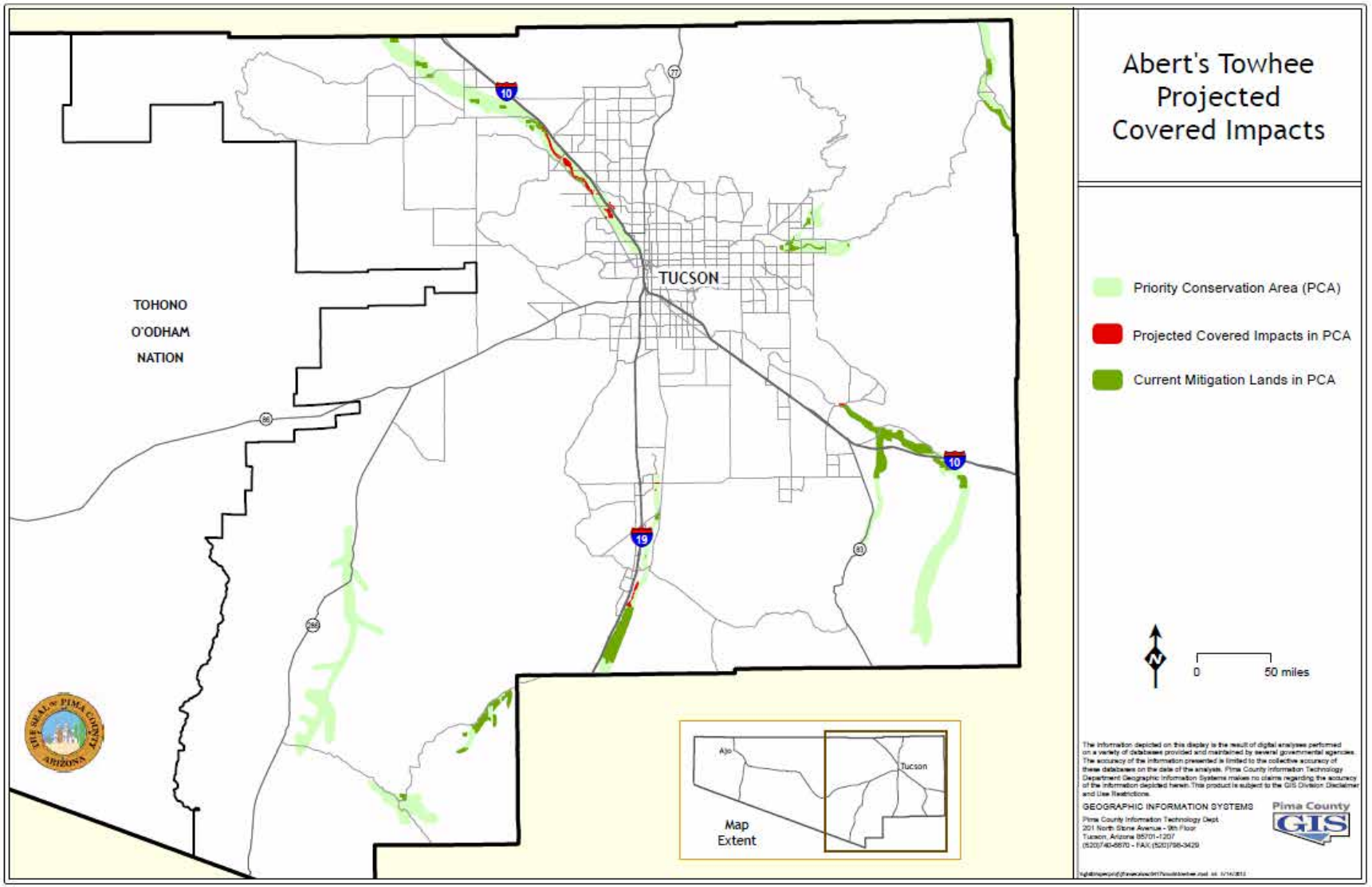


Figure A-17. Map of projected impacts and mitigation for the Abert's towhee.

Arizona Bell's vireo (*Vireo bellii arizonae*)

Conservation Status

Endangered Species Act Status: None. Subspecies in California is listed as Endangered.

State: None.

Other: U.S. Forest Service Sensitive Species; Migratory bird under the Migratory Bird Treaty Act.

Rankings: G5, S4.

Description

The Bell's vireo is a small bird, with a length of 4.5 to 5.0 inches (115 to 125 mm) and weight from 7 to 10 g. Its short, rounded wings make its tail look long. It has a short, straight bill, somewhat compressed at the base. Males and females have similar plumage throughout the year. The plumage color varies; it is generally drab gray to green above, and white to yellow below; the breast is unstreaked. There is a faint white eye ring. There are 2 pale wing bars, and the lower bar is more prominent. Juvenile plumage resembles that of adults in worn summer plumage—essentially white and gray, but whiter below with more distinct wing bars (Brown 1993).

Distribution and Trend

The Bell's vireo is widespread in central and southwest United States and northern Mexico (Brown 1993). It breeds from southern California to southern Nevada, Utah, northwest and southern Arizona and New Mexico; and from Texas north to North Dakota, east to Ohio, and south to Tennessee, and in the northern half of Mexico. The winter range is not well known. Records have been reported from southern Baja California and southern Sonora south along the west coast of Mexico and Central America to Honduras and casually to northern Nicaragua. It has also been reported from the east coast of Central America from Veracruz south to Honduras. There are scattered winter records from extreme southern California, southern Arizona, southern Texas, Louisiana, and southern Florida (Brown 1993).

The subspecies present in Pima County, the Arizona Bell's vireo, breeds from southern Nevada, southwest Utah, and northwest and central Arizona south to southeast California (the lower Colorado River Valley) and southern Sonora, Mexico (Brown 1993). In Pima County, locations include foothills of the Santa Catalina, Rincon, Santa

Rita, and Baboquivari mountains (Lloyd et al. 1998; Powell and Steidl 2000; Arizona Game and Fish Department 2002f; Powell and Steidl 2002; Corman and Wise-Gervais 2005; Powell 2006; Tucson Bird Count 2012); large rivers, creeks, and washes of eastern Pima County including the Santa Cruz River, Rillito River, Pantano and Brawley washes, and Rincon and Cienega creeks (Mills et al. 1989; Powell 2004; Kirkpatrick et al. 2007; Tucson Bird Count 2012). In western Pima County they also nest in xeroriparian washes such as at the Organ Pipe Cactus National Monument and Barry M. Goldwater Range (Groschupf et al. 1988; Arizona Game and Fish Department 2002f; Hardy et al. 2004; Organ Pipe Cactus National Monument 2006a; Schmidt et al. 2007). In Pima County-owned and managed lands, the Arizona Bell's vireo has been observed at most properties with natural open space and xeroriparian vegetation, excluding properties in the upper Cienega Valley and at the Oracle Ridge property.

The Arizona Bell's vireo has been declining along the lower reaches of the Colorado River and along the lower reaches of the Gila, Santa Cruz, and Salt rivers (Rosenberg et al. 1991; Arizona Game and Fish Department 2002f), but remains common throughout its range at higher elevations (Brown 1993) and this probably includes eastern Pima County. Since the late 1960s, the Arizona Bell's vireo has been expanding its range eastward along the Colorado River into Grand Canyon National Park (Brown et al. 1983).

Habitat Requirements

General: Arizona Bell's vireo prefers dense, low, shrubby vegetation in riparian areas. Characteristically it is found in dense shrubland or woodland along lowland stream courses, with willows (*Salix* spp.), mesquite (*Prosopis* spp.), and seepwillows (*Baccharis glutinosa*) being characteristic plant species (Brown 1993). It is known to be a habitat generalist in riparian scrubland dominated by the introduced shrub tamarisk (*Tamarix ramosissima*) along the Colorado River in Grand Canyon, Arizona (Brown et al. 1983); however, in the lower Colorado River Valley of Arizona it is known to prefer native seepwillow and mesquite habitats, but also uses tamarisk (Brown 1993). In southern Arizona it has been documented to use a wide range of plants for nesting, including willows, hackberry, and ash (Powell and Steidl 2000, 2002; Kirkpatrick et al. 2007). Where present during the breeding season, they can often be found nesting near the edge of dense thickets of vegetation (Arizona Game and Fish Department 2002f).

Current and Potential Threats

General: Current threats to this subspecies include the continued loss and degradation of habitat due to urbanization (Mills et al. 1989), water projects, flood control projects, agriculture, livestock grazing, introduced competitors, exotic invasive plants (especially giant reed), off-road vehicles, and nest parasitism by brown-headed cowbirds (Brown 1993).

Existing and potential pest species: Arizona Bell's vireo is frequently used as a host by brown-headed cowbirds (*Molothrus ater*) (Averill-Murray et al. 1999; Powell and Steidl 2000), though parasitism is lower in mesic vegetation as compared to more xeric sites

(Brand et al. 2010). Success of the brood parasite is usually low, since vireos typically respond to the presence of cowbird eggs by abandoning the nest (Brown 1993) or occasionally by building a second floor of the nest over the cowbird eggs (Ehrlich et al. 1988).

Threat mechanism: Loss of riparian habitat, invasive plant species, and parasitism by brown-headed cowbirds.

Management Needs

General: The management priority for the Arizona Bell's vireo should be the return of healthy stands of cottonwood-willow habitat with a brushy understory that provide this riparian-obligate subspecies with the breeding habitat it requires. Activities such as revegetation of disturbed riparian areas, control of invasive exotic plants, reduction of cattle grazing in riparian areas, and limiting off-road vehicle traffic are key management actions. Trapping and removal of cowbirds where rates of brood parasitism are high may increase productivity of Bell's vireo.

Current protective measures: This species is protected under the Migratory Bird Treaty Act. The Migratory Bird Treaty Act makes it unlawful to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird, including feathers, parts, nests, or eggs. Violations of the Migratory Bird Treaty Act are considered criminal offenses and can result in significant fines and imprisonment. Habitat protection is afforded by the various county and local wash protection and floodplain ordinances and by Section 404 of the Federal Clean Water Act.

Corridor needs: There is no known information on corridor requirements.

Key relationships: Arizona Bell's vireo is a riparian-obligate and requires dense riparian habitat to persist and breed. However, the species of plants that make up that habitat vary throughout the species range. It requires insects for its diet, but appears to be an opportunistic gleaner. It has an adverse relationship with the brown-headed cowbird.

Migratory requirements: Bell's vireo leaves the northernmost limits of its breeding range in August or September, although southern populations (such as in southern Arizona) may depart as late as November. The species overwinters primarily along the Pacific coast of southern Mexico. Spring migrants begin to return to the breeding range from early to mid-March (Brown 1993).

Existing monitoring and research programs: No specific monitoring and research programs for this species are currently known, but it is recorded by the Tucson Bird Count (2012) along select washes and river of the Tucson Basin. Annual surveys at Organ Pipe Cactus National Monument (2006a) occasionally record this species.

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-18): 72.

Acres of mitigation habitat within the current portfolio of conservation lands: 8,244.

Determination of Incidental Take

Pima County anticipates that take of the Arizona Bell's vireo will be difficult to detect because of the large Permit Area; the secretive nature of the species; its small body size; losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); and natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as invasive species, etc. Therefore, Pima County will use acres of PCA habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of Arizona Bell's vireos. Effects to habitat can result in the following impacts to the Arizona Bell's vireos: collision with vehicles and equipment; increased occurrence of non-native predators; direct impacts to nests; abandonment of nests due to noise, activity, light, etc; loss of riparian vegetation as breeding, feeding and sheltering habitat; injury or death of nestlings or young if they are abandoned or fall or are forced from nests; being forced into suboptimal habitat or already-occupied habitat; increased erosion and sedimentation affecting life history requirements; increased predation; and starvation and reduced reproductive output due to reduced habitat quality and increased competition.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Arizona Bell's vireo:

- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Identify and pursue opportunities for restoration of mesquite bosques and xeroriparian vegetation communities on appropriate County-controlled mitigation lands.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

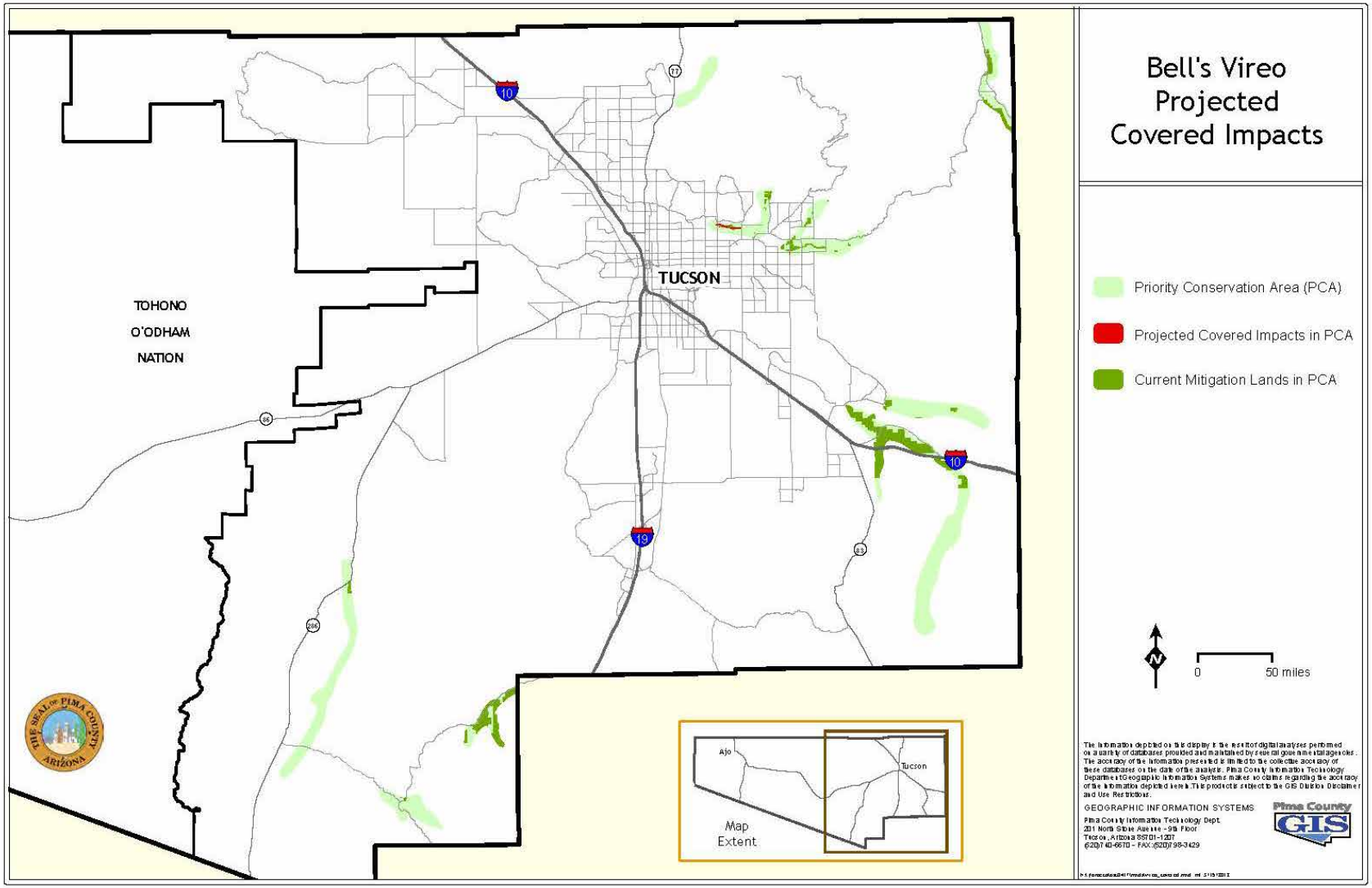


Figure A-18. Map of projected impacts and mitigation for the Arizona Bell's vireo.

Southwestern willow flycatcher (*Empidonax traillii extimus*)

Conservation Status

Endangered Species Act Status: Listed as Endangered in 1995, critical habitat originally designated in 1997 and was revised and redesignated in 2013 (U.S. Fish and Wildlife Service 2013a).

State: Wildlife of Special Concern in Arizona.

Other: U.S. Forest Service Sensitive Species; Listed as a migratory bird under the Migratory Bird Treaty Act.

Rankings: G5, S1.

Description

The southwestern willow flycatcher is a small bird, approximately 5.75 inches (15 cm) long. The body is brownish olive to grayish green on the upper parts with a pale olive breast, pale yellow belly, and whitish throat, and two white wing bars. An eye ring may be faint or absent. The bill is relatively large, the maxilla dark and the mandible usually entirely yellow or pale orange, and it often has a dusky tip. Both sexes are alike. The species is most easily identified by its vocalizations (Arizona Game and Fish Department 2002d).

Distribution and Trend

Southwestern willow flycatchers are known from southern Nevada, southern Utah, southern California, most of Arizona and New Mexico, western Texas, and southwestern Colorado (Finch and Stoleson 2000). They winter in Mexico, Central America, and/or northern South America (Arizona Game and Fish Department 2002d).

In Arizona, willow flycatchers have been documented along 12 drainages. The major concentrations have occurred near the confluence of the Gila and San Pedro Rivers, Roosevelt Lake, Alamo Lake, Topock Marsh, the lower Grand Canyon, the Gila River, and Camp Verde. Three high elevation sites were also documented, 2 on the Little Colorado River near Greer and 1 on the San Francisco River near Alpine (Paradzick et al. 2000). The species has relatively high breeding densities in Arizona along the San Pedro River at the confluence with the Gila River (Pinal County) (Ellis et al. 2008), and it has been documented breeding at Redington, along the San Pedro in Pima County in 1998 (Arizona Game and Fish Department 2002d). It has also been documented as a breeder along Upper Cienega

Creek in Pima County, though only sporadic records exist (Finch and Stoleson 2000). Surveys along the Santa Cruz River in recent years have not found any breeding individuals (Scott Wilbor, in personal communication to the Town of Marana, 2009). For Pima County-owned and managed lands, the southwestern willow flycatcher has not been found during recent surveys at the Cienega Creek Natural Preserve in 2008, 2010 (Rodden 2010) and 2014 (Brian Powell and Susan Sferra, *unpublished data*).

The subspecies suffered a significant decline in numbers and distribution, which led to the USFWS decision to list the species in 1993 (U.S. Fish and Wildlife Service 1995a). Since its listing, considerable attention went into surveying for the species. In Arizona, for example, the number of known territories increased from 111 at the time of listing to 1,214 in 2005 (Durst et al. 2007), an increase that was probably due to increased survey effort.

Habitat Requirements

Breeding southwestern willow flycatchers are riparian obligates; they typically establish territories and nest in relatively dense riparian vegetation where surface water is present or soil moisture is high enough to maintain the appropriate vegetation characteristics. Beyond these generalities, the flycatcher shows adaptability in habitat selection, as the dominant plant species (both native and exotic), size and shape of breeding territories, and canopy height and structure for foraging and nesting can be variable (Paradzick 2005; Paxton et al. 2007; Bakian et al. 2012). This use of diverse plant species suggests that vegetation structure, not species composition, is the most important feature of flycatcher habitat. Vegetation characteristics of southwestern willow flycatcher breeding habitat generally include high canopy or midstory cover, dense twig structure, and high levels of live green foliage (Hatten and Paradzick 2003). Flycatchers appear to prefer young habitat, and have bred in some riparian patches that were only 3 years of age. However, they will occupy older habitat, perhaps as refugia until younger habitat becomes available. The use of vegetation communities appears to differ by elevation. Low-elevation sites were characterized by two vegetation types: (1) mixed native/exotic associations and (2) monotypic exotic habitat dominated by dense stands of tamarisk forming a nearly closed canopy (Paradzick et al. 2000). A large proportion of seemingly suitable habitat remains unoccupied.

Current and Potential Threats

General: Historic habitat loss and degradation was the cause of population declines that led to the species' listing under the ESA (U.S. Fish and Wildlife Service 1995a). These threats continue and other threats include fluvial geomorphic changes and corresponding modification of vegetation, overgrazing, cowbird parasitism, fire, predation, and human disturbance (Arizona Game and Fish Department 2002d). Changes in the operation of the Roosevelt Dam will likely impact the species in the short-term, but the perhaps the most significant change for the species may be the recent introduction of the saltcedar leaf beetle (*Diorhabda elongate)* into many areas along the Colorado River. Because the flycatcher utilizes tamarisk as nesting sites, loss of tamarisk may negatively impact the flycatcher (Paxton et al. 2011), though if former

tamarisk-dominated sites can be restored back to native vegetation, this may ultimately benefit the flycatcher.

Existing and potential pest species: Brown-headed cowbird parasitism rates can be high for this species (Stoleson and Finch 2000).

Management Needs

General: The highest priority is for protection of occupied and potential willow flycatcher habitat. Riparian areas with little or no survey effort need to be identified and surveys conducted. Coordinated surveys and research studies for this species have been done since 1993 in Arizona and data have revealed a lot of information on the nesting requirements of the species (Finch and Stoleson 2000; Paradzick et al. 2000; Hatten and Paradzick 2003; Durst 2004; Paradzick 2005; Sogge et al. 2005; Durst et al. 2007; Hatten and Sogge 2007; Ellis et al. 2008).

Current protective measures: The species and its habitat are protected under the Endangered Species Act, local wash or floodplain ordinances, and public land management agency policies. This species is also protected under the Migratory Bird Treaty Act. The Migratory Bird Treaty Act makes it unlawful for anyone to kill, capture, collect, possess, buy, sell, trade, ship, import, or export any migratory bird, including feathers, parts, nests, or eggs. Violations of the Migratory Bird Treaty Act are considered criminal offenses and can result in significant fines and imprisonment.

Corridor needs: There is no specific information available on the corridor or migratory requirements of this species' biology, but it is assumed that riparian corridors are used for migration. Because of the mobile nature the species, occupying new habitat is not likely to be a problem.

Key relationships: Southwestern willow flycatchers are early-successional obligates in mesic riparian systems, but they also use mature tamarisk forests for nesting.

Existing monitoring and research programs: Surveys and monitoring studies have been done under the coordination of the AGFD and USFWS since 1993. No long-term monitoring is taking place in Pima County, but considerable effort is focused on the confluence of the San Pedro and Gila rivers in adjacent Pinal County (Ellis et al. 2008).

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-19): 0.

Acres of mitigation habitat within the current portfolio of conservation lands: 420.

Determination of Incidental Take

Though no habitat take is modeled, take (especially at the level of individuals) is still possible for the southwestern willow flycatcher, but it will be difficult to detect because of its small body size and natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is possible from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as invasive species. As noted, direct impacts to acres of PCA habitat by covered activities is not modeled, but is still possible, and the protection of habitat will effectively mitigate take not associated with habitat impacts. Therefore, habitat can still be used as a surrogate for the incidental take of southwestern willow flycatchers. Effects to habitat can result in the following impacts to the southwestern willow flycatchers: collision with vehicles and equipment; direct impacts to nests; abandonment of nests due to noise, activity, etc; loss of riparian vegetation as breeding, feeding and sheltering habitat; injury or death of nestlings or young if they are abandoned or fall or are forced from nests; being forced into suboptimal habitat or already-occupied habitat; increased erosion and sedimentation affecting life history requirements; increased predation; and starvation and reduced reproductive output due to reduced habitat quality and increased competition.

Impact of Covered Activities on Critical Habitat

A portion of the southwestern willow flycatcher's critical habitat occurs in northeastern Pima County along the San Pedro River. The USFWS proposed expanding the critical habitat designation to include areas along Cienega Creek in the Las Cienegas National Conservation Area that are upstream of Pima County' Cienega Creek Natural Preserve (U.S. Fish and Wildlife Service 2013a). A final designation of critical habitat occurred in January 2013 (78 FR 344). Due to the location of the species' critical habitat in a reserve or conservation area, there are no projected direct or indirect impacts on the species' critical habitat as a result of the Covered Activities. Pima County is proposing approximately 360 acres of critical habitat as mitigation.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the southwestern willow flycatcher:

- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- For County-controlled mitigation lands, enact a 100 m buffer "restricted activity zone" around known nests during the nesting period. Only short duration "pass through" activities will be allowed.
- Develop management guidelines for County-controlled mitigation lands that include efforts to reduce impacts from feral pets (e.g., cats and dogs), recreation, shooting, invasive species, etc. in the vicinity of occupied habitat.
- Protect all known and potential habitat for this species on County-controlled mitigation lands as described in Chapters 4 and 5.
- Acquire and protect water rights to maintain and restore habitat, where appropriate.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

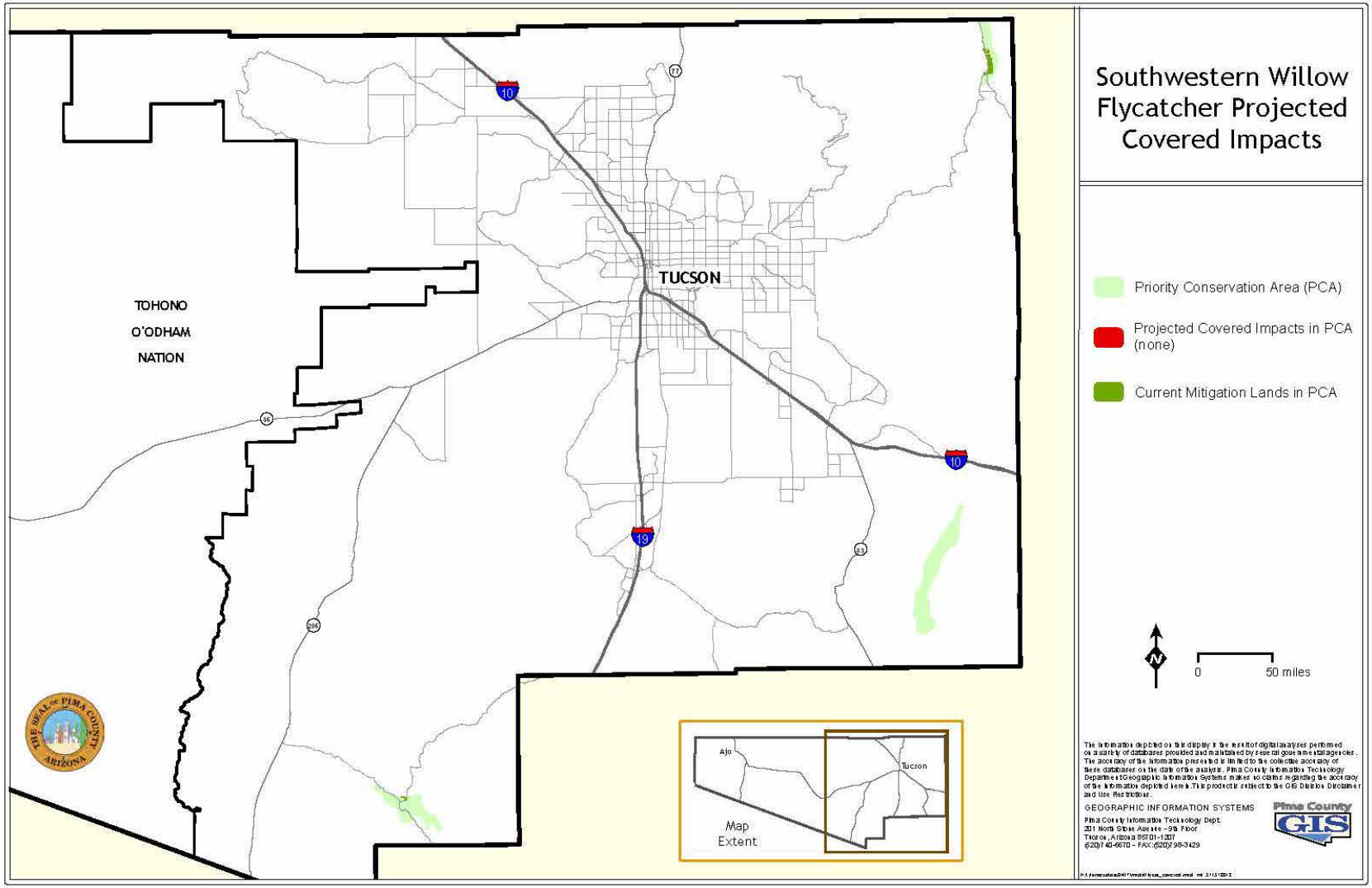


Figure A-19. Map of projected impacts and mitigation for the southwestern willow flycatcher.

Fishes

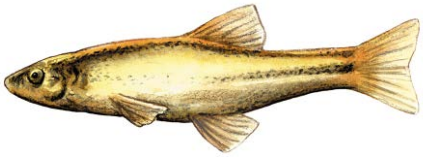
Longfin Dace (*Agosia chrysogaster*)

Conservation Status

Endangered Species Act Status: None. Former candidate for Category 2 listing.

State: None.

Other: USFWS Species of Concern; U.S. Forest Service Sensitive Species. Special protection in Mexico.

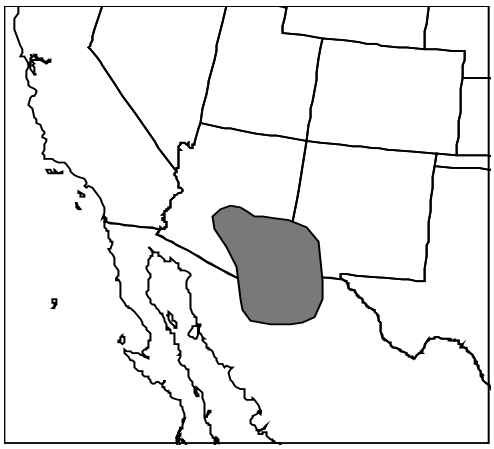


Rankings: G4; S3,S4.

Description

The longfin dace is a small silvery fish that is usually found in water with a sandy substrate. The body of the longfin dace is fusiform, with small scales. Adults rarely exceed 2.6 inches (6.5 cm) standard length. There are approximately 70 to 90 scales in the lateral line. The head is thick and blunt, and the mouth is small, subterminal, oblique; overhung by a bluntly rounded snout; the mouth terminates posteriorly at a point under the nares. The back and upper sides are silvery gray to olive, sides sometimes with golden flecks; the lower sides and abdomen are whitish, and the peritoneum black. A diffuse, dusky lateral stripe originates at the upper corner of the opercule, terminating in a black spot at the base of the caudal fin.

Distribution and Trend



The longfin dace was historically found throughout large areas of Arizona, New Mexico, and northwestern Mexico (Arizona Game and Fish Department 2006a). The longfin dace is currently found in a broad area that consists of disjunct populations. It is known to be present in the Bill Williams and Gila River drainages in Arizona and New Mexico; south into Sonora, Mexico (coastal streams and Rio Yaqui basin), the Rio Sinaloa, Mexico, and perhaps farther south (Arizona Game and Fish Department 2006a). It is native to the Gila River basin (including the San Francisco River), the Bill Williams, Yaqui, Magdalena, and Sonoyta drainages and has been introduced into the Virgin River basin, Arizona, and into the Zuni and Mimbres rivers, New Mexico, and the Rio Grande basin, New Mexico (Biota Information System of New Mexico 2000; Arizona Game and Fish Department 2006a).

Known populations of the longfin dace in Pima County occur in: (1) Cienega Creek Natural Preserve and further upstream in Las Cienegas National Conservation Area (Rosen and Schwalbe 1988; Simms et al. 2006; Bodner et al. 2007); (2) Buehman Canyon (including lands owned by Pima County); (3) upper reaches of the Canada del Oro; and in Arivaca Creek. There are populations upstream of Pima County in the Santa Cruz River (Voeltz and Bettaso 2003; Powell et al. 2005) and following significant floods, individuals may potentially become established in the Santa Cruz River in Pima County. They were reintroduced to Bingham Cienega Preserve in 2006 but have since been lost, because that site is now dry.

Habitat Requirements

The habitat of longfin dace is variable, ranging from intermittent hot low-desert streams to clear and cool higher elevations streams. They tend to occupy relatively small or medium size streams, with sandy or gravely bottoms; eddies, pools near overhanging banks or other cover (Arizona Game and Fish Department 2006a). Usually in water less than 6 inches (0.2 m) deep with moderate velocities of around 1.1f/s (0.3m/s). They are rarely abundant in large streams or above 5,000 ft (1524 m). Generally found in water less than 75° F (24° C), but are tolerant of high temperatures and low dissolved oxygen. During low water, they may take refuge in moist detritus and algal mats (Sublette et al. 1990).

Current and Potential Threats

Suitable aquatic areas in Pima County have been significantly reduced and widespread alteration of hydrologic regimes has occurred as a result of groundwater pumping, drought, and climate change. Many watercourses that likely supported longfin dace at one time no longer have perennial flows that can sustain viable populations, rather they convey water only during storm events. Therefore, continued loss of perennial stream habitat will negatively impact this species. Flood control programs and groundwater pumping may contribute to the drying-out of suitable stream habitat and overgrazing may impact habitat quality.

Existing and potential pest species: Longfin dace are known to be vulnerable to 5 species of native parasites (Mpoame and Rinne 1983). The most dangerous parasite appears to be *Ichthyophthirius multifiliis*, of which epizootic outbreaks appear to be common in streams throughout Arizona. Other parasites found on longfin dace include: *Myxobolus macrocapsularis*, *Rhabdochona decaturensis*, *Rhabdochona* sp., and *Lernaea cyprinacea* (Mpoame and Rinne 1983). Like all native fish, longfin dace are subject to predation by non-native and invasive fish, frogs, and crayfish.

Threat mechanism: Loss of stream habitat through water management practices or high water consumption; also, natural flood events can decimate local populations, as can non-native species.

Management Needs

General: Protection of existing occupied habitat should continue, and transplantation to recovered suitable habitat may be appropriate. Invasion of non-native fishes should be

prevented, and existing populations of non-native fish and other species (if any) in this species' habitat should be eliminated.

Current protective measures: All known habitat for this species in Pima County is under some form of protection.

Corridor and migratory needs: The species is reliant on intact stretches of streams for dispersal, though they can seek refuge in small pools for long periods of time. Long-term metapopulation dynamics probably requires at least occasional connection between isolated local populations and flood events will disperse or displace the species downstream to other locations.

Key relationships: None are specifically known.

Existing monitoring and research programs: Long-term monitoring of this species in Pima County and surrounding areas has occurred as a result of a number of efforts. Monitoring is undertaken throughout central and southern Arizona as part of the Central Arizona Project's non-native species detection effort (Marsh et al. 2009; Clarkson et al. 2011). This monitoring takes place in the Cienega Creek Preserve. The BLM monitors for this and other native species annually at Las Cienegas National Conservation Area (Simms et al. 2006). Monitoring for this and other native species has occurred annually in Aravaipa Canyon since 1970 (Eby et al. 2003). Finally, the species is periodically monitored at the Muleshoe Ranch (Cochise County) (Brunson et al. 2001).

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-20): 0.

Acres of mitigation habitat within the current portfolio of conservation lands: 4,868.

Determination of Incidental Take

Pima County anticipates that take of longfin dace will be difficult to detect because of the species' small body size; losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, increased human activity, and indirect impacts such as subsequent erosion. Though direct impacts to acres of PCA habitat by covered activities are not modeled (see Table 3.3 of the MSCP), impacts to habitat are still possible, and the protection of habitat will effectively mitigate take not associated with habitat impacts. Therefore, habitat will be used as a surrogate for the incidental take of longfin dace. Effects to habitat can result in the following impacts to longfin dace; direct impacts to nests in stream bottoms; increased predation; increased occurrence of non-native competitors and predators (e.g., bullfrogs, sunfish, and crayfish); increased erosion and sedimentation affecting life history requirements; starvation and reduced

reproductive output due to reduced habitat quality and increased competition; effects to stream flow resulting in reduced pool and surface water habitats, loss of aquatic vegetation as breeding, feeding and sheltering habitat; habitat fragmentation preventing or reducing the ability of species to move, disperse, or migrate to meet life history needs; spread of diseases that can result in mortality or reduce health and productivity; etc.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the longfin dace:

- Work with AZGFD to carry out the County's intention to reestablish longfin dace (as articulated in the Riparian and Aquatic Species Management Plan) on mitigation and County-owned lands;
- Continue current effort to obtain surface-water rights for wildlife in Buehman Canyon;
- Support Outstanding Waters protection by ADEQ for Cienega Creek, Davidson Canyon and Buehman Canyon;
- Place restrictive covenants or conservation easements on County-controlled mitigation lands as described in Chapter 4.
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

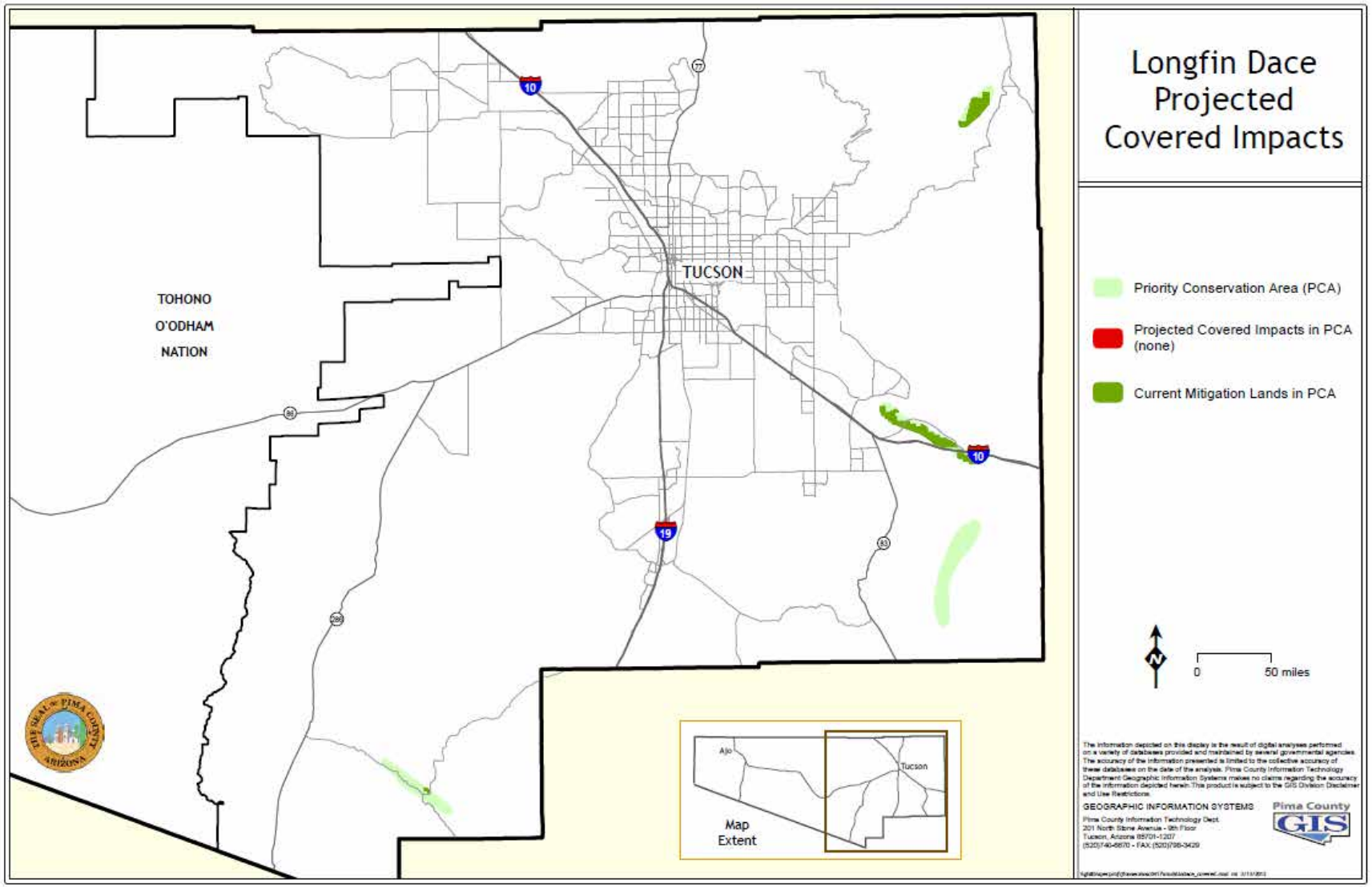
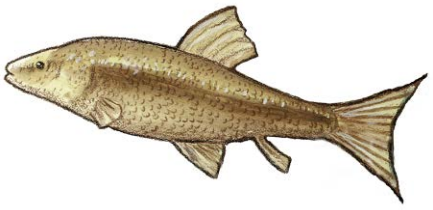


Figure A-20. Map of projected impacts and mitigation for the longfin dace.

Gila chub (*Gila intermedia*)



Conservation Status

Endangered Species Act Status: Listed as Endangered in 2002. Critical habitat designated in 2005 (U.S. Fish and Wildlife Service 2005a).

State: Wildlife of Special Concern in Arizona.

Other: State Endangered in New Mexico; U.S. Forest Service Sensitive Species; Listed Endangered in Mexico.

Rankings: G2, S2.

Description

The Gila chub is a small-finned, deep-bodied, chunky and dark colored minnow (Weedman et al. 1996). Females are typically larger than males and attain lengths up to approximately 9.8 inches (25 cm); males are rarely greater than 5.9 inches (15 cm) in length. The scales are large, thick, and broadly overlap, and usually have prominent growth rings. The lateral-line scales are almost always fewer than 80. Dorsal fin-rays are usually 8 or fewer (rarely 9); anal fin-rays are 8 or fewer; and pelvic fin-rays number 8 or 9. An abrupt, soft, and fatty nuchal hump sometimes develops in large females of some populations. The total vertebrae vary from 38-45, but are usually fewer than 42. Diffuse lateral bands are rarely present and there is no basicaudal spot. Breeding males are red or orange on the lower cheek and posterior parts of lips, paired fin bases, and on the ventro-lateral surfaces including the caudal peduncle.

The Gila chub is similar in appearance to the roundtail chub, *Gila robusta*, but can be distinguished by having a chunkier body type. In addition, the length of head measured from terminus to posterior edge of operculum divided by the minimum depth of caudal peduncle is usually less than 3.0 (Arizona Game and Fish Department 2002e).

Distribution and Trend

The Gila chub is currently known from the following drainages: Santa Cruz River (Cienega Creek, Sabino Canyon, Sheehy Spring), Middle Gila River (Eagle, Bonita and Harden Cienega Creeks and San Carlos and Blue Rivers), San Pedro River (Bass, O'Donnell and Redfield Canyons, Babocomari River and Turkey Creek), Agua Fria River (Silver and Sycamore [rare] Creeks), Verde River (Spring and Walker Creeks). Gila chub populations were extirpated from Monkey Spring (Santa Cruz River), and Fish and Cave Creeks (Salt River) (Weedman et al. 1996). The

distribution of the Gila chub in Pima County is very restricted and is found only in Sabino Creek (Dudley and Matter 2000), and Cienega Creek (Marsh et al. 2010), including the County's Cienega Creek Natural Preserve.

The Gila chub has experienced a decline in distribution and abundance. The species' historical range likely included suitable habitat throughout the entire Gila River basin except the Salt River drainage above Roosevelt Lake. Records include rivers, streams, and stream-fed tributaries in Arizona, New Mexico, and northern Sonora, Mexico. In Arizona, occupied habitats included suitable cienegas and small tributaries, as well as artificial habitats such as Buckeye Canal (Weedman et al. 1996). By 1973, populations of Gila chubs had declined throughout their range (Minckley 1973). The species is found in only one drainage in New Mexico (Carman 2006). In Arizona, populations of Gila chub (e.g., Turkey Creek) have been disappearing (Arizona Game and Fish Department 2002e), but at the Cienega Creek Preserve they were noted in 2003 for the first time since the County acquired the property in 1986. Agradation of some pool habitat in 2014 and 2015 may have negatively impacted this population (Pima County, unpublished data).

Habitat Requirements

Home range requirements: Gila chubs are normally found in small headwater streams, cienegas and springs, or marshes of the Gila River basin. They utilize diverse habitat types based on the season and age of the fish. Adults have been collected from deep pools with heavily vegetated margins and undercut banks. Juveniles have been collected from riffles, pools and undercut banks of runs (Arizona Game and Fish Department 2002e). Gila chubs have an affinity for deeper pools in slow velocity water and are almost always associated with cover such as undercut banks, root wads, and instream debris piles (Biota Information System of New Mexico 2008e). In larger stream systems they utilize heavily vegetated backwaters for cover and feeding. The limit of their elevational range is unknown (Arizona Game and Fish Department 2002e).

Current and Potential Threats

General: Alteration of habitat from groundwater pumping, climate change, and drought, along with introduction of non-native predators has caused significant declines in Gila chub populations throughout their former range (U.S. Fish and Wildlife Service 2005a). Suitable aquatic areas in Pima County have been significantly reduced and widespread alteration of hydrologic regimes within watersheds has taken place in the last century. Many watercourses that likely supported Gila chub at one time no longer have the perennial flows required for the species' existence; rather they convey water only during storm events.

Existing and potential pest species: The inability of Gila chub populations to reproduce successfully and thrive after the introduction of green sunfish was documented at Sabino Canyon by Dudley and Matter (2000). Many water bodies in Pima County have been colonized by a wide array of other non-native species that may contribute to the decline of the chub. These may include the following: introduced plants such as saltcedar (*Tamarix ramosissima*), which alter hydrology and change habitat

characteristics; invertebrates such as the Asian clam (*Corbicula fluminea*) and crayfish (*Orconectes* sp.); amphibians such as the bullfrog (*Lithobates catesbeianus*); and numerous other non-native fish such as smallmouth bass (*Micropterus dolomieu*) (Weedman 1998). Additionally, parasites introduced incidentally with nonnative species may jeopardize Gila chub populations (U.S. Fish and Wildlife Service 2002).

Threat mechanism: Loss or degradation of habitat due to water diversion and groundwater depletion, dam and reservoir construction, increased peak flood discharges, and increased sedimentation; and negative interactions with competitive and predatory non-native fishes (Weedman et al. 1996).

Management Needs

General: Detection and control of non-native species in streams and other aquatic habitats that support Gila chub is critical. Land management activities that affect watersheds, alter stream flow characteristics or affect the amount of perennial water in streams may be detrimental to populations of Gila chub, especially those activities that increase erosion and degrade stream banks (Arizona Game and Fish Department 2002e). In areas that have been modified, steps should be taken to restore aquatic habitat, where necessary.

Current protective measures: Habitat restoration projects are ongoing at Las Cienegas National Conservation Area and Empire-Cienega Ranch and Pima County protects Cienega Creek Natural Preserve. The state water-quality standards provide limited protection through the Outstanding Waters designations applied to Cienega Creek. The Federal government's Section 404 requirements and Endangered Species Act also provide protection for this species and its aquatic habitat.

Corridor and migratory needs: Dispersal corridors within rivers and streams must be available for this species to become reestablished within former portions of its range. Currently, Gila chub populations are effectively isolated by ephemeral reaches of stream or in-channel structures that impede movement and harbor predatory non-natives (Weedman et al. 1996). Removal of aggressive non-native fish and other species such as crayfish and bullfrogs within these corridors may be necessary for any level of long-term success.

Key relationships: Historically, Gila chub were commonly found in association with Gila topminnow, desert sucker, Sonora sucker, longfin dace, and speckled dace. The plant community that characterizes habitat where this species is found is broadleaf riparian vegetation consisting of cottonwood, willow, ash, alder, sycamore, walnut, and *Baccharis* spp. in association with submerged aquatic vegetation typical of cienega/marsh habitats (Arizona Game and Fish Department 2002e). A major cause of decline of Gila chub populations is the introduction of non-native species, discussed above.

Existing monitoring and research programs: Long-term monitoring of this species in Pima County and surrounding areas has occurred as a result of a number of efforts. Monitoring is undertaken throughout central and southern Arizona as part of the Central

Arizona Project's non-native species detection effort (Marsh et al. 2009; Clarkson et al. 2011). This monitoring takes place in the Cienega Creek Preserve. The BLM monitors for this and other native species annually at Las Cienegas National Conservation Area (Simms et al. 2006). Also, monitoring for this and other native species has occurred annually in Aravaipa Canyon since 1970 (Eby et al. 2003). Finally, the species is periodically monitored at the Muleshoe Ranch (Cochise County) (Brunson et al. 2001).

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-21): 0.1.

Acres of mitigation habitat within the current portfolio of conservation lands: 3,556.

Determination of Incidental Take

Pima County anticipates that take of Gila chub will be difficult to detect because of the species' small body size; losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

Despite the very small percentage of an acre that might be impacted by Covered Activities, incidental take in the form of harm, harassment, and mortality is nevertheless anticipated from land clearing, habitat fragmentation, increased human activity, and indirect impacts such as subsequent erosion. Though direct impacts to acres of PCA habitat by covered activities are very small, impacts to additional habitat are still possible, and the protection of habitat will effectively mitigate take not associated with habitat impacts. Therefore, habitat will be used as a surrogate for the incidental take of Gila chub. Effects to habitat can result in the following impacts to Gila chub; direct impacts to nests in stream bottoms; increased predation; increased occurrence of non-native competitors and predators (e.g., bullfrogs and crayfish); increased erosion and sedimentation affecting life history requirements; starvation and reduced reproductive output due to reduced habitat quality and increased competition; effects to stream flow resulting in reduced pool and surface water habitats, loss of aquatic vegetation as breeding, feeding and sheltering habitat; habitat fragmentation preventing or reducing the ability of species to move, disperse, or migrate to meet life history needs; spread of diseases that can result in mortality or reduce health and productivity; etc.

Impact of Covered Activities on Critical Habitat

Critical habitat for the Gila chub was designated in several sections of watercourses in Pima County: Sabino Canyon (Coronado National Forest), Cienega Creek (Pima County-owned lands, Las Cienegas National Conservation Area, and Arizona State Land), and Mattie Canyon and Empire Gulch (U.S. Fish and Wildlife Service 2005a). Conservation in these areas is achieved by Federal agencies and, in the case of the County-owned portion of Cienega Creek Natural Preserve, by the County's implementation of the Cienega Creek Management Plan (McGann and Associate Inc. 1994). Approximately 0.1 acre of critical habitat is expected to be impacted by the Covered Activities.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Gila chub:

- Work with AZGFD and USFWS to carry out the County's intention to reestablish Gila chub (as articulated in the Riparian and Aquatic Species Management Plan) on mitigation and County-owned lands;
- Seek to prohibit Pima County Health Department from using the nonnative mosquitofish for mosquito control in watershed tributaries that are contiguous to reintroduction sites as well as in the Cienega Creek watershed upstream of Colossal Cave Road.
- Support protection of Cienega Creek water quality via ADEQ's Outstanding Waters program;
- Identify and address management of non-native aquatic organisms through management plans and ranch infrastructure projects on County-controlled mitigation lands in the Cienega Creek watershed.
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

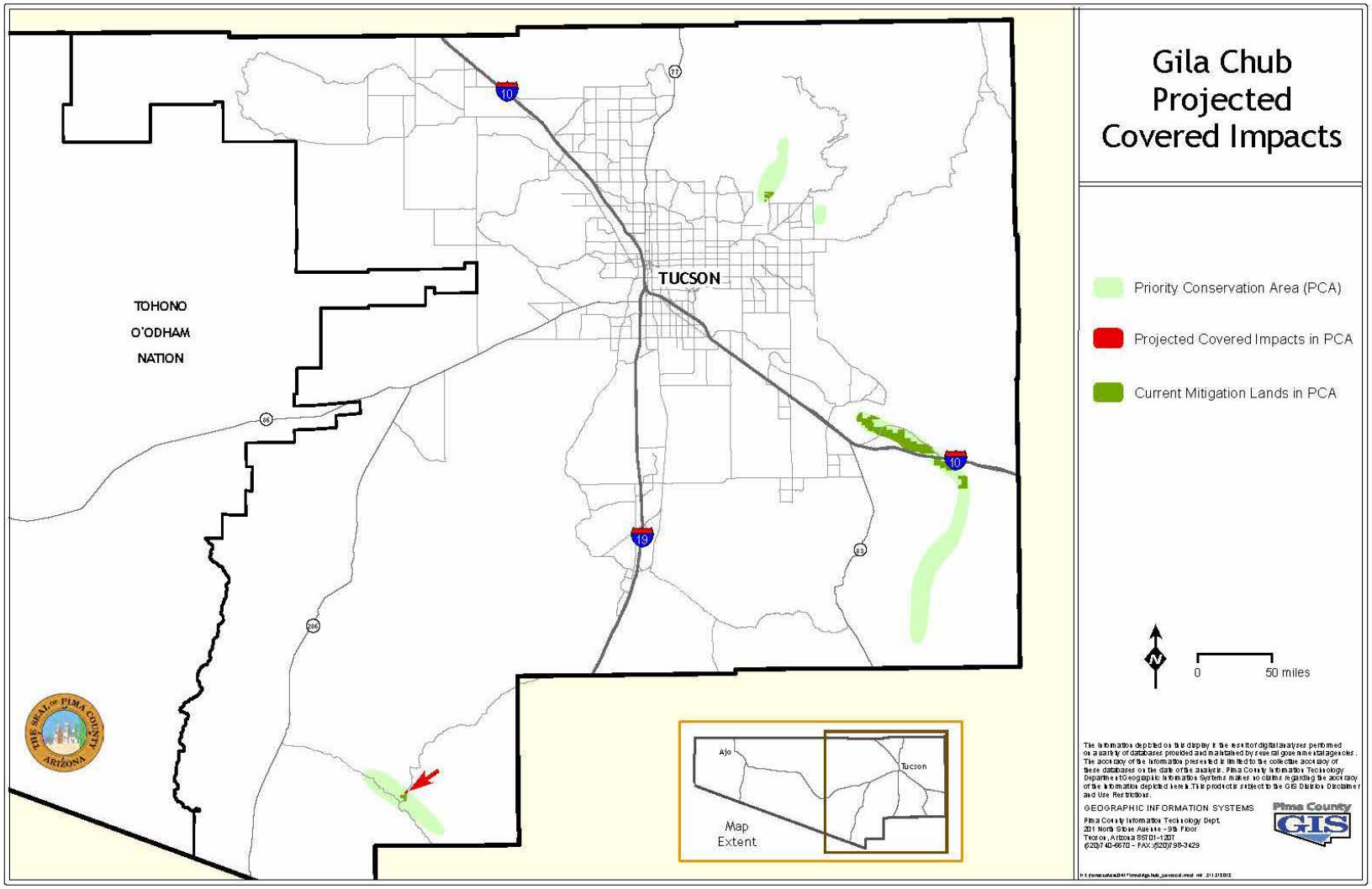


Figure A-21. Map of projected impacts and mitigation for the Gila chub.

Gila topminnow (*Poeciliopsis occidentalis occidentalis*)

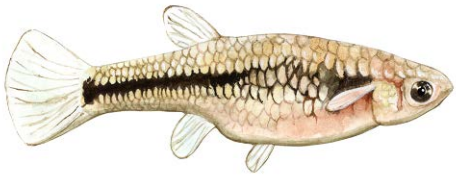
Conservation Status

Endangered Species Act Status: Listed as Endangered in 1967.

State: Wildlife of Special Concern in Arizona.

Other: U.S. Forest Service Sensitive Species; Threatened in Mexico.

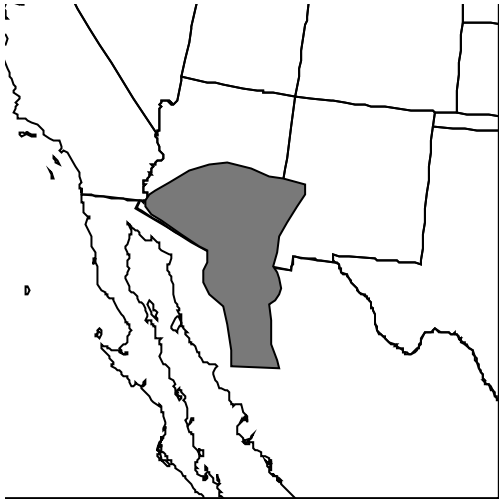
Rankings: G3, S2



Description

The Gila topminnow is a small fish that is generally tan- to olive-colored, with darker dorsal coloration and a light to whitish ventral coloration. A dark band is present along both sides of the body. Scales on the dorsum are darkly outlined and extend as black speckles to the upper belly and pre-pectoral area. The dorsal profile is slightly curved and the body is somewhat elongated. The caudal fin is rounded to almost square. The fins are characterized by rays that are outlined with melanophores and lack dark spots. Breeding males are blackened with varying degrees of golden coloration in the pelvic, pectoral, and caudal fins and in the front of the body along the midline. Orange coloration is present at the base of the gonopodium. Males are smaller than the females and rarely measure more than 1 inch (2.5 cm) standard length; the females sometimes reach lengths of 2 inches (5 cm) or more, but are usually 1.2 to 1.8 inches (3.0 to 4.5 cm.) standard length (Minckley 1973).

Distribution and Trend



Weedman (1998) cited reports that the Gila topminnow was once the most common fish in the Gila River Basin, but that there was a well-documented decline of the species once the basin was settled by historic settlements. Historically the subspecies was found in most perennial springs and streams, and along the vegetated margins of rivers within the Gila River drainage in Yavapai, Gila, Pinal, Maricopa, Graham, Greenlee, Cochise, Pima, Santa Cruz and Yuma Counties (AGFD 2009a). By 1994, the Gila topminnow was restricted to 10 known populations in widely separated, isolated locations (Weedman and Young 1997). Currently, nine naturally occurring localities are known to support Gila topminnows within Arizona (Arizona Game and Fish Department 2001i). The species is still widespread in some river drainages in Sonora, Mexico (Weedman et al. 1998). The only stable populations of the Gila topminnow in Pima County are along stretches of Cienega Creek including the County-

owned Cienega Creek Natural Preserve (Weedman and Young 1997; Voeltz and Bettaso 2003; Simms et al. 2006; Bodner et al. 2007). Numerous reintroductions have occurred for this species in Pima County, but these efforts have had limited success (Constantz 1979; Weedman and Young 1997; Sheller et al. 2006). There are populations upstream of Pima County in the Santa Cruz River (Voeltz and Bettaso 2003; Powell et al. 2005) and following floods, individuals may potentially establish in the Pima County reach of the river. Captive-bred populations can be found throughout the County.

The Gila topminnow was once a widespread and abundant fish in southern Arizona that has steadily declined to a small number of disjunct populations. According to Weedman et al. (1998), more than 350 Gila topminnow stockings to wild and captive localities have been executed. These included 206 reintroductions at 178 wild locations. Successfully re-established populations have resulted in from about 8% of these efforts (Weedman and Young 1997).

Habitat Requirements

The basic habitat requirement for the Gila topminnow is water that is permanent and free from non-native predators. Beyond that, habitat requirements of Gila topminnows are broad. The subspecies historically occupied headwater springs and vegetated margins and backwater areas of intermittent and perennial streams and rivers. Topminnows can withstand water temperatures from near freezing to 90-100 degrees Fahrenheit (32-38 degrees Celsius) (Arizona Game and Fish Department 2001i; Carveth et al. 2006). Weedman et al. (1998) cited reports that Gila topminnows can live in a fairly wide range of water chemistry conditions, with pH's ranging from 6.6 to 8.9, dissolved oxygen readings from 2.2 to 11 mg/l, salinities from tap water to sea water and that topminnows can temporarily tolerate almost total loss of water by burrowing into mud for 1 to 2 days. Preferred habitats contain dense mats of algae and debris, usually along stream margins or below riffles, with sandy substrates sometimes covered with organic mud and debris (Minckley 1973). Gila topminnows are restricted to springs, cienegas, permanent and interrupted streams, and margins of large rivers (Weedman et al. 1998).

Current and Potential Threats

General: Like other fish species covered under this MSCP, the Gila topminnow is faced with a variety of threats including: irrevocable loss of habitat and habitat degradation from drought, climate change, and groundwater pumping; and non-native species introductions (Weedman et al. 1998).

Existing and potential pest species: The inability of Gila topminnow populations to survive and thrive after the introduction of mosquitofish (*Gambusia*) has been well documented (Weedman et al. 1998). Pima County water bodies have been planted with a wide array of other non-native species that may also reduce their suitability to support the Gila topminnow. These include introduced plants such as saltcedar (*Tamarix ramosissima*) and water primrose (*Ludwigia peploides*) which alter hydrology and change habitat characteristics; invertebrates such as the Asian clam (*Corbicula*

fluminea) and crayfish (*Orconectes* sp.); amphibians such as the bullfrog (*Lithobates catesbeianus*); and numerous additional non-native fish such as smallmouth bass (*Micropterus dolomieu*), green sunfish (*Lepomis cyanellus*), and western mosquitofish (Weedman et al. 1998).

Threat mechanism: Habitat alteration and destruction, and introduction of predaceous non-native fish, principally mosquitofish, are the main reasons for decline of the Gila topminnow (Weedman et al. 1998). Introduction of other non-native species, including crayfish and bullfrogs, have likely contributed to the decline of this species as well.

Management Needs

General: Protection of remaining extant populations is critical to the survival of the species. The revised recovery plan for the Gila topminnow (Weedman et al. 1998) identifies the following actions:

- reintroduction and protection of populations throughout the historic range and monitoring of both natural and re-introduced populations should be continued;
- a protocol for managing populations including protection of genetic integrity should be developed and implemented;
- further studies of the life-history, genetics, ecology and habitat of Gila topminnow and interactions with non-native species should be conducted; and
- the public and resource managers should be informed and educated regarding the subspecies.

The Arizona Game and Fish Department (2001i) recommends that land management activities such as mining, grazing, fuel-wood cutting, logging, etc., should be evaluated in relation to site-specific characteristics, as these activities can have either a positive or negative effect on Gila topminnow populations due to timing, intensity or other activity-related factors. In addition, managers should reevaluate the use of mosquitofish for use in mosquito control and instead consider the use of Gila topminnow, which has been shown to be just as effective for mosquito control (Childs 2006).

Current protective measures: Endangered status for this species affords Federal protection under the Endangered Species Act. Restoration efforts along Cienega Creek (BLM and Pima County) have contributed to significant populations of the species there. A Memorandum of Understanding was signed in 1981 between the USFWS, AGFD, and USFS allowing coordination for the reintroduction of Gila topminnow on Forest Service-administered lands. Gila topminnows are currently being held in several refugia, with isolation of genetic stocks from different sources or origin, for potential reintroduction to suitable habitats (Arizona Game and Fish Department 2001i). Federal Clean Water Act protections under Section 404 and state Outstanding Water (surface water quality regulations) designations may also provide protections for the subspecies.

Corridor and migration needs: The current recovery plan recommends that, until further genetic studies are completed for the Gila topminnow, each existing population of Gila topminnow should remain separate (Weedman 1998). Corridor planning should also include prevention of non-native species movement into habitats occupied by Gila

topminnow populations. To this end, the Bureau of Reclamation pays for monitoring of sites inhabited by Gila topminnow with the goal of early detection of invasive species (Clarkson et al. 2011). Because populations of Gila topminnow historically expanded into intermittent waters during wet years and then retreat to headwater springs and perennial reaches of streams during drier years, future planning should attempt to incorporate this facet of the species' life history and distribution.

Key relationships: No beneficial key relationships are known. Key adverse relationships exist with exotic predators and competitors, as discussed above.

Existing monitoring and research programs: Long-term monitoring of this species in Pima County and surrounding areas has occurred as a result of a number of efforts. Monitoring is undertaken throughout central and southern Arizona as part of the Central Arizona Project's non-native species detection effort (Marsh et al. 2009; Clarkson et al. 2011). This monitoring takes place annually in the Cienega Creek Preserve. The BLM monitors for this and other native species annually at Las Cienegas National Conservation Area (Simms et al. 2006).

MSCP Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-22): 0.5.

Acres of mitigation habitat within the current portfolio of conservation lands: 4,480.

Determination of Incidental Take

Pima County anticipates that take of Gila topminnow will be difficult to detect because of the species' small body size; losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that result from land clearing, habitat fragmentation, increased human activity, and indirect impacts such as subsequent erosion. Though direct impacts to acres of PCA habitat by covered activities are very small (see Table 3.3 of the MSCP), impacts to additional habitat are still possible, and the protection of habitat will effectively mitigate take not associated with habitat impacts. Therefore, habitat will be used as a surrogate for the incidental take of Gila topminnow. Effects to habitat can result in the following impacts to Gila topminnow; increased predation; increased occurrence of non-native competitors and predators (e.g., bullfrogs, crayfish, and mosquitofish); increased erosion and sedimentation affecting life history requirements; starvation and reduced reproductive output due to reduced habitat quality and increased competition; effects to stream flow resulting in reduced pool and surface water habitats, loss of aquatic vegetation as breeding, feeding and sheltering habitat; habitat fragmentation preventing or reducing the ability of species to move, disperse, or migrate to meet life history needs; spread of diseases that can result in mortality or reduce health and productivity; etc.

MSCP Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Gila topminnow:

- Work with AZGFD and USFWS to carry out the County's intention to reestablish Gila topminnow (as articulated in the Riparian and Aquatic Species Management Plan) on mitigation and County-owned lands;
- Continue to support protection of Cienega Creek water quality via Arizona Department of Environmental Quality's Outstanding Waters program;
- Identify and address management of non-native aquatic organisms through management plans and ranch infrastructure projects on County-controlled mitigation lands in the Cienega watershed.
- Continue to support eradication of non-native predatory, invasive aquatic species in select areas.
- Use as mosquito control if suitable agreements can be reached with AGFD and USFWS.
- Prohibit Pima County Health Department from using *Gambusia* for mosquito control in watershed tributaries that are contiguous to reintroduction sites as well as in the Cienega Creek watershed upstream of Colossal Cave Road.
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

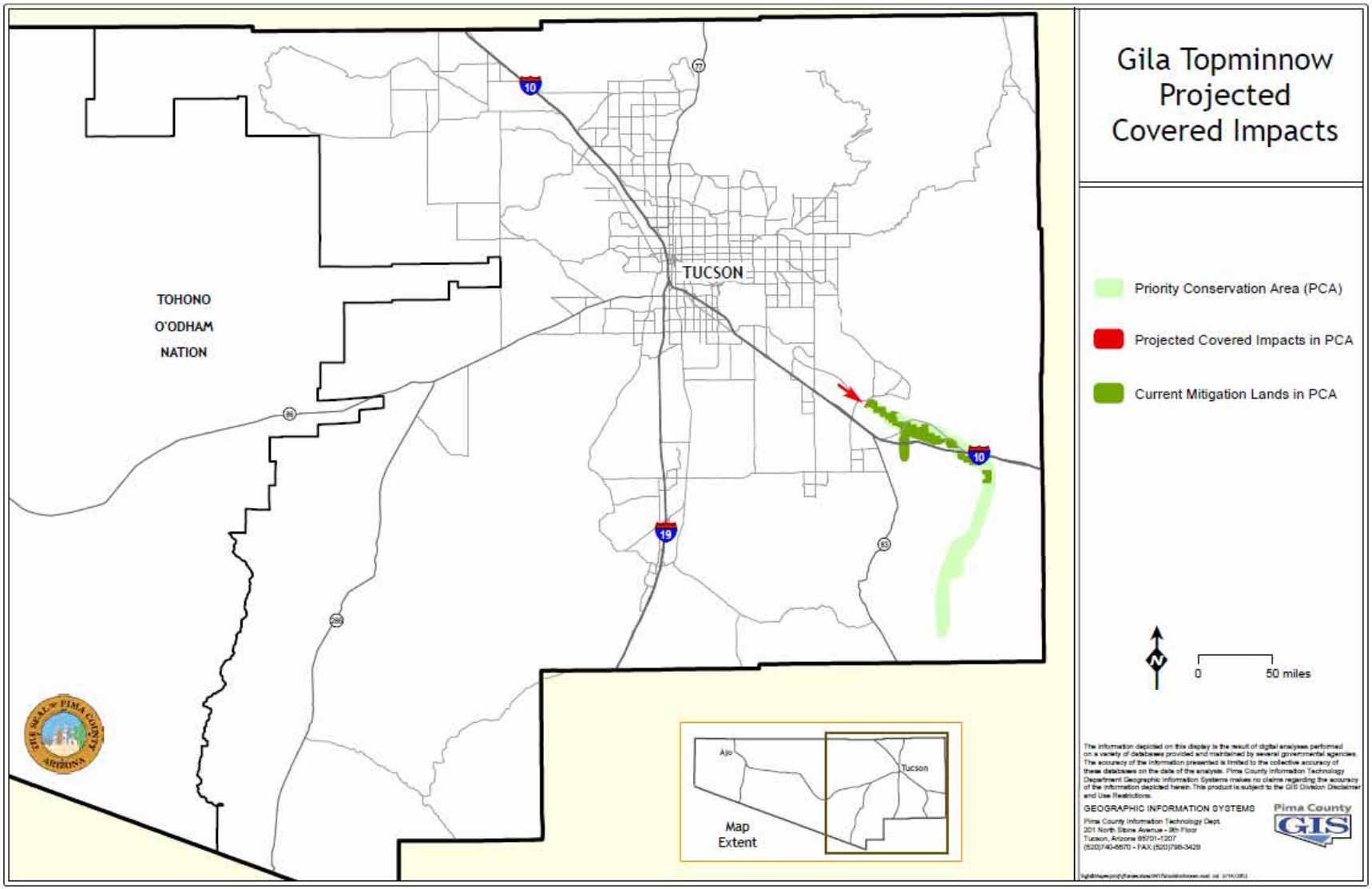


Figure A-22. Map of projected impacts and mitigation for the Gila topminnow.

Desert Sucker (*Catostomus clarki*)

Conservation Status

Endangered Species Act Status: None. Former FWS candidate for Category 2 listing.

State: Wildlife of Special Concern in Arizona.

Other: USFWS Species of Special Concern; U.S. Forest Service Sensitive Species.

Rankings: G3,G4; S3,S4.

Description

This is a medium sized catostomid fish, attaining adult size of 4 to 11 inches (10 to 28 cm) standard length. It has large lips with small papillae evenly dispersed over the lower lip; and jaws with cartilaginous scraping edges. The scales in the lateral line have been recorded ranging from 61 to 104. There are 8 to 12 dorsal rays (usually 10 or 11) and 8 to 12 pelvic rays. There is usually a small flap of skin present at the base of each pelvic fin. Coloration ranges from silvery tan to dark greenish above, and is silvery to yellowish below (Arizona Game and Fish Department 2002a).

Distribution and Trend

The historic range of the desert sucker includes Arizona, New Mexico, Nevada, Utah, and Mexico. The desert sucker occurs in suitable habitats of the lower Colorado River downstream from the Grand Canyon, generally including tributary streams of the Gila River drainage upstream of Gila, Arizona, along with the Virgin River basin of Utah, Arizona, and Nevada including the pluvial White River and Meadow Valley Wash. Populations of desert sucker are declining, although its distribution is still widespread. The decline is due mainly to diminished habitat through the alteration of historic flow regimes and construction of reservoirs (Arizona Game and Fish Department 2002a).

No known natural populations of this species currently occur in Pima County. There are populations upstream of Pima County in the Santa Cruz (Powell et al. 2005) and San Pedro rivers and, following floods, individuals may potentially establish in Pima County.

Habitat Requirements

The desert sucker is found in rapids and flowing pools of streams, primarily over bottoms of gravel-rubble with sandy silt in the interstices. It can tolerate a wide range of water temperatures, from 50 to 70 degrees Fahrenheit (10 to 21 degrees C). Water

depth is generally less than 1 foot (0.3 m). Habitat usage information for the desert sucker is life-stage specific. Larval desert suckers utilize backwaters, embayments, and some pools. As juveniles, desert suckers move into faster flowing habitats like riffles and rapids. As desert suckers mature into adults they move from riffles into deeper pools and pool-like areas. They exhibit varying levels of site fidelity and even in the absence of floods can move considerable distances (Booth and Shipley 2012; Booth et al. 2013).

Current and Potential Threats

General: Loss, fragmentation or modification of habitat from water development projects, stream diversions, and aquifer pumping is a major threat to the species. Invasion of non-native fishes, either from fish stockings or livestock watering tanks upstream of the Gila River, and extending downstream, is an equal or greater threat. The nonnative red shiner is present in the Gila River and has been suggested as a potential competitor of native fish species. At early life stages, the desert sucker may be preyed upon by nonnative fish in some areas. Hybridization with other sucker species is also a threat to desert suckers at some locations.

Existing and potential pest species: Desert suckers are known to be vulnerable to six species of native parasites. The most dangerous parasite appears to be *Ichthyophthirius multifiliis*, of which epizootic outbreaks appear to be common in streams throughout Arizona. Other parasites found on desert suckers include *Myxobulus oblongus*, *Ornithodiplostomum ptychocheilus, Clinostomum marginatum*, *Isoglaridacris bulbocirrus*, and *Rhabdochona decaturensis* (Mpoame and Rinne 1983).

Threat mechanism: Loss of stream habitat through water management practices and/or depletion of groundwater. Also, natural flood events can locally decimate populations. Non-native predators and competitors are also a threat to native fish species.

Management Needs

General: To protect this species, Aravaipa Creek canyon area should have its upstream aquifer protected. Maintenance of flow in this stream is highly critical because of the habitation of shallow riffle areas by 5 of the 7 remaining native Cypriniform fishes (including desert suckers).

Current protective measures: There are no current protective measures for this species. Desert suckers are known to be relatively sedentary and migrational or seasonal movements do not occur (Bestgen et al. 1987)

Corridor and migratory needs: Corridor needs of the desert sucker are not known.

Key relationships: None are specifically known.

Existing monitoring and research programs: There are no known research and monitoring programs at this time.

Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-23): 0.

Acres of mitigation habitat within the current portfolio of conservation lands: 99.

Determination of Incidental Take

Pima County anticipates that take of desert sucker will be difficult to detect because of the rarity of the species; losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that result from land clearing, habitat fragmentation, increased human activity, and indirect impacts such as subsequent erosion. Though direct impacts to acres of PCA habitat by covered activities were not modeled, impacts to habitat are still possible, and the protection of habitat will effectively mitigate take not associated with habitat impacts. Therefore, habitat will be used as a surrogate for the incidental take of desert sucker. Effects to habitat can result in the following impacts to desert sucker; direct impacts to nests in stream bottoms; increased predation; increased occurrence of non-native competitors and predators (e.g., bullfrogs and crayfish); increased erosion and sedimentation affecting life history requirements; starvation and reduced reproductive output due to reduced habitat quality and increased competition; effects to stream flow resulting in reduced pool and surface water habitats; habitat fragmentation preventing or reducing the ability of the species to move, disperse, or migrate to meet life history needs; etc.

Management and Conservation Commitment

Pima County will pursue the following management actions and conservation commitments for the desert sucker:

- Work with AZGFD to carry out the County's intention to reestablish desert sucker (as articulated in the Riparian and Aquatic Species Management Plan) on mitigation and County-owned lands;
- Continue to support eradication of non-native predatory, invasive aquatic species in select areas.
- Place restrictive covenants or conservation easements on County-controlled mitigation lands in the San Pedro watershed, as described in Chapter 4;
- Pima County will protect its existing water rights associated with County-owned mitigation lands in the San Pedro watershed.
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

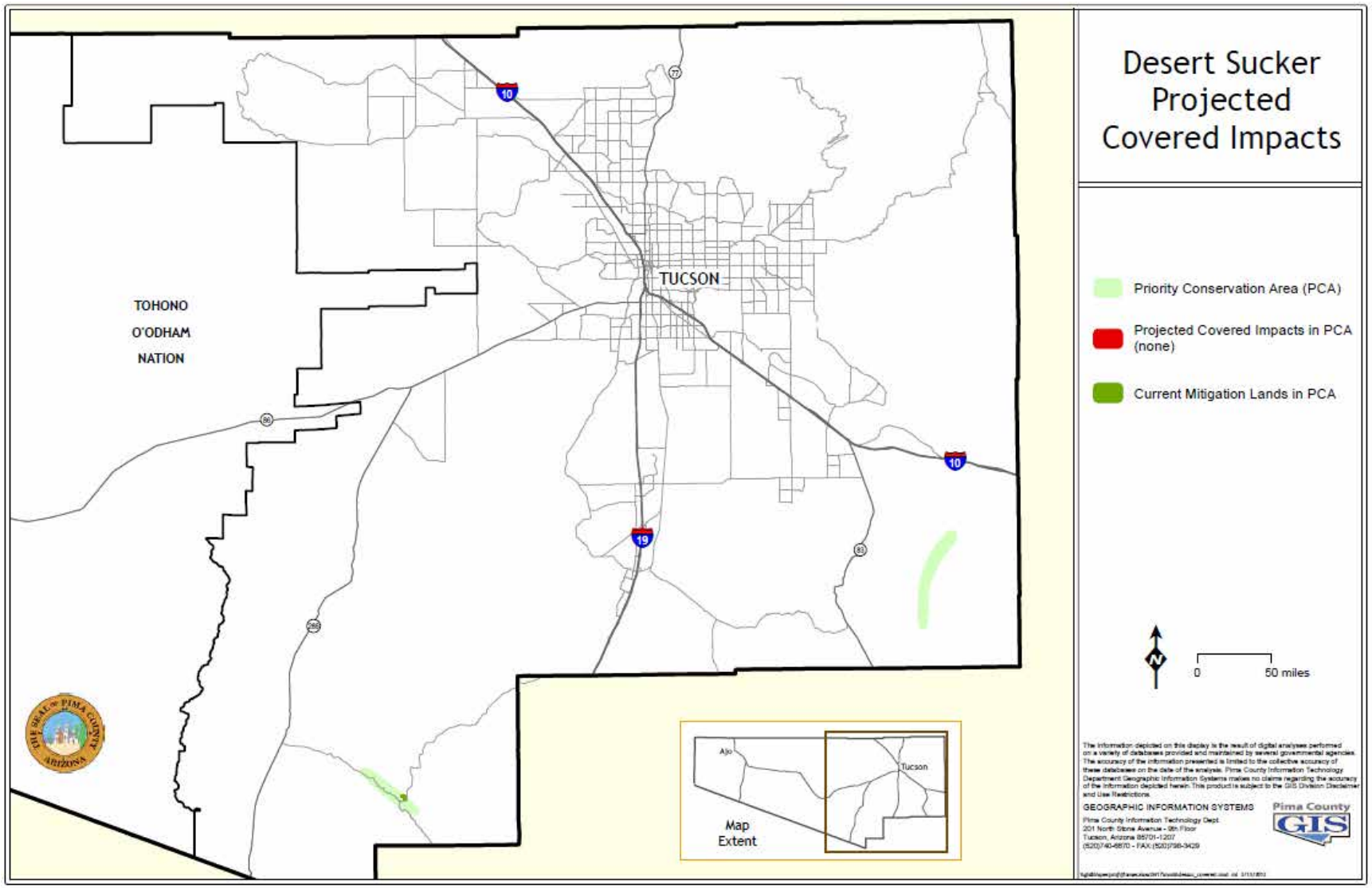


Figure A-23. Map of projected impacts and mitigation for the desert sucker.

Sonora Sucker (*Catostomus insignis*)

Conservation Status

Endangered Species Act Status: Former FWS candidate for Category 2 listing (1994).

State: Wildlife of Special Concern in Arizona.

Other: USFWS Species of Special Concern; U.S. Forest Service Sensitive Species, Region 3; Endangered in Mexico.

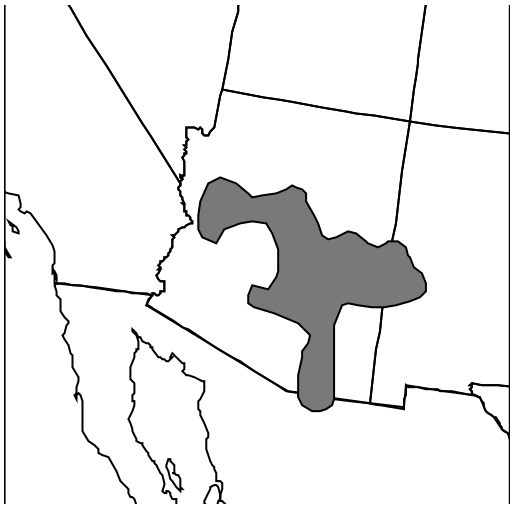
Rankings: G3, S3.

Description

This is a large catostomid fish, attaining adult size of 8 to 31 inches (20 to 79 cm) standard length. Its lower lip is about 3 times as thick as its upper lip. There are 10 to 11 rays in the dorsal fin. The body is sharply bicolored, olive brown above and deep yellow below. The scales on the upper half of the body have dark spots forming faint dashed lines. Weights of Sonora suckers range from 4 ounces to 4 pounds (Arizona Game and Fish Department 2002b).

Distribution and Trend

The historic range of the Sonora sucker includes Arizona, New Mexico, and Mexico. The Sonora sucker is native to the Gila and San Francisco drainages (except in extreme headwaters). In Arizona, the Sonora sucker has been recorded in the Apache-Sitgreaves and Coconino National Forests in Arizona, and is widespread in the Gila and Bill Williams river basins of Arizona (Arizona Game and Fish Department 2002b). Populations are stable in the San Francisco and Gila River drainages (Arizona Game and Fish Department 2002b).



No known natural populations of this species occur in Pima County. There are populations upstream of Pima County in the Santa Cruz (Powell et al. 2005) and San Pedro rivers and following floods, individuals may potentially establish in Pima County.

Habitat

The Sonora sucker requires lentic pool habitats within stream systems, with gravel-rubble bottoms. It is found in a variety of habitats from warm water rivers to trout

streams (Arizona Game and Fish Department 2002b). They exhibit varying levels of site fidelity and appear to move less than desert suckers (Booth and Shipley 2012).

Current and Potential Threats

General: Loss, fragmentation or modification of habitat from water development projects, stream diversions, and aquifer pumping is a threat to the species. Invasion of non-native fishes either from fish stocking or livestock watering tanks upstream of the Gila River, and extending downstream, is an equal or greater threat. The nonnative red shiner is present in the Gila River and has been suggested as a potential competitor for native species. The red shiner has been reported in the lower reaches of Aravaipa Creek where it may potentially impact the Sonora sucker.

Existing and potential pest species: Sonora suckers are known to be vulnerable to 10 species of parasites. The most dangerous parasite appears to be *Ichthyophthirius multifiliis,* of which epizootic outbreaks appear to be common in streams throughout Arizona. Other parasites found on desert suckers include *Myxobulus catostomi, M. discrepans, M. nodularis, Ornithodiplostomum ptychocheilus, Clinostomum marginatum, Ligula intestinalis, Isoglaridacris bulbocirrus, Neoechinorhynchus* sp., *and Rhabdochona decaturensis* (Mpoame and Rinne 1983).

Threat mechanism: Loss of stream habitat through water management practices or high water consumption; also, natural flood events can locally decimate populations. Non-native predators and competitors also threaten native fish populations.

Management Needs

General: To protect this species, Aravaipa Creek canyon area should have its upstream aquifer protected. Maintenance of flow in this stream is highly critical because of the habitation of shallow riffle areas by 5 of the 7 remaining native Cypriniform fishes (including Sonora suckers). In the event of reduction in flow, intermittent surface flow could result which would be detrimental to all of these fish species (Biota Information System of New Mexico 2008c).

Current protective measures: There are no current protective measures for this species.

Corridor and migratory needs: Corridor needs of the Sonora sucker are not known. This species tends to be relatively sedentary (Bestgen et al. 1987).

Key relationships: The Sonora sucker requires rivers or streams that have deep and quiet, rocky or gravelly pools. They are intolerant of lake conditions created by dams.

Migratory requirements: Unknown

Existing monitoring and research programs: There are no known research and monitoring programs at this time.

Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-24): 0.

Acres of mitigation habitat within the current portfolio of conservation lands: 50.

Determination of Incidental Take

Pima County anticipates that take of Sonoran sucker will be difficult to detect because of the rarity of the species; losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, increased human activity, and indirect impacts such as subsequent erosion. Though direct impacts to acres of PCA habitat by covered activities were not modeled, impacts to habitat are still possible, and the protection of habitat will effectively mitigate take not associated with habitat impacts. Therefore, habitat will be used as a surrogate for the incidental take of Sonoran suckers. Effects to habitat can result in the following impacts to Sonoran suckers; direct impacts to nests in stream bottoms; increased predation; increased occurrence of non-native competitors and predators (e.g., bullfrogs and crayfish); increased erosion and sedimentation affecting life history requirements; starvation and reduced reproductive output due to reduced habitat quality and increased competition; effects to stream flow resulting in reduced pool and surface water habitats; habitat fragmentation preventing or reducing the ability of the species to move, disperse, or migrate to meet life history needs; etc.

Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Sonora sucker:

- Work with AZGFD to carry out the County's intention to reestablish Sonora sucker (as articulated in the Riparian and Aquatic Species Management Plan) on mitigation and County-owned lands;
- Pima County will place restrictive covenants or conservation easements on County-controlled mitigation lands in the San Pedro watershed, as described in Chapter 4.
- Continue to support eradication of non-native predatory, invasive aquatic species in select areas.
- Pima County will protect its existing water rights associated with County-owned mitigation lands in the San Pedro watershed.
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

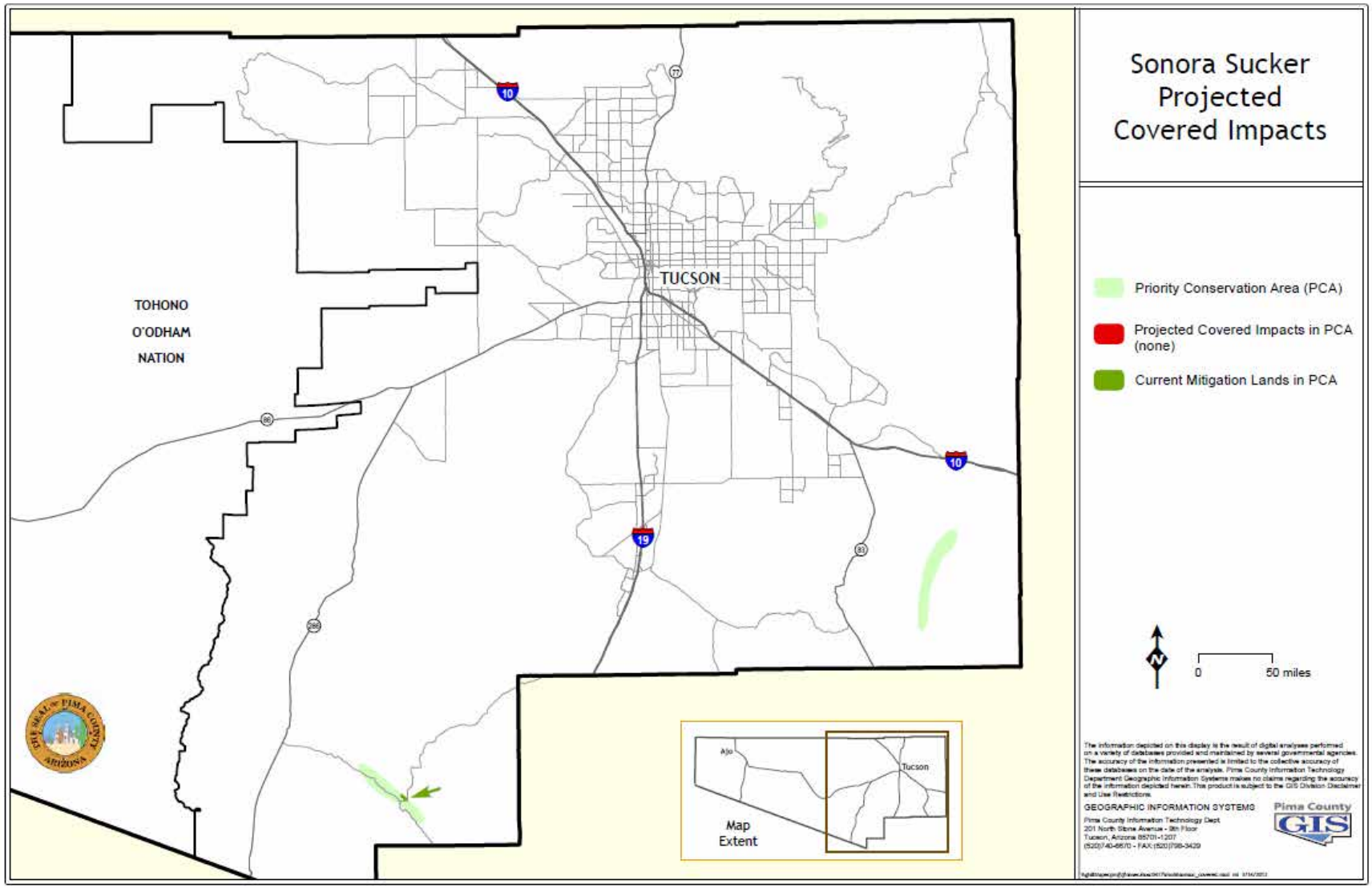


Figure A-24. Map of projected impacts and mitigation for the Sonoran sucker.

Amphibians

Chiricahua leopard frog (*Lithobates chiricahuensis*)

Conservation Status

Endangered Species Act Status: Listed Threatened in 2002. A Recovery plan was finalized in 2007 (U.S. Fish and Wildlife Service 2006) with critical habitat proposed in 2011 (U.S. Fish and Wildlife Service 2012) and finalized in 2012.

State: Wildlife of Special Concern in Arizona, Endangered in New Mexico.

Other: U.S. Forest Service Sensitive Species, Threatened in Mexico.

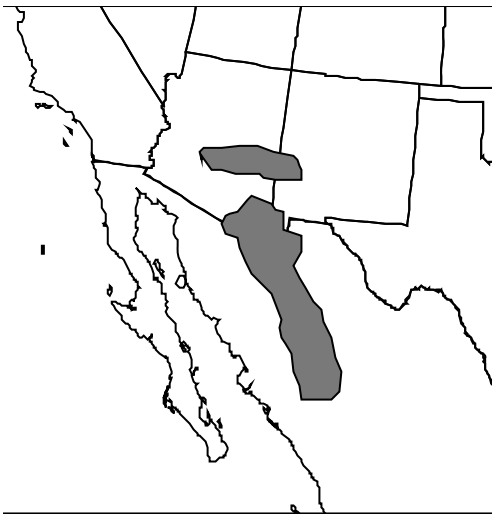
Rankings: G3, S3.

Description

Description: Eggs are black and white and strongly demarcated between the animal and vegetal poles. Tadpoles are darkly pigmented with darkly blotched tails. Adults are distinguished from other leopard frogs by their unique thigh pattern that includes prominent, white-tipped tubercles on a dark field. Generally, adults are stout-bodied, medium-sized frogs with many dorsal spots, spots on the head, and poorly defined or discontinuous dorsolateral folds.

Distribution and Trend

Historical distribution of this species is difficult to ascertain because it was formerly considered *Rana pipiens*, and so classified by observers before it was described as a separate species in 1979. Positive historical records are known from over 114 sites in southeastern Arizona, where it occupied most large rivers and lakes, as well as many small tributaries and ponds. From 1990 to 1994, 265 potential sites, including 87 of the 114 known historical sites were surveyed, and Chiricahua leopard frogs were found in 12 historical and 51 previously unknown sites (Sredl and Howland 1994).



The total range includes montane regions in central and southern Arizona, southwestern New Mexico south into the Sierra Madre Occidental to western Jalisco, Mexico, at elevations from 3,500 to 8,400 feet (1,066 to 2,450 m). Two disjunct distributions exist within central and southeastern Arizona, from montane central Arizona east and south along the Mogollon Rim to montane areas of

west-southwestern New Mexico, and southeastern montane areas of Arizona into Sonora and Chihuahua, Mexico (U.S. Fish and Wildlife Service 2006). Elevational range of the central and eastern Arizona distribution is 3,500 to 8,040 feet (1,068 to 2,452 m), and 1,219 to 4,023 feet (372 to 1,227 m) near the Arizona-Mexico border.

Populations in Pima County occur in stock tanks in the Buenos Aires National Wildlife Refuge, canyons in the Santa Rita and Baboquivari mountains, and in Cienega Creek adjacent to the Empire Ranch and Cinco ponds areas. In 1994, this species was found ranging from Empire Gulch to Springwater Canyon, but failed to appear there in 1996 (Rosen and Caldwell 2004). Three individuals were found in Cienega Creek at Empire Ranch in 1986 (Rosen and Schwalbe 1988) and that area has been a rearing and release site in recent years. Surveys of the north end of the Santa Rita Mountains at the site of the proposed Rosemont Mine revealed individuals in 9 locations in around the proposed project site (WestLand Resources Inc 2009). As of June 2014, there are no populations within County-owned and leased lands, but renovation of two sites on the Sands or Clyne ranches will facilitate reintroductions of the species after the MSCP is finalized.

Habitat Requirements

The Chiricahua leopard frog is an aquatic and riparian species. Habitat includes a variety of water sources including rocky streams with deep, rocky pools, overflow pools and oxbows of rivers, permanent springs, ponds, and wetlands at elevations from 3,500 to 8,040 feet in central and eastern Arizona, and from 1,219 to 4,023 feet in southeastern Arizona (U.S. Fish and Wildlife Service 2006). It also occurs in thermal springs and seeps, stock tanks, wells, and river reaches. Adjacent upland vegetation communities include oak and pine-oak woodland, chaparral, grassland, and desert. Ideal habitat includes permanent water (required during breeding season, and at least muddy conditions otherwise for survival), aquatic heterogeneity (deep pools with nearby shallow areas), undercut banks (retain moisture during drought), overhanging terrestrial vegetation, and abundant aquatic vegetation (U.S. Fish and Wildlife Service 2006).

Home range requirements: Known habitat requisites are detailed above. Home range requirements beyond these are not known, though recent work suggest that they can disperse overland for 4-5 miles from breeding sites (David Hall and Phil Rosen, *unpublished data*).

Ability to use major land use categories: The Chiricahua leopard frog uses agricultural land, water, streams and canals, lakes, and unforested wetlands.

Current and Potential Threats

The cause of the species' historical decline is not known for certain, but is thought to be a combination of habitat loss, exotic, invasive species, and disease (chytrid fungus). Today, invasive species such as introduced fishes, crayfish, and bullfrogs are one of the most important threats to the Chiricahua leopard frog on the local scale (U.S. Fish and Wildlife Service 2006). This, coupled with habitat fragmentation and loss resulting from water diversion, groundwater pumping, and pollution have meant that recovery criteria outlined in the recovery plan have not been met for this species. Climate change and

increases in UV radiation will likely impact this species in the future. Finally, the cold-loving chytrid fungus is thought to be a major problem for this and other amphibian species in Arizona and elsewhere in the U.S. (Bradley et al. 2002; Lips et al. 2006).

Existing and potential pest species: The introduced crayfish (*Oronectes virilis*) is having major negative effects on native populations of frogs in North America (Kats and Ferrer 2003), probably contributing to the statewide decline of *L. chiricahuensis* in Arizona (U.S. Fish and Wildlife Service 2006). Bullfrogs are also important predators of native frogs and recent eradication efforts in southern Arizona (Atascosa Mountains and Cienega Valley) appear to have established conditions that are favorable to the reestablishment of the Chiricahua leopard frog.

Threat mechanism: Historical habitat loss and isolation of local populations has disrupted the metapopulation structure of this species. Multiple threats impact local populations, and without a healthy metapopulation structure, recovery of local populations in not possible (Sredl and Howland 1994).

Management Needs

General: Management actions for this species should focus on protecting existing populations, establishing new habitat, and reducing threats. Factors to assure available quality habitat include (1) maintenance or development of permanent water sources within a metapopulation area, while minimizing further groundwater pumping, (2) development and maintenance of heterogeneous habitats that include cover, shelter, breeding microhabitats, (3) increase depth, duration, and surface area of water, (4) prevent introduction of non-native predators and eradicate such species whenever possible, and (5) prevent pollution, especially from agricultural and industrial sources.

Current protective measures: The most important protections have been the establishment of critical habitat and the resulting protections that that action affords on Federal lands. Arizona implemented an open season on bullfrogs, and set an unlimited bag and possession limit for dead bullfrogs. The regulations will simplify efforts to pressure bullfrog populations in specific areas to favor native species.

Key relationships: This species requires perennial water for survival and reproduction.

Existing monitoring and research programs: The Cienega Watershed Partnership is working on a watershed-wide conservation project within the Cienega Valley. A key focus of that conservation effort is eradication of non-native species (bullfrogs, sunfish, and crayfish), restoration of potential breeding sites, and reintroduction of native leopard frogs. The Arizona Game and Fish Department and the U.S. Fish and Wildlife Service developed a safe harbor agreement for the species and that has led to a host of local restoration efforts for the species. Key populations of the species are periodically monitored by the Arizona Game and Fish Department and the USFWS.

Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-25): 2.

Acres of mitigation habitat within the current portfolio of conservation lands: 13,471.

Determination of Incidental Take

Pima County anticipates that take of Chiricahua leopard frog will be difficult to detect because of the species' cryptic coloration; the species is secretive by nature; the species has a small body size for most of their life history (eggs, tadpoles, metamorphs, etc.); losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that result from land clearing, habitat fragmentation, dredging, increased human activity, and indirect impacts such as subsequent erosion, invasive species, light, etc. Though the numbers of acres of impacts to habitat are small, these are modeled impacts and the number of acres impacted might be larger. Therefore, Pima County will use acres of PCA habitat impacted by covered activities as a surrogate for the incidental take of Chiricahua leopard frogs. Effects to habitat can result in the following impacts to Chiricahua leopard frogs; direct impacts to breeding habitat; abandonment of breeding areas due to noise, activity, cattle, etc; individuals being forced into suboptimal habitat; increased predation; increased occurrence of non-native competitors and predators (e.g., crayfish and bullfrogs); increased erosion and sedimentation affecting life history requirements; starvation and reduced reproductive output due to reduced habitat quality and increased competition; effects to stream flow pattern resulting in reduced pool and surface water habitats, loss of aquatic vegetation as breeding, feeding and sheltering habitat; habitat fragmentation preventing or reducing the ability of species to move, disperse, or migrate to meet life history needs; spread of diseases such as chytrid fungus that can result in mortality or reduced health and productivity; etc.

Impact of Covered Activities on Critical Habitat

In March 2011, the USFWS proposed critical habitat for the Chiricahua leopard frog in Arizona and New Mexico, of which 3,333 acres (30%) are in Pima County. The two primary sites in Pima County included in the proposed critical habitat designation are within the Buenos Aires National Wildlife Refuge (1,721 acres) and Las Cienegas National Conservation Area (1,421 acres). Only 349 acres of critical habitat are in the Permit Area and no acres are anticipated to be impacted by Covered Activities. Final designation of critical habitat for the Chiricahua leopard frog occurred on March 20, 2012 (U.S. Fish and Wildlife Service 2012) and is essentially the same as the proposed designation. Approximately 1 acre of critical habitat is in the Permit Area, but no impacts to this acre are likely. Pima County has no anticipated mitigation of critical habitat.

Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Chiricahua leopard frog:

- Actively manage this species on county-controlled mitigation lands; maintain and/or re-establish several viable populations in springs, tinajas, stock ponds and other suitable sites, where appropriate and in consultation with AGFD and USFWS.
- Continue to support eradication of non-native predatory, invasive aquatic species in select areas.
- Acquire and protect water rights to maintain and restore habitat for this species where appropriate.
- County-controlled mitigation lands >3,400 feet in elevation will be managed for control/removal of invasive aquatic exotic species to create suitable habitat for this species and protect sites from other stresses such as spread of chytrid fungus and controllable desiccation, where prudent and feasible.
- Support simultaneous removal of bullfrogs and crayfish across whole landscapes, where feasible, such as is being accomplished in the Cienega watershed.
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

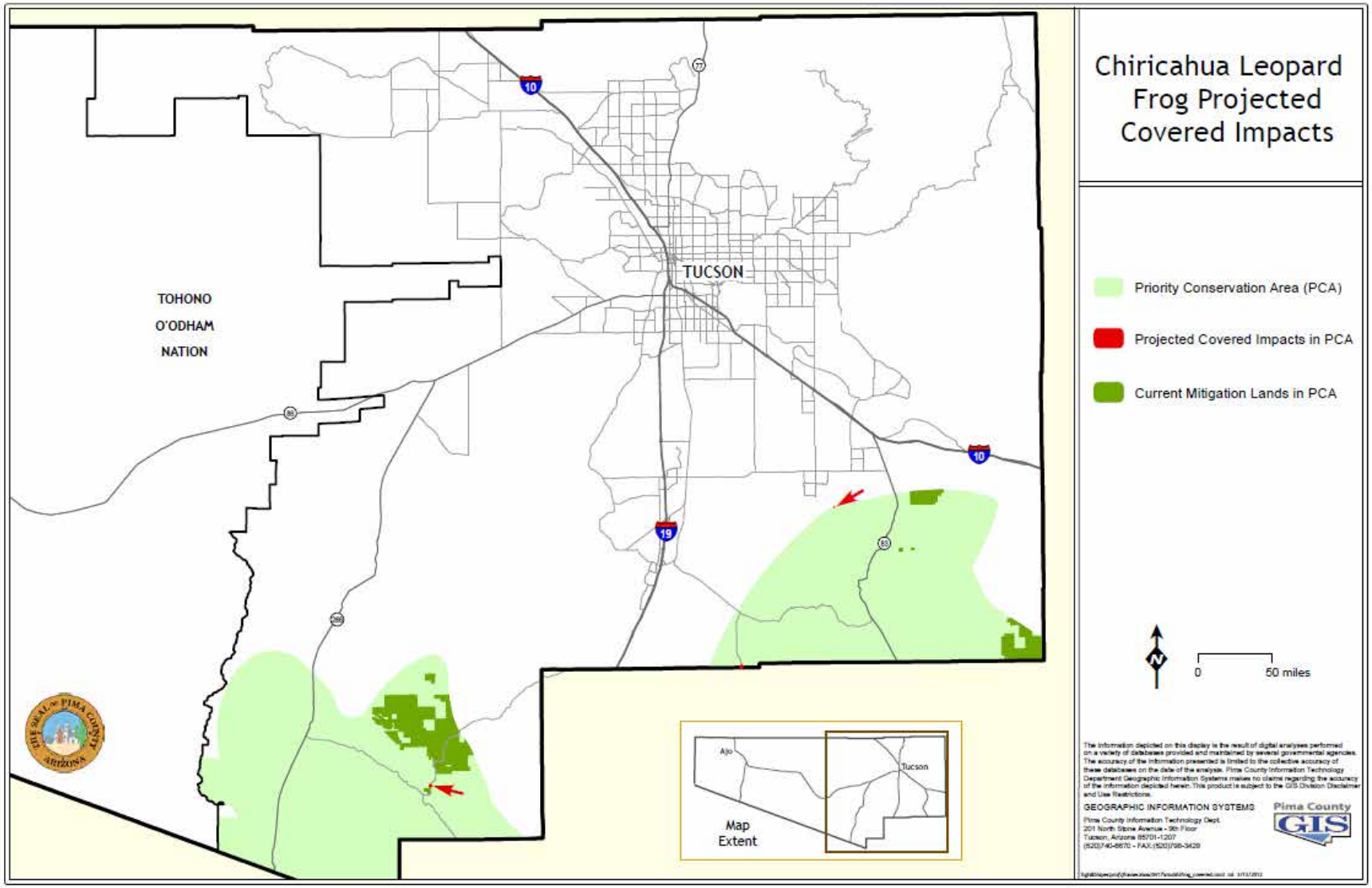


Figure A-25. Map of projected impacts and mitigation for the Chiricahua leopard frog.

Lowland leopard frog (*Lithobates yavapaiensis*)

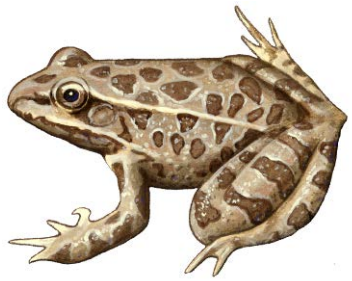
Conservation Status

Endangered Species Act Status: None. Former FWS Category 2 candidate for listing.

State: Wildlife of Special Concern in Arizona; Endangered in New Mexico.

Other: USFWS Species of Concern; Sensitive by U.S. Forest Service.

Rankings: G4, S4.

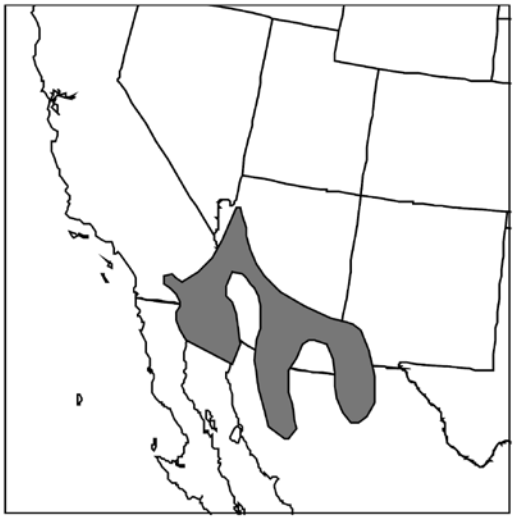


Description

The lowland leopard frog is a medium-sized frog. The dorsal field color of adults is a light gray-green, green, tan, or brown, with dark brown spots and no halos. Adults can be distinguished from other leopard frogs by their prominent dorsolateral folds that are discontinuous posteriorly and deflected medially in the sacral area. The supralabial stripe diffuses anterior to the eye, the venter is cream-colored, and yellow pigment on the groin often extends posterior to the venter and to the ventral portions of the legs (Arizona Game and Fish Department 2006d). This species lacks the white-tipped tubercules on the posterior thighs that characterize the Chiricahua leopard frog.

Distribution and Trend

The range of the lowland leopard frog once included lower elevations of the lower Colorado River and its tributaries in Nevada, California, Arizona, New Mexico, northern Sonora and extreme northeast Baja California, Mexico. This frog occurred in the Colorado River near Yuma in extreme southwestern Arizona, in west, central, and southeastern Arizona south of the Mogollon Rim, and the Virgin River drainage in extreme northwestern Arizona (Arizona Game and Fish Department 2006d). The lowland leopard frog currently occurs in central and southeastern part of Arizona. They are absent from the lower Colorado River and have declined significantly in southeastern Arizona.



Populations in Pima County are found at Cienega Creek (Caldwell 2002; Rosen and Caldwell 2004) and nearby Davidson Canyon (WestLand Resources Inc 2008), several canyons in the Rincon Mountain District of Saguaro National Park (Flesch et al. 2006; Swann and Wallace 2008), and several sites in the Santa Catalina Mountains including Buehman, Youtcy, Alder, and Romero canyons. In the last 10 or so years they have

been extirpated from Sabino and Molino canyons, and Agua Caliente Wash (Sartorius and Rosen 2000). A comprehensive survey of the Santa Catalina and Rincon Mountains was recently completed by Pima County and partners (Powell et al. 2013). The results of that survey indicate that Pima County owns and manages some of the most important lowland leopard frog habitat in Pima County, including at Youtcy Spring, Cienega Creek Natural Preserve, Buehman Canyon, Peck Spring, Edgar Canyon, and Oracle Ridge.

Habitat Requirements

This species is generally restricted to permanent waters south and west of the Mogollon Rim, below 5,500 feet elevation and chiefly below 3,000 feet. This frog apparently prefers small to medium streams over ponds, stock tanks, and other aquatic habitats (Arizona Game and Fish Department 2006d). Populations typically occur in aquatic systems with surrounding Sonoran Desert Scrub, Semidesert Grassland, or Madrean Evergreen Woodland upland vegetation communities at elevations from 800 to 5,500 feet in Arizona. In canyon systems of southern Arizona, they occur in large pools with high canyon cover and pool-side vegetation (Wallace et al. 2010). In New Mexico, lowland leopard frogs were associated with vegetation that includes Arizona sycamore (*Platanus wrightii*), seepwillow (*Baccharis glutinosa*), other trees and shrubs, and various forbs and graminoid plants. Lowland leopard frogs often concentrate near deep pools associated with root masses of large riparian trees (Biota Information System of New Mexico 2000). Large pools are essential for adult survival and reproduction, and small pools and marsh habitats probably enhance survival of juveniles (Arizona Game and Fish Department 2006d).

Current and Potential Threats

General: This species is threatened by a multitude of human impacts to its aquatic habitats, including groundwater pumping, habitat destructions, drought, and climate change. Chytrid fungus appears to be a particularly important threat (Bradley et al. 2002) and winter dieoffs have been observed on County lands (Brian Powell, *unpublished observation*). There is documentation that some populations are able to withstand the disease (e.g., Forrest and Schlaepfer 2011; though this is an extraordinary situation) and other populations do not appear to be impacted (Savage et al. 2011). Other threats include introduction of non-native predatory fishes (bass, sunfish, and catfish) and bullfrogs (Arizona Game and Fish Department 2006d), human use of aquatic habitats, and the invasion of the introduced Rio Grande leopard frog (*R. berlandieri*) in the lower Gila and Salt rivers (Arizona Game and Fish Department 2006d).

Existing and potential pest species: Non-native predators and competitors include bullfrogs, Rio Grande leopard frogs, crayfish, predatory fish, and diseases.

Management Needs

General: Management actions for this species should focus on protecting existing populations, establishing new habitat, and reducing threats. Factors to assure available quality habitat include (1) maintenance or development of permanent water sources

within a metapopulation, while minimizing further groundwater pumping, (2) development and maintenance of heterogeneous habitats that include cover, shelter, breeding microhabitats, (3) increase depth, duration, and surface area of water, (4) prevent introduction of non-native predators and eradicate such species whenever possible, and (5) prevent pollution, especially from agricultural and industrial sources.

Current protective measures: Arizona implemented a closed season for the lowland leopard frog and implemented a year round, open season on bullfrogs. The regulations will simplify efforts to remove bullfrog populations in specific areas to favor persistence of native species. Most of the areas known to be currently occupied by this species are protected by a variety of land management agencies and regulations.

Corridor needs: Like the Chiricahua leopard frog, the lowland leopard frog appears to be a classic metapopulation species whose avenues of connection between local populations have been significantly impacted by human activities and their consequences. This species probably requires dispersal corridors consisting of streams and adjacent riparian habitat in reasonably good condition, without insurmountable interruptions or barriers.

Key relationships: No specific key relationships are known for this species.

Migratory requirements: See above under corridor needs.

Existing monitoring and research programs: Don Swann with the National Park Service has been monitoring lowland leopard frogs at sites throughout the Rincon Mountain Unit of Saguaro National Park for approximately 10 years. An inventory of the Santa Catalina and Rincon Mountains was completed in early 2013 (Powell et al. 2013).

Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-26): 7,145.

Acres of mitigation habitat within the current portfolio of conservation lands: 44,316.

Determination of Incidental Take

Pima County anticipates that take of lowland leopard frogs will be difficult to detect because of the species' cryptic coloration; the species is secretive by nature; the species has a small body size for most of their life history (eggs, tadpoles, metamorphs, etc.); losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, dredging, increased human activity, and indirect impacts such as subsequent erosion, invasive species, light, etc. Therefore, Pima County will use acres of PCA habitat impacted by covered activities (as described in Table 3.3 of

the MSCP) as a surrogate for the incidental take of lowland leopard frogs. Effects to habitat can result in the following impacts to lowland leopard frogs; direct impacts to breeding habitat; abandonment of breeding areas due to noise, activity, cattle, light, etc.; individuals being forced into suboptimal habitat; increased predation; increased occurrence of non-native competitors and predators (e.g., crayfish and bullfrogs); increased erosion and sedimentation affecting life history requirements; starvation and reduced reproductive output due to reduced habitat quality and increased competition; effects to stream flow pattern resulting in reduced pool and surface water habitats, loss of aquatic vegetation as breeding, feeding and sheltering habitat; habitat fragmentation preventing or reducing the ability of species to move, disperse, or migrate to meet life history needs; spread of diseases such as chytrid fungus that can result in mortality or reduced health and productivity; etc.

Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the lowland leopard frog:

- Actively manage this species on County-controlled mitigation lands; maintain and/or re-establish several viable populations in springs, tinajas, stock ponds and other sites, where appropriate and in coordination with the USFWS and AGFD.
- Continue to support eradication of non-native predatory, invasive aquatic species in select areas.
- Acquire and protect select water rights to maintain and restore habitat for this species.
- County-controlled mitigation lands will be managed and monitored for the detection and subsequent removal of aquatic invasive species to create suitable habitat for this species and protect sites from other stresses.
- Support simultaneous removal of bullfrogs, crayfish, and non-native fish across whole landscapes, such as is being conducted in the Cienega watershed.
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Implement the Pima County Floodplain Ordinance as described in Chapter 4 to minimize loss of habitat for this species.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

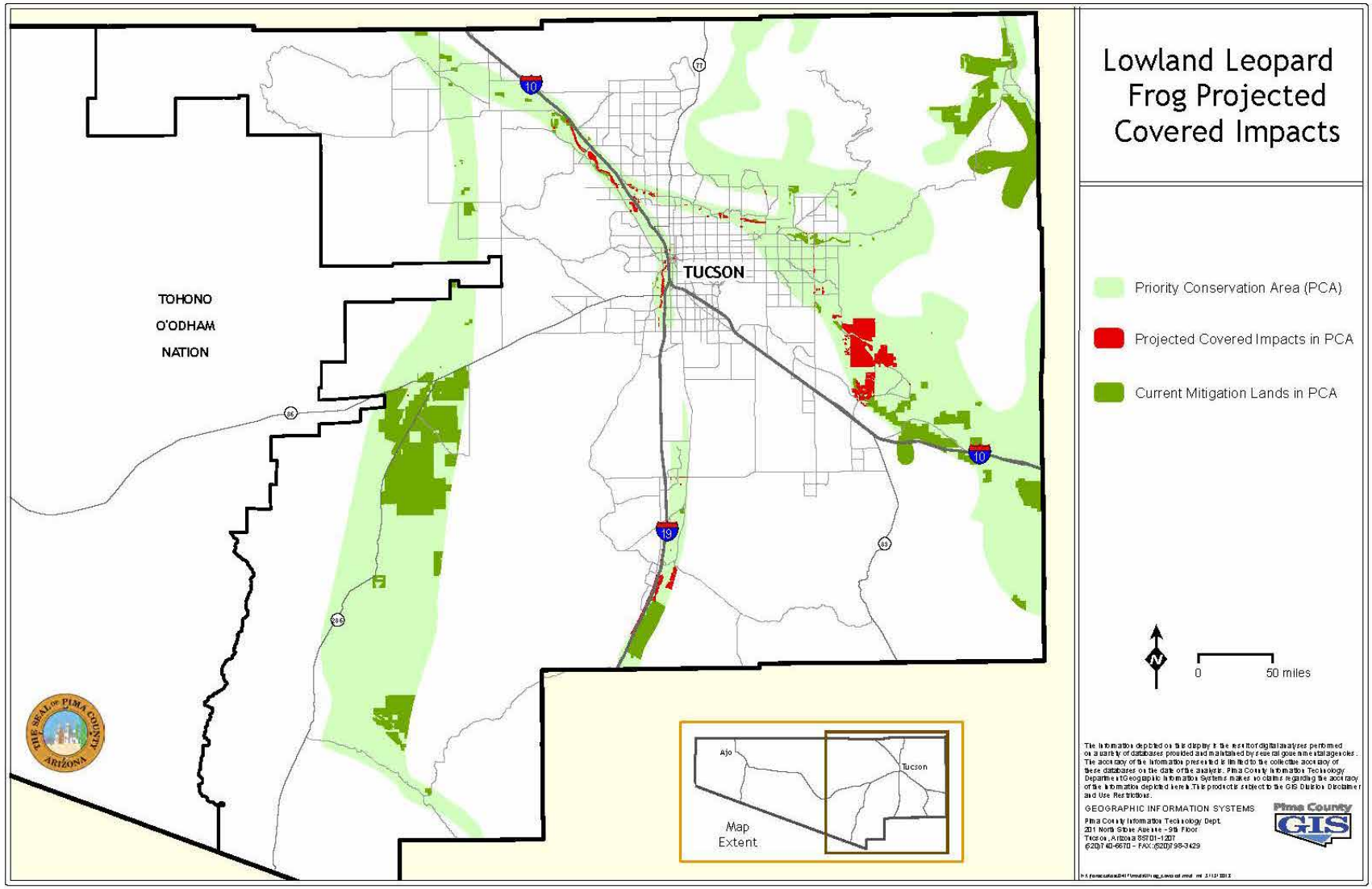


Figure A-26. Map of projected impacts and mitigation for the lowland leopard frog.

Reptiles

Giant spotted whiptail lizard (*Aspidoscelis stictogramma*)

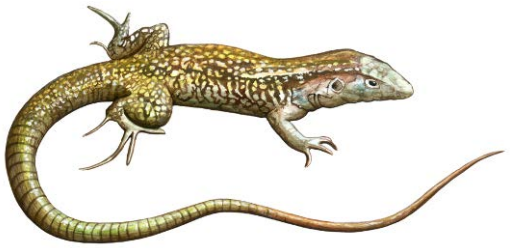
Conservation Status

Endangered Species Act Status: None.

State: None.

Other: U.S. Forest Service Sensitive Species; Bureau of Land Management Sensitive Species; Threatened in New Mexico.

Rankings: G4, S3.



Description

This is a slender, fast-moving lizard. The adult size for the species is 3.5 to 5.5 inches (8.7 to 13.7 cm) snout-vent length, with a tail generally longer than the snout-vent length. The medial and upper surfaces of the neck, legs, and feet are dark grayish green to bluish, with green or pale spots, and a reddish brown to reddish orange color on the head and neck. The tail is brown in adults and reddish or orange in young. Large males may have no stripes (Stebbins 1985).

Distribution and Trend

The historical range of the giant spotted whiptail includes Arizona, the extreme southwestern edge of New Mexico, and Sonora, Mexico (Arizona Game and Fish Department 2001a). Its range in Arizona extends from the Baboquivari and Pajarito Mountains on the west, to Guadalupe Canyon in extreme southwestern New Mexico. It includes the Santa Cruz and San Pedro river basins in the south-central part of the state, from the Santa Catalina Mountains near Oracle southward to the Yaqui River basin and the Rio de la Concepcion in Sonora (Lowe 1964).

In Pima County, the giant spotted whiptail currently occurs in the foothills of the Santa Catalina, Rincon, San Luis, Baboquivari and Santa Rita mountains; and along the West Branch of the Santa Cruz River, Arivaca Creek, and Empire Gulch (Arizona Game and Fish Department 2001a; Edwards and Swann 2003; Flesch et al. 2006; Rosen 2008c). Within Pima County-owned and leased lands, the species has been confirmed at Canoa Ranch and along Santa Cruz River parcels, though it is probably more widespread.

Habitat

Giant spotted whiptails are found in lower Sonoran (chiefly riparian areas) and upper Sonoran life zones, in mountain canyons, arroyos, and mesas in arid and semi-arid regions, entering lowland deserts along stream courses (Stebbins 1985). It is found in dense shrubby vegetation, often among rocks near permanent and intermittent streams, and in grassy areas within riparian areas (Degenhardt et al. 1996; Arizona Game and Fish Department 2001a), through an elevation range of near sea level to around 4,500 feet (1,370 m).

Current and Potential Threats

General: Giant spotted whiptails could be impacted by uncontrolled wildfire or by loss of riparian vegetation in its limited habitat. In New Mexico, habitat alteration and over-collecting represent the major perceived threats to the species (Biota Information System of New Mexico 2008a).

Existing and potential pest species: None have been cited, although it is probable that invasive non-native grasses, such as red brome and buffelgrass, may increase incidence and severity of fires in the limited habitat of this subspecies.

Threat mechanism: Direct loss of individuals by collecting, and loss of habitat resulting from all factors that cause degradation of riparian habitat.

Management Needs

General: Distribution, population, habitat and life history studies are needed (Arizona Game and Fish Department 2001a).

Current protective measures: Arizona prohibits commercial collection of reptiles, but enforcement is limited. Some protection and mitigation of habitat is afforded by Pima County's floodplain ordinance and the Federal Clean Water Act, Section 404 program.

Corridor and migratory needs: No known information is available on corridor needs of this subspecies. It is apparently found in several disjunct populations and may be a relict of cooler and moisture climatic era that has survived in isolated refugia.

Key relationships: No known information is available on key relationships of this subspecies.

Existing monitoring and research programs: There are no known monitoring and research programs for this subspecies.

Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-27): 4,355.

Acres of mitigation habitat within the current portfolio of conservation lands: 11,771.

Determination of Incidental Take

Pima County anticipates that take of giant spotted whiptail will be difficult to detect because of the large Permit Area; the scattered distribution of the giant spotted whiptail; its cryptic coloration; the species' narrow above-ground activity patterns (owning to the fact that is an ectothermic animal); the species' small body size; losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as subsequent erosion, invasive species, pets, etc. Therefore, Pima County will use acres of PCA habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of giant spotted whiptails. Effects to habitat can result in the following impacts to giant spotted whiptails: direct impacts to burrows; abandonment of burrows due to noise, activity, etc.; being forced into suboptimal habitat or already-occupied habitat; increased predation; increased erosion and sedimentation affecting life history requirements; starvation and reduced reproductive output due to reduced habitat quality and increased competition; habitat fragmentation preventing or reducing the ability of species to move, disperse, or migrate to meet life history needs; etc.

Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the giant spotted whiptail:

- Implement the Pima County Floodplain Ordinance to minimize loss of habitat as described in Chapter 4;
- Place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4;
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Enforce off-highway vehicle laws on County properties and work with Arizona Game and Fish to address additional off-highway vehicle enforcement needs.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

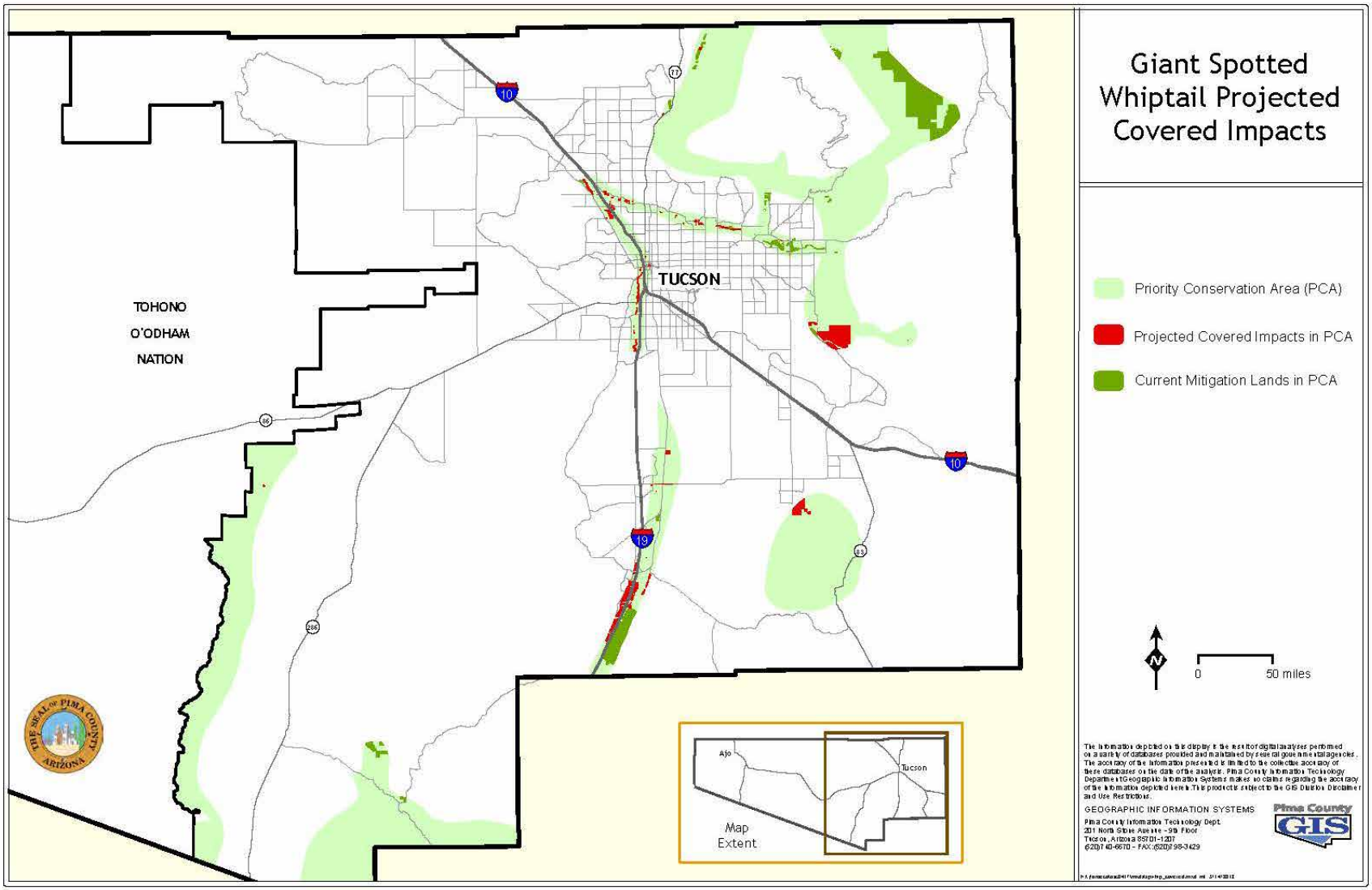


Figure A-27. Map of projected impacts and mitigation for the giant spotted whiptail lizard.

Desert box turtle (*Terrapene ornata luteola*)

Conservation Status

Endangered Species Act Status: None.

State: None.

Other: Special protection in Mexico; protected from international trade by CITES.

Rankings: G5; S3,S4.

Description

This chiefly terrestrial turtle is from 4 to 5.75 inches (10 to 15 cm) in carapace length. The plastron has a single hinge in front and can be drawn tightly against the carapace. The carapace is high and round, and is typically marked with pale radiating lines or a series of black or dark brown dots on a yellow field. The plastron may have similar markings. The markings become less distinct as age advances and are eventually lost. This subspecies can be distinguished from the other subspecies (the ornate box turtle, *T. o. ornata,* which does not occur in Arizona) by the typical loss of dorsal markings as an old adult, and younger individuals having 11 or more light radiating lines on the second costal scute, whereas *T. o. ornata* has a maximum of 9 or 10 (Degenhardt and Christiansen 1974). The shells of older individuals are uniform straw color or pale greenish brown. The first nail on each hind foot turns inward on males. The iris and spots on forelimbs are reddish (yellowish in females), and the head is sometimes greenish. Females grow larger than males (Stebbins 1985; Degenhardt et al. 1996). Recent genetic evidence suggests that subspecies status for the desert box turtle may not be warranted (Martin et al. 2013).

Distribution and Trend

The desert box turtle ranges from south-central New Mexico south to central Chihuahua and Sonora, Mexico, and from western Texas across New Mexico to the eastern base of the Baboquivari Mountains at elevations from sea level to about 6,000 feet (Stebbins 1985). There is no rangewide trend data for this subspecies.

The distribution of this species in Pima County is not well known, but it has been observed in the Las Cienega Conservation Area, in the Santa Cruz River valley near Sahuarita, and in the Altar Valley. A few specimens have been found along the San Pedro River in Pima County (Hall and Steidl 2007). A carcass was located on Esperanza Ranch south of Tucson (Llewellyn and Zetlan 2007). Two individuals

were found in the Rincon Mountain District of Saguaro National Park in 2005 (Flesch et al. 2006), but it is unclear if these are natural populations or released pets. Within Pima County-owned and leased lands, the species has been confirmed periodically at the Cienega Creek Natural Preserve. It likely occurs on the Sands and Clyne ranches in the Cienega Valley and in the Sopori and Rancho Seco ranches in the Altar Valley.

Habitat

The western box turtle is primarily a prairie turtle that inhabits arid and semi-arid grasslands and shrub land across much of its range where soils are sandy. It also occurs in open woodland with herbaceous understory (Stebbins 1985). Desert box turtles are found in land use and land-cover associations that include rangeland, water, streams and canals, wetland, barren land, and sandy areas other than beaches (Biota Information System of New Mexico 2008g). It has also been found in pecan orchards in Sahuarita (K. Kingsley, *unpublished data*).

Current and Potential Threats

General: Declines in southeastern Arizona are likely for this species, most likely as a result of loss of grassland habitat to development, shrub encroachment, and a change in the fire regime. The desert box turtle is also sensitive to highway traffic and collecting (Hall and Steidl 2007). It may also have been affected be Compound DRC-1339 used by Animal Damage Control and has apparently been caught in leghold traps as well (Biota Information System of New Mexico 2008g).

Existing and potential pest species: Ectoparasites of *T. ornata* include fly larvae in some parts of the range and chigger mites in other areas (Biota Information System of New Mexico 2008g). It is not known whether this is a problem in Pima County. It is possible that invasive non-native grasses, such as red brome, Lehmann lovegrass, and buffelgrass may increase the incidence of fires which could cause significant mortality in local populations of this species. Further, the desert box turtle seems to prefer more open areas, so the increase in non-native grasses may impact habitat quality. Furthermore, possible localized declines in banner-tailed kangaroo rats, which create burrow systems utilized by desert box turtles, may negatively impact the species.

Threat mechanism: Road mortality and possibly collecting, as well as residential development (subdivisions) in this species' limited habitat. Grass fires may also cause mortality.

Management Needs

General: Encourage or support further study. The range, population ecology, and threats to this species in Pima County are not well known.

Current protective measures: Collection is prohibited by state law.

Corridor and migratory needs: No known information is available on this species' need for corridors or migration, though the latter is unlikely.

Key relationships: No key relationships are known for this species in this area. In some parts of its range, the western box turtle may be associated with prairie dog towns and is often associated with banner-tailed kangaroo rat burrow mounds (Biota Information System of New Mexico 2008g).

Existing monitoring and research programs: The Arizona Game and Fish Department is soliciting confirmed sightings of the species.

Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-28): 748.

Acres of mitigation habitat within the current portfolio of conservation lands: 5,799.

Determination of Incidental Take

Pima County anticipates that take of desert box turtle will increase as a result of road building. On roads, direct mortality will be easy to detect, but detection will be difficult elsewhere because of its cryptic coloration; the species' narrow above-ground seasonal and daily activity patterns (owning to the fact that is an ectothermic animal); losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as subsequent erosion, invasive species, pets, light, etc. Therefore, Pima County will use acres of PCA habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of desert box turtles. Effects to habitat can result in the following impacts to desert box turtles: direct impacts to burrows or other burrow-creating mammals whose burrows it utilizes; abandonment of burrows due to noise, activity, etc; being forced into suboptimal habitat or already-occupied habitat; increased predation; increased erosion and sedimentation affecting life history requirements; starvation and reduced reproductive output due to reduced habitat quality and increased competition; habitat fragmentation preventing or reducing the ability of species to move, disperse, or migrate to meet life history needs; etc.

Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the desert box turtle:

- Keep track of credible sightings of individuals within Pima County.
- Place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4;

- Protect and enhance habitat conditions for existing natural populations (mainly Cienega Creek and San Pedro River) as indicated by emerging research and where feasible;
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Enforce off-highway vehicle laws on County properties and work with Arizona Game and Fish to address additional off-highway vehicle enforcement needs.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

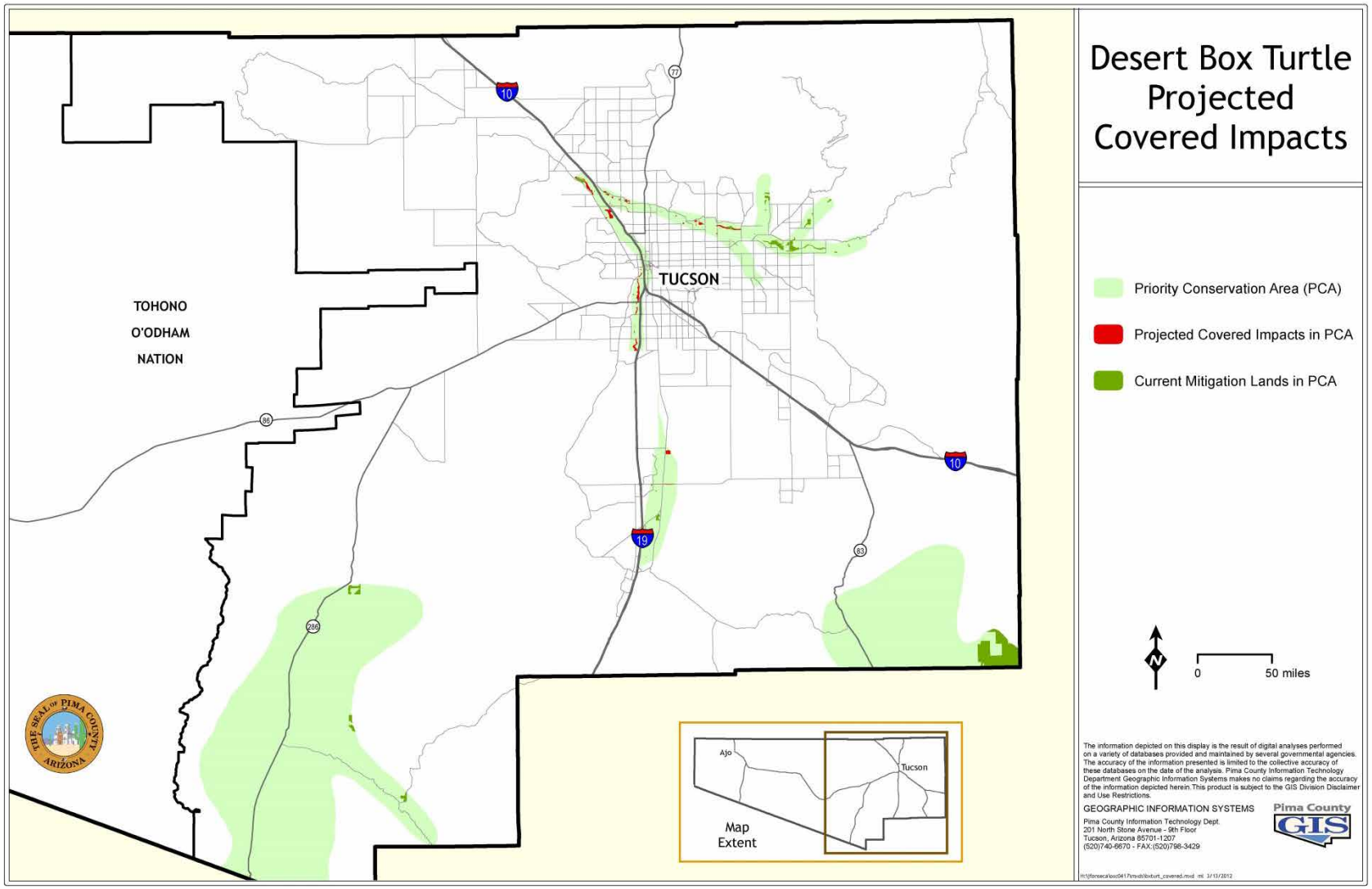
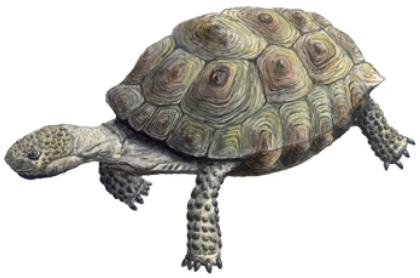


Figure A-28. Map of projected impacts and mitigation for the desert box turtle.

Sonoran desert tortoise (*Gopherus morafkai*)

Conservation Status



Endangered Species Act Status: Petitioned (in 2008) for protection under the Endangered Species Act. A positive 12-month finding was made in December 2010 indicating that listing was warranted, but precluded by other higher priority actions. As such, it was listed as a candidate species under the ESA. In October 2015, the USFWS declared the Sonoran desert tortoise does not warrant Endangered Species protection and it has been removed from the ESA candidate list. This species was recently split from the Agassiz's desert tortoise (*Gopherus agassizii),* which is found west of Pima County.

State: Wildlife of Special Concern in Arizona.

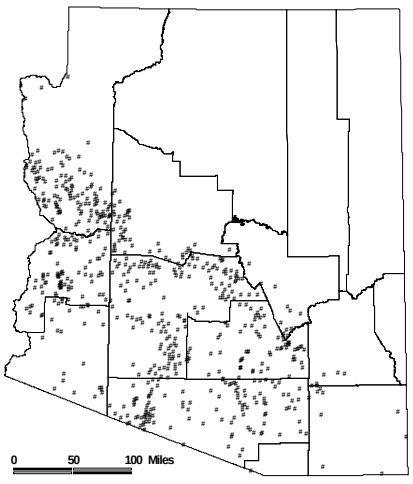
Other: Has special protection in Mexico; protected from international trade by CITES.

Rankings: G4, S4.

Description

The Sonoran desert tortoise is a terrestrial species that reaches adult sizes of about 20 to 38 centimeters (Stebbins 1985). The Sonoran desert tortoise has a high domed shell, usually a brown or grey carapace, with a definite pattern and growth lines on the carapace. The plastron is unhinged and often pale yellow in coloration. The limbs are very stocky, including elephant-like rear conical limbs; the forelimbs are flattened and covered with large conical scales. The tail is short. Males have long gular projections on the plastron below the throat and larger chin glands on each side of the lower jaw. Individuals of the Sonoran species tend to be more pear-shaped, with narrower front ends, wider flared rear ends and flatter carapaces, while Mojave desert tortoises tend to be more oval and have a higher domed carapace.

Distribution and Trend



The Sonoran desert tortoise lives south and east of the Colorado River, from locations near Pearce Ferry in Mohave County, to the south beyond the International Boundary, and many scattered locations in between. The northeastern-most tortoise records in Arizona occur along the Salt River near Roosevelt Lake in Gila County. The middle San Pedro River drainage in Cochise County harbors the eastern-most substantial populations. Tortoises have been found as far west as the Barry M. Goldwater Range, Yuma Proving Ground, and the Cabeza Prieta National Wildlife

Refuge (Arizona Game and Fish Department 2001e). Populations throughout its range are becoming increasingly fragmented due to threats to habitat in valley bottoms used for dispersal and exchange of genetic material between populations (U.S. Fish and Wildlife Service 2008).

In Pima County, the Sonoran desert tortoise is widespread across many low-elevation areas of the county where rocky outcrops, caliche-incised washes, and bajadas occur. They are found west of Tucson in the Altar and Avra valleys and nearby mountain ranges including the Sierrita, Baboquivari, Tortolita and Silverbell mountains (Rosen 2003; Flesch et al. 2006; Zylstra 2008; Town of Marana 2009), north and east of Tucson in the Santa Catalina and Rincon mountains (Murray 1996; Flesch et al. 2007; Zylstra 2008), Pantano Wash, and the far western portion of the County (Rosen and Lowe 1996; Wirt et al. 1999; Schmidt et al. 2007). Within Pima County-owned and leased lands, the species has been confirmed at Cienega Creek Natural Preserve, Pantano Wash (FLAP), Tucson Mountain Park, Diamond Bell Ranch, Sweetwater Reserve, McKenzie, Bar-V Ranch, and the A7 Ranch.

Habitat Requirements

The Sonoran desert tortoise occurs primarily on rocky slopes and bajadas of Mojave and Sonoran desertscrub, but may encroach into desert grassland, juniper woodland, and interior chaparral communities, with rare observations in ponderosa pine woodlands. Washes and valley bottoms may be used for dispersal. Tortoises are found from approximately 1,000 feet to 7,800 feet in elevation, with most observations below 4,000 feet (Arizona Game and Fish Department 2001e). Adequate shelter sites are one of the most important habitat features for this species and winter hibernacula are burrows that are often excavated in loose soil or under vegetation, as well as including rock crevices and the incised caliche caves formed in the sides of many large washes.

Home range requirements: According to several short-term telemetry studies, male Sonoran desert tortoises are reported to have variable home range sizes, from 2.6 hectares to 25.8 hectares (Averill-Murray and Klug 2000). Individual home ranges overlap both within and between the sexes. Tortoises require loose soil in which to excavate burrows, or the availability of cavities and crevices in rock outcroppings or wash banks. Burrows are one of the most important tortoise habitat features in the Sonoran Desert.

Current and Potential Threats

General: Threats include loss and degradation of habitat, road mortality, illegal collection and vandalism, predation by feral dogs and, to a lesser degree, Upper Respiratory Tract Disease (URTD) (Jones et al. 2005), and predation by ravens. Causes of habitat loss include roads, housing, and energy development; conversion of habitat to agriculture; overgrazing; and off-road vehicle use, and invasion of exotic plant species which may cause negative impacts associated with fire, the impingement of movement through thick patches of buffelgrass, and reduced body condition presumably due to nutrition-related impacts of nonnative grasses (Arizona Game and Fish Department 2001e).

Existing and potential pest species: Mountain lions are one of the few, if not only, natural predators capable of breaking through an adult tortoise's shell, but other carnivores, including coyote, kit fox, bobcat, gray fox, gila monsters and large snakes, and badger, may prey on hatchlings, juveniles, and eggs or kill adults by chewing on exposed limbs. Feral dogs are also a threat. Other potential predators of small tortoises include golden eagle, other raptors, common ravens, and greater roadrunners.

Threat mechanism: Desert tortoise populations have been impacted by fragmentation, degradation, and loss of habitat and by elevated mortality rates caused by drought, shooting, road mortality, predation by dogs and ravens (especially near human settlements and roads), disease, livestock trampling, and collecting, among other causes. Release of captive tortoise may result in disruption of wild populations or introduction of diseases; although a recent study indicates that captive tortoises in the Tucson area are not important repositories for URTD (Jones et al. 2005). However, Jones et al. (2005) found that tortoises in suburban areas were significantly more likely than those from remote areas to possess antibodies for the URTD, suggesting that urbanization may have a negative impact on tortoise health. Fires affect tortoises directly, killing them with heat or low oxygen levels, and indirectly by altering their habitats (Esque et al. 2003). The threat of fire in areas occupied by tortoises is increasing with the expansion of non-native, invasive plant species, especially non-native grasses.

Management Needs

General: The Arizona Game and Fish Department has monitored 26 permanent plots sporadically since the 1970s, with 13 sites being surveyed at least 4 times each. That monitoring program has received attention in the last few years, with a more concerted effort being put forth in the western part of Arizona (Cristina Jones, *personal communication* to Brian Powell). Additional research is also necessary to develop a more complete understanding of tortoise populations and how they respond to different land management practices. Research should include studies on population dynamics (reproductive ecology, life tables, population viability, population genetics), habitat (effects of exotic vegetation, fire, and grazing), disease, and effectiveness of mitigation measures.

Current protective measures: AGFD lists the desert tortoise as a species of special concern and it is fully protected in the state of Arizona. It is illegal to kill or capture a desert tortoise except under special permits issued by AGFD. Tortoises salvaged from urban or developing areas must be relinquished to the AGFD or to the Arizona-Sonora Desert Museum for adoption. Release of captive wildlife, including desert tortoises, into the wild is prohibited. Pima County's Floodplain ordinance provides some avoidance and minimization measures for areas along certain watercourses, including Pantano Wash. Pima County's Hillside ordinance restricts grading of steep hillsides and protects certain peaks and ridges.

Corridor and migratory needs: No known information is available on this species' need for corridors, but recent genetic data indicate that gene flow has regularly occurred between mountain ranges in southern Arizona, and such genetic exchange is likely to

decrease or stop completely because of anthropogenic barriers to tortoise movement such as roads (Edwards et al. 2004). Examples of such barriers include interstate highways (I-10 and I-19), CAP canals, railroads, and busy streets.

Key relationships: No key relationships are known for this species in the study area, although the presence of rocky hillsides, outcrops, and incised caliche formations in wash sides are necessary habitat requirements.

Existing monitoring and research programs: Saguaro National Park, Organ Pipe Cactus National Monument, Arizona Game and Fish Department, and Bureau of Land Management all have ongoing monitoring programs. Revisions to the statewide monitoring program for the species was suggested by Zylstra and Steidl (2009).

Management goals: Reduction in habitat fragmentation, habitat loss and degradation from urban and agricultural development and roads, and control of non-native grass and forbs would assist in maintaining stable populations of desert tortoise in the planning area. The establishment of reserves within Pima County allows for permanent protection from conversion of natural land cover of large areas of desert tortoise habitat, as well as opportunities for long-term monitoring of tortoise populations.

Projected Modeled Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-29): 9,473.

Acres of modeled habitat within the current portfolio of conservation lands: 52,069.

Determination of Incidental Take

Pima County anticipates that take of the desert tortoise will increase as a result of road building. On roads, direct mortality will be easy to detect, but detection will be difficult elsewhere because of the species' narrow above-ground seasonal and daily activity patterns (owning to the fact that is an ectothermic animal); losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as subsequent erosion, invasive species, pets, etc. Therefore, Pima County will use acres of modeled habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of Sonoran desert tortoise. Effects to habitat can result in the following impacts to Sonoran desert tortoise: direct impacts to burrows; abandonment of burrows due to noise, activity, etc.; being forced into suboptimal habitat or already-occupied habitat; increased predation; increased erosion and sedimentation affecting life history requirements; starvation and reduced reproductive output due to reduced habitat quality and increased competition; habitat fragmentation preventing or reducing the ability of species to move, disperse, or migrate to meet life history needs; etc.

Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the Sonoran desert tortoise:

- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4;
- Enforce off-highway vehicle laws on County properties and work with Arizona Game and Fish to address additional off-highway vehicle enforcement needs.
- Implement the Floodplain and Hillside ordinances as described in Chapter 4:
- Investigate opportunities for minimizing lethal take.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

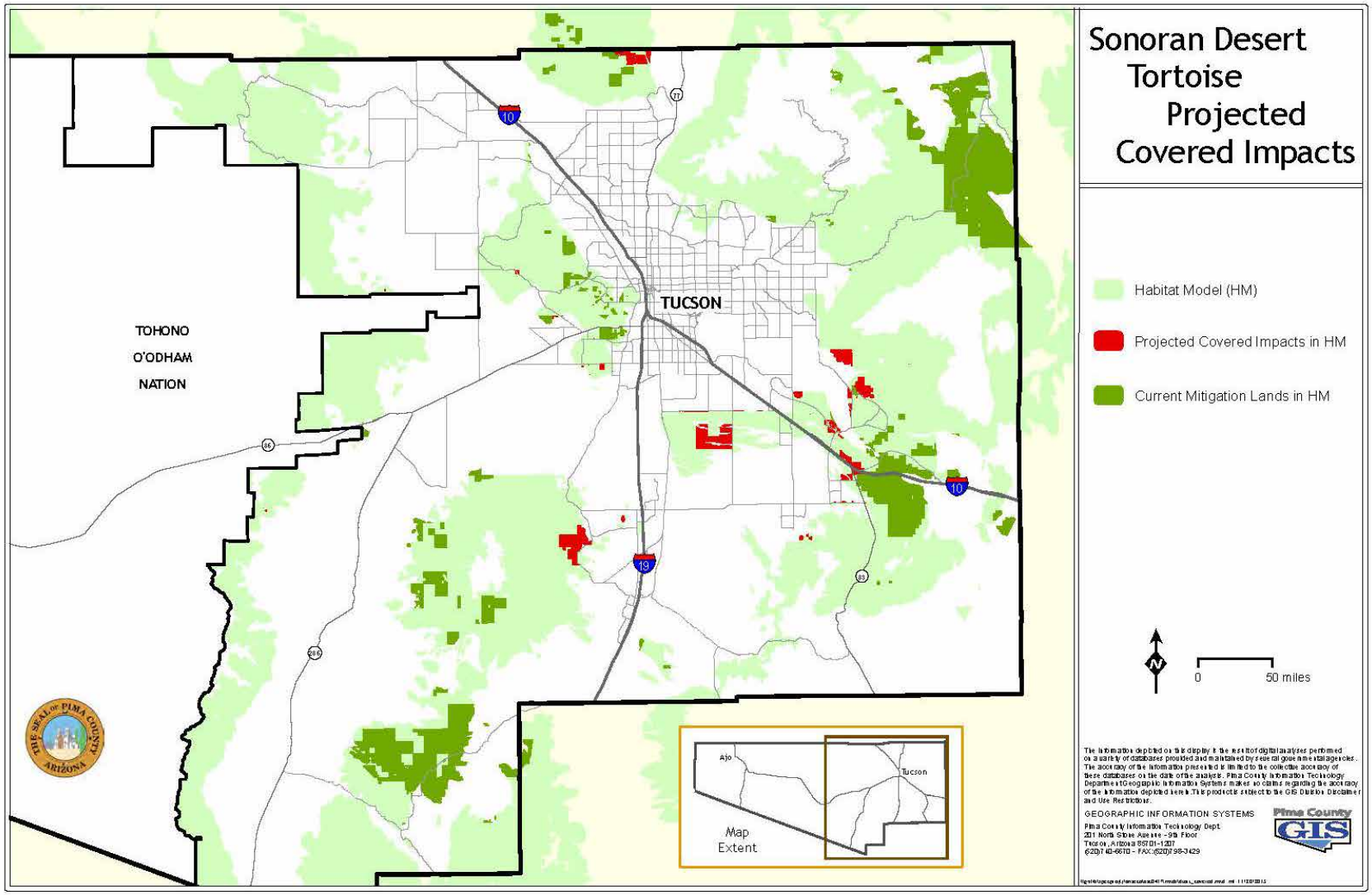


Figure A-29. Map of projected impacts and mitigation for the Sonoran desert tortoise.

Northern Mexican Gartersnake (*Thamnophis eques megalops*)

Conservation Status

Endangered Species Act Status: Petitioned (in 2003) for protection under the Endangered Species Act (Center for Biological Diversity 2003). In 2008 the species was determined to be "warranted" for listing under the ESA, but was precluded from listing due to higher priorities and became a candidate species. However, in 2014 the species was designated as a threatened species (U.S. Fish and Wildlife Service 2014c). Critical habitat was proposed in 2013 (U.S. Fish and Wildlife Service 2013b).

State: Wildlife of Special Concern in Arizona, State endangered in New Mexico.

Other: Determined subject to special protection in Mexico; protected from international trade by CITES.

Rankings: G3; S2, S3.

Description

The northern Mexican gartersnake has a relatively stout body with a total length of 18.0 to 40.0 inches (45.7 to 101.6 cm). Individuals are brown to greenish brown with a yellow-white dorsal stripe flanked by stripes on the third and fourth scale rows in the anterior region. Large brown blotches are on the back of the head that are separated from the corner of the mouth by light-colored crescents (Stebbins 1985).

Distribution and Trend

The historical range of the northern Mexican gartersnake includes Arizona, New Mexico, and northwest Mexico, from southern Arizona to Oaxaca, Mexico, but it is now extirpated from the Colorado River near Yuma, the apparent western limit of this snake's historical range (Arizona Game and Fish Department 2001j). In Arizona, this subspecies ranges from the southeast corner of the state from the Santa Cruz Valley east and north (Arizona Game and Fish Department 2001j) as far as the Verde River (Schmidt et al. 2005). Records after 1980 include the San Rafael Valley and Sonoita grasslands areas, Arivaca, the Agua Fria, Verde, Salt, and Black rivers, and Oak Creek. *T. e. megalops* is extirpated from the Santa Cruz and Rillito rivers, and Tanque

Verde and Pantano washes in the Tucson area (Rosen and Schwalbe 1988). In a rangewide survey in 1988, this species was found in Lower and Upper Sonoran Life Zones, at elevations from 1,739 to 6,152 feet, within 50 ft of permanent water where lush vegetation grew (Rosen and Schwalbe 1988).

Within Pima County, the northern Mexican gartersnake was historically found at Cienega Creek, including the County's Cienega Creek Natural Preserve (Rosen and Schwalbe 1988; Rosen and Caldwell 2004), but the status of the population there is uncertain because a recent and extensive survey of the population on the Las Cienegas National Conservation Area (upstream of the County property) found a precipitous decline from 2003 to 2011 (Rosen et al. 2013). However an adult specimen was documented on the Cienega Creek Preserve in 2014. It may occur in the Altar Valley and Arivaca Cienega (Rosen and Schwalbe 1988). A 2007 survey of the lower Santa Cruz River found no Mexican gartersnakes (D. Abbate personal communication, in Town of Marana 2009). The species is found in greater abundance to the southeast of Pima County in the San Raphael Valley, Canelo Hills, and Sonoita grasslands (Rosen et al. 2001).

Habitat

In Arizona, habitat for this species is chiefly cienegas within desert grassland to elevations of 8,500 feet (Arizona Game and Fish Department 2001j). However, habitat occasionally includes desert and lower oak woodland habitats. This subspecies also occurs in and adjacent to streams in valley floors and generally open areas, but not in steep mountain canyon stream habitats. Within streams and cienegas, the species uses areas that are characterized by shallow, slow moving, and at least partially vegetated water bodies, such as springs. In general, this species requires intact riparian vegetation communities along permanent water that is free from bullfrogs, but which also includes habitat for prey species, such as native fish and leopard frogs.

Current and Potential Threats

General: "Mexican gartersnake historical localities in the Phoenix and Tucson areas have all been devastated by urbanization, introduction of bullfrogs and predatory fishes and removal of dense vegetation" (Rosen and Schwalbe 1988). Lowering of the water table, destruction, degradation, and fragmentation of habitat, predation by introduced bullfrogs and predatory fishes, and direct mortality are all considered threats to this species (Arizona Game and Fish Department 2001j).

Existing and potential pest species: Non-native predators are known to include bullfrogs, fishes, and may include crayfish (Rosen and Schwalbe 1988; Arizona Game and Fish Department 2001j).

Threat mechanism: Habitat loss through water depletion and diversion combined with invasive, aquatic predators. The species does not appear to be severely impacted by cattle grazing in Mexico as long as non-native predators and competitors are absent or at low levels (Jeff Servoss, *personal communication* to Brian Powell).

Management Needs

General: Management of introduced species, water, and riparian cover are needed for this species. Studies of distribution, habitat, populations, and life history are suggested (Arizona Game and Fish Department 2001j).

Current protective measures: The USFWS has proposed threatened status under the ESA.

Corridor and migratory needs: This is probably a metapopulation species that has historically existed as multiple local populations, formerly connected by contiguous rivers and streams. The conditions that would foster maintenance of local populations and connections between them have been eliminated as a result of human activities. Artificial maintenance of local populations and gene flow may be necessary.

Key relationships: The best-known key relationships are adverse for this species and involve non-native species. Healthy populations of this species are found in association with leopard frogs (*Lithobates* sp.) and the fish genera *Gila* and *Poeciliopsis* (Rosen and Schwalbe 1988). Conservation of these prey species is thought to be critical for the Mexican gartersnake.

Existing monitoring and research programs: An extensive survey for this species was conducted in 2012 at Las Cienegas National Conservation Area and revealed population declines as compared to surveys in 2002-2003 (Rosen and Caldwell 2004; Rosen et al. 2013).

Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-30): 3,210.

Acres of mitigation habitat within the current portfolio of conservation lands: 10,856.

Determination of Incidental Take

Pima County anticipates that take of northern Mexican gartersnake will be difficult to detect because of the species' cryptic coloration; the species is secretive by nature and is very difficult to detect; losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, cannibalism, starvation, etc.); and natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, dredging, increased human activity, and indirect impacts such as subsequent erosion, invasive species, etc. Therefore, Pima County will use acres of PCA habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of northern Mexican gartersnakes. Effects to habitat can result in the following impacts to northern Mexican gartersnakes; abandonment of breeding areas due to noise, activity, presence of cattle, light, etc.; individuals being forced into suboptimal habitat; increased predation; increased

occurrence of non-native competitors and predators (e.g., crayfish and bullfrogs); increased erosion and sedimentation affecting life history requirements; starvation and reduced reproductive output due to reduced habitat quality and increased competition; effects to stream flow pattern resulting in reduced pool and surface water habitats, loss of aquatic and riparian vegetation as breeding, feeding and sheltering habitat; habitat fragmentation preventing or reducing the ability of species to move, disperse, or migrate to meet life history needs; etc.

Impact of Covered Activities on Critical Habitat

Critical habitat for the northern Mexican gartersnake was proposed on July 10, 2013, with approximately 157,000 acres in Pima County. In the proposed critical habitat, three areas of Pima County are included: (1) Buenos Aires National Wildlife Refuge in the Altar Valley, (2) Cienega Creek, and (3) San Pedro River. The area of the Cienega Creek Natural Preserve is being proposed for exclusion from the critical habitat designation. Covered activities are modeled to impact 0 acres of proposed critical habitat for the northern Mexican gartersnake. Approximately 4,459 acres of critical habitat are in Pima County's proposed mitigation lands.

Management and Conservation Commitments

Pima County will pursue the following management actions and conservation commitments for the northern Mexican gartersnake:

- Work with AZGFD and USFWS to carry out the County's intention to reestablish northern Mexican gartersnakes (as articulated in the Riparian and Aquatic Species Management Plan) on mitigation and County-owned lands;
- Continue to support eradication of predatory, invasive aquatic species in select areas.
- Implement the Pima County Floodplain Ordinance to minimize loss of habitat as described in Chapter 4.
- Place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4;
- Acquire and protect existing water rights to maintain and restore habitat, where feasible.
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

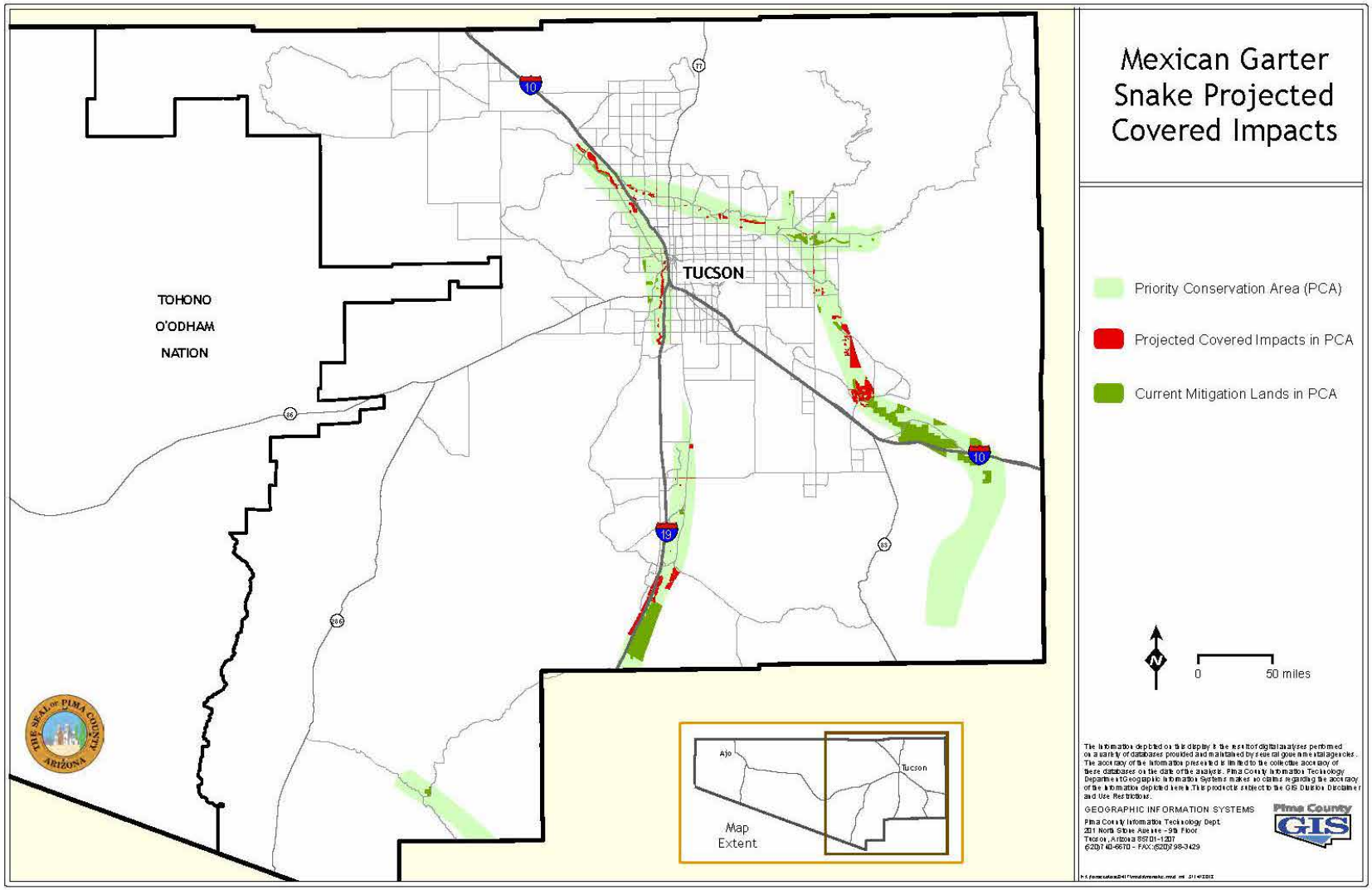


Figure A-30. Map of projected impacts and mitigation for the northern Mexican gartersnake.

Groundsnake (valley form) (*Sonora semiannulata*)

Conservation Status

Endangered Species Act Status: None.

State: None.

Other: None.

Rankings: G5, S5.

Description

The ground snake is a small species that may reach about 18 inches (45 cm) total length. The species is highly polymorphic. Dorsal color is brownish, orange, reddish, or gray. Patterns include plain, cross-banded, longitudinally banded (red or orange if present), or a combination (Stebbins 1985). Plain, striped, and cross-banded individuals sometimes occur at the same locality (Stebbins 1985).

Distribution and Trend

The ground snake is known to occur in New Mexico, Arizona, Colorado, Utah, Texas, and Chihuahua and Sonora, Mexico at elevations from 2,000 to 5,500 feet (Stebbins 1985). The valley form is known only from an undetermined limited area in Pima County. The range of *S. semiannulata* includes grassland areas of the central United States from southeastern Colorado to southwest Missouri, south and west into northern Mexico. It ranges across the deserts of west Texas, New Mexico, Mexico, Arizona, Nevada, and California. Apparent isolated populations exist in eastern Oregon and western Idaho, Baja California, northern Utah, and northern Kansas (Stebbins 1985; Degenhardt et al. 1996). Scattered localities occur from the southern half and northwestern quarter of Arizona (Lowe 1964). The valley form is only known from Pima County.

In Pima County, the species is found in desert grassland areas around the base of the Tortolita, Santa Catalina, and Rincon mountains. Two individuals were found at the Rincon Mountain District of Saguaro National Park in 2001-2002 (Flesch et al. 2007), but no individuals were found in the Tucson Mountain District of Saguaro National Park (Flesch et al. 2006). Rosen (2004) reports other credible historical sightings near Oracle and Redington Pass and throughout the Avra Valley. Four historical records of the ground snake show that it once occurred along the Blanco Wash, from the

confluence with the Santa Cruz River south to Avra Valley Road (City of Tucson 2008). In June 2003, one ground snake was found at Blanco Wash and Silverbell Road (Rosen 2004). In 2004, ground snakes were confirmed to persist at Red Rock (Pinal County). Surveys in 2004 found no reconfirmation of the species along I-10, near the Marana exit (Rosen 2004), but surveys in 2008 revealed two individuals (Rosen 2008a). A photographic voucher was collected at the base of the Tortolita Mountains in the Town of Marana, near Stone Canyon (Rosen 2004). No individuals have been confirmed in the lands that are owned or leased by Pima County, but the species may occur on Avra Valley FLAP parcels or at Lord's Ranch.

Habitat

This species occupies plains, valley, and foothill habitats (Lowe 1964; Degenhardt et al. 1996). It has been found mostly near mountains with higher slopes and areas with poorly drained soils, and speculation is that this is because subsurface moisture is required for the species and its arthropod prey (Stebbins 1985; Degenhardt et al. 1996). Vegetation may be scant (Great Basin sagebrush plains and creosote desert), or dense (lower Colorado River thickets of mesquite, arrowweed, and willow communities). The species ranges from prairies through desert communities, thornscrub, and pinyon-juniper woodland to the pine-oak zone (Stebbins 1985). Specifically, this species has been found in Tobosa desert grassland over silty, loamy clay soils on the Tohono O'odham Nation (P. Rosen, *personal communication* to D. Scalero, 4 Mar 1999).

Current and Potential Threats

The valley form of the ground snake is thought to be impacted by habitat destruction, primarily conversion to agriculture and development. It is likely also impacted by road mortality as a result of seeking out roads for warmth. Recent increases in the spread of buffelgrass and the associated impacts of fire and desiccation may also be impacting this species.

Management Needs

General: The most pressing need is for identification and delineation of the habitat of this form and determination of actual threats to it. This may be followed by development of specific management policies and methods.

Current protective measures: None are specifically known.

Corridor and migratory needs: No information is known for this species.

Key relationships: No information is known for this species.

Existing monitoring and research programs: No known programs are specifically directed at this species. Numerous amateur and professional herpetologists maintain their own records of the species they encounter, generally in an informal way, and they may have information of use in understanding the distribution, biology, and conservation needs of this form.

Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-31): 11.

Acres of mitigation habitat within the current portfolio of conservation lands: 904.

Determination of Incidental Take

Pima County anticipates that take of the ground snake will be difficult to detect because of the species' narrow above-ground seasonal and daily activity patterns (owning to the fact that is an ectothermic animal); losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); and natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as subsequent erosion, invasive species, pets, etc. Therefore, Pima County will use acres of modeled habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of the ground snake. Effects to habitat can result in the following impacts to the ground snake: direct impacts to burrows; abandonment of burrows due to noise, activity, light, etc.; being forced into suboptimal habitat or already-occupied habitat; increased predation; increased erosion and sedimentation affecting life history requirements; starvation and reduced reproductive output due to reduced habitat quality; habitat fragmentation preventing or reducing the ability of species to move, disperse, or migrate to meet life history needs; etc.

Management and Conservation Commitments

Pima County will pursue the following management action and conservation commitment for the ground snake:

- Implement the Pima County Floodplain Ordinance to minimize loss of habitat as described in Chapter 4;
- Place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4; especially for lands in northern Avra Valley north of the Avra Valley Road.
- Management plans for mitigation lands in northern Avra Valley will address means to detect and limit off-road vehicular impacts to habitat.
- Enforce off-highway vehicle laws on County properties and work with Arizona Game and Fish to address additional off-highway vehicle enforcement needs.
- Work with City of Tucson and Marana to encourage conservation of lands in northern Avra Valley;
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

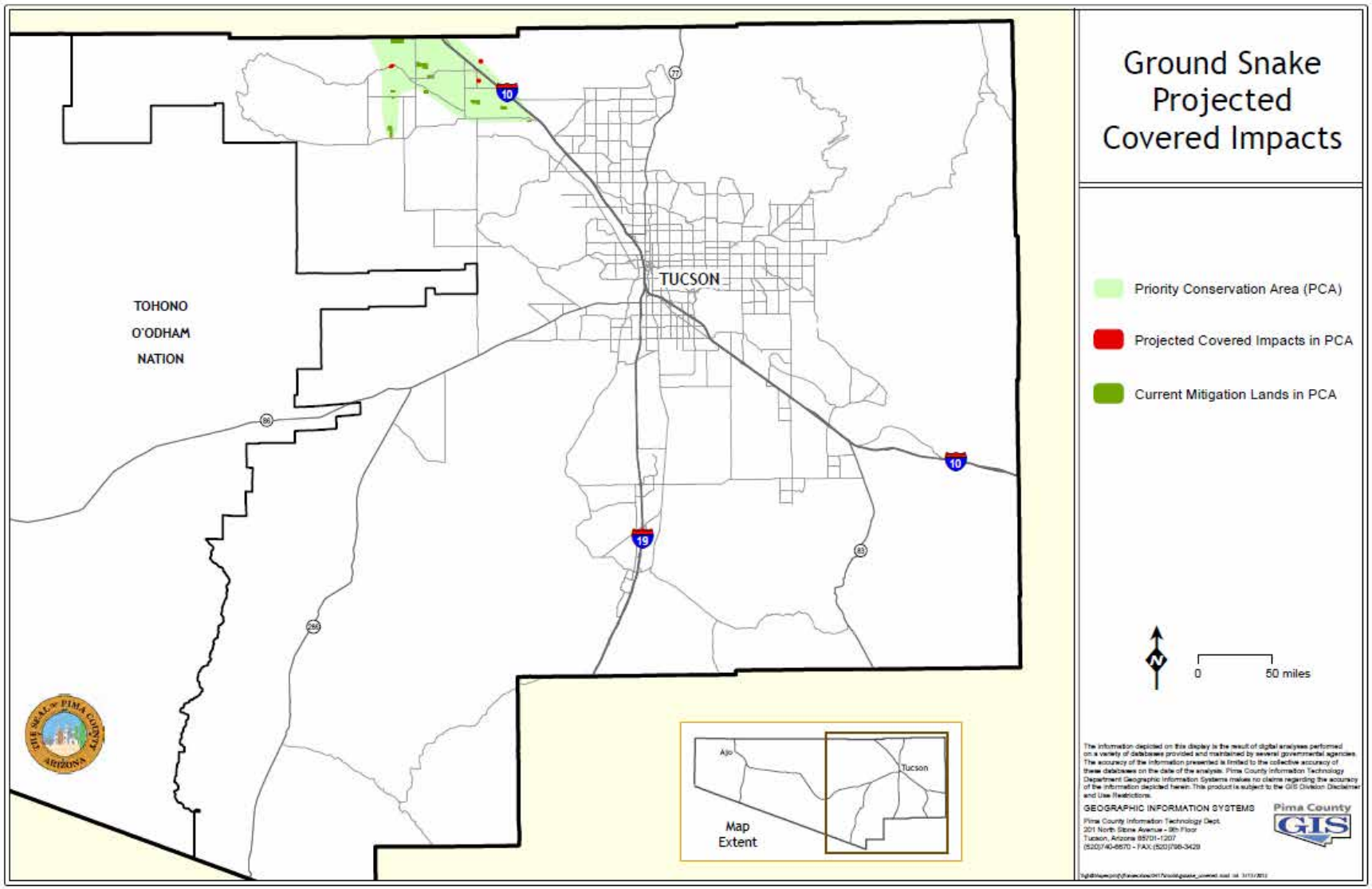


Figure A-31. Map of projected impacts and mitigation for the groundsnake.

Tucson shovel-nosed snake (*Chionactis occipitalis klauberi*)

Conservation Status

Endangered Species Act Status: Petitioned for listing in 2004. In 2010, the subspecies was determined to warrant protection under the ESA, but it was precluded by higher priority actions and became a candidate species. In September 2014 the USFWS concluded that this subspecies did not warrant protection under the Endangered Species act, and was removed from the Endangered Species candidate list. Subspecies status was recently upheld for the Tucson shovel-nosed snake (Wood et al. 2014).

State: None.

Other: None.

Rankings: G5, S5 for the western shovel-nosed snake.

Description

The adult Tucson shovel-nosed snake is 10 to 17 inches (25 to 42 cm) long. Markings vary considerably between individuals and between subspecies. Tucson shovel-nosed snakes have a cream-colored, whitish or yellowish body with approximately 21 or more black or brown bands across the back, reaching almost to the belly or encircling the body. Between these bands are black or brown smaller bands. The snout is flattened and shaped somewhat like a shovel (Stebbins 1985). The taxonomy of this species is a subject of debate (Wood et al. 2008).

Distribution and Trend

Historically, the range of the western shovel-nosed snake in Arizona includes the Sonoran and Mohave deserts in the southwestern portion of the state, within which its distribution is limited chiefly to dry desert habitat (e.g., dunes, washes, bajadas) and similar areas with soft, sandy loams and sparse gravel (Lowe 1964; USFWS 2014). This species has been found in an area from northern Pima County across southwestern Pinal County into southern Maricopa County (Stebbins 1985). However, recent genetic information is available from a U.S. Geological Survey study using both mitochondrial DNA and 11 microsatellite loci

to assess whether patterns of population genetic structure follow the spatial structuring of phenotypic variation that originally led to the subspecies description and included samples from all subspecies of the western shovel-nosed snake throughout its range (Wood et al. 2008). The genetic data indicate that the Tucson shovel-nosed snake is a much wider ranging subspecies than originally thought. Therefore, the current range of the Tucson shovel-nosed snake, as defined by the USFWS, includes portions of central and western Arizona in Pinal, Maricopa, Yavapai, Yuma, Pima, and La Paz counties.

In Pima County, the most recent records of the Tucson shovel-nosed snake in or near the County were: (1) Sanders Road and Avra Valley Road in 1979 (Rosen 2003) and (2) near Picacho Reservoir (Pinal County) in 2006 and 2007 (Rosen 2008b), and (3) north of the West Silverbell Mountains (Pinal County) (Rosen 2008b). One individual was found in the Sonoran Desert National Monument on State Route 238. Despite extensive survey efforts to locate the species in the Avra Valley, particularly in 2007-2008, no individuals were found (Rosen 2003, 2007; Rosen 2008b). It is unknown if the species currently persists in the Permit Area.

Habitat

The western shovel-nosed snake is known from the Lower Sonoran life zone, in areas with sand and loose soil. It consistently occurred on open, sandy sites and was present in mixed riparian scrub (xeroriparian), creosotebush (lower Colorado desert), and Sonoran desert scrub (Arizona Upland) and it was also present in mesquite bosque (floodplain woodland) (Jones 1988). It is absent or infrequent in rocky desert terrain. It is most abundant in flat and sparsely vegetated areas with fine, wind-blown sand, such as dunes, washes, sandy flats, loose soil, and rocky hillsides having sandy gullies or pockets of sand among rocks (Lowe 1964; Stebbins 1985). Associated vegetation includes creosote, desert grasses, desert forbs, cactus, and mesquite (Stebbins 1985).

Current and Potential Threats

General: Loss of habitat to agricultural and urban development is likely to impact this species in portions of its range. Off-road vehicle activities are likely to adversely affect this species. Road building is likely to have destroyed and possibly fragmented some habitat and increased traffic probably increases road kill of individuals.

Specific: This subspecies has probably suffered significant losses of habitat due to agricultural and urban development in the Avra Valley. It also is impacted by highway traffic within its habitat, and it may be affected by scientific and commercial collecting.

Existing and potential pest species: There is no known evidence of any pest species that affects this species. It is possible that invasion of its habitat by non-native plants, such as red brome, buffelgrass, or black mustard may be detrimental to this species by reducing or eliminating open ground and increasing the occurrence of fire.

Threat mechanism: Habitat loss due to agricultural and urban development; off-road vehicle activity, including military activity, may compact soil or crush buried snakes; increased highway traffic may cause direct mortality. Collection by herpetologists and illegal commercial collectors may cause local population losses. Recent increases in the

spread of buffelgrass and the associated impacts of fire and desiccation may also be impacting this species.

Management Needs

General: Protection of habitat from development and disturbance by off-road vehicle activities, and enforcement of laws against commercial collection are necessary to protect this species. Speed limits or other road use limitations (such as seasonal restriction of use after dark) may help protect snakes (Rosen and Lowe 1994).

Current protective measures: Some of this species' habitat is protected within Organ Pipe Cactus National Monument and Saguaro National Park, Tucson Mountain District. Arizona prohibits commercial collection of reptiles, and any collection of this subspecies, but enforcement is limited. Pima County's Floodplain ordinance may afford suitable habitat some avoidance, minimization or mitigation measures.

Corridor and migratory needs: None are specifically identifiable. This species is capable of crossing roads, including paved highways, although road kill may be a significant cause of mortality in some locations.

Key relationships: In much of its range, the western shovel-nosed snake is associated with creosotebush, which it may use as escape cover and as a foraging substrate. Glass (1972) made observations that strongly suggested that this subspecies may have a physiological resistance to scorpion (*Vejovis spinigeris*) venom, and contrasted scorpion capture behavior of this subspecies with that of *C.o. occipitalis* described by other authors. This suggests that scorpions may be a significant part of this subspecies' diet, and that subspecies may differ in behavior and physiology. Banded sand snakes (*Chilomeniscus cinctus*) appear to be replacing or out competing Tucson shovel-nosed snakes out of existing areas of the Tucson shovel-nosed snake's range.

Existing monitoring and research programs: While no specific studies are currently known within Pima County, the AGFD is conducting surveys, telemetry work, and other monitoring in adjacent Pinal County on lands associated with the Arizona National Guard.

Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-32): 63.

Acres of PCA habitat within the current portfolio of conservation lands: 1,276.

Determination of Incidental Take

Pima County anticipates that take of the Tucson shovel nosed snake will be difficult to detect because of the species' narrow above-ground seasonal and daily activity patterns (owning to the fact that is an ectothermic animal); rarity; losses may be masked by normal seasonal fluctuations in numbers and other causes (predation, migration, starvation, etc.); and natural events (runoff, floods, scavenging, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing, habitat fragmentation, increased human activity, and collisions with vehicles and equipment, and indirect impacts such as subsequent erosion, invasive species, pets, light, etc. Therefore, Pima County will use acres of modeled habitat impacted by covered activities (as described in Table 3.3 of the MSCP) as a surrogate for the incidental take of the Tucson shovel nosed snake. Effects to habitat can result in the following impacts to the Tucson shovel nosed snake: direct impacts to burrows; abandonment of burrows due to noise, activity, light, etc.; being forced into suboptimal habitat; increased predation; increased erosion and sedimentation affecting life history requirements; starvation and reduced reproductive output due to reduced habitat quality and increased competition; habitat fragmentation preventing or reducing the ability of species to move, disperse, or migrate to meet life history needs; etc.

Management and Conservation Commitments

Pima County will pursue the following management action and conservation commitment for the Tucson shovel nosed snake:

- Implement the Pima County Floodplain Ordinance to minimize loss of habitat as described in Chapter 4;
- Place restrictive covenants or conservation easements on County-owned mitigation lands, as described in Chapter 4;
- As funds permit, acquire and restore floodprone lands along the Brawley Wash corridor;
- Work with City of Tucson and Marana to encourage conservation of lands in northern Avra Valley;
- Where feasible, incorporate wildlife crossings into transportation project design in appropriate locations.
- Enforce off-highway vehicle laws on County properties and work with Arizona Game and Fish to address additional off-highway vehicle enforcement needs.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database.

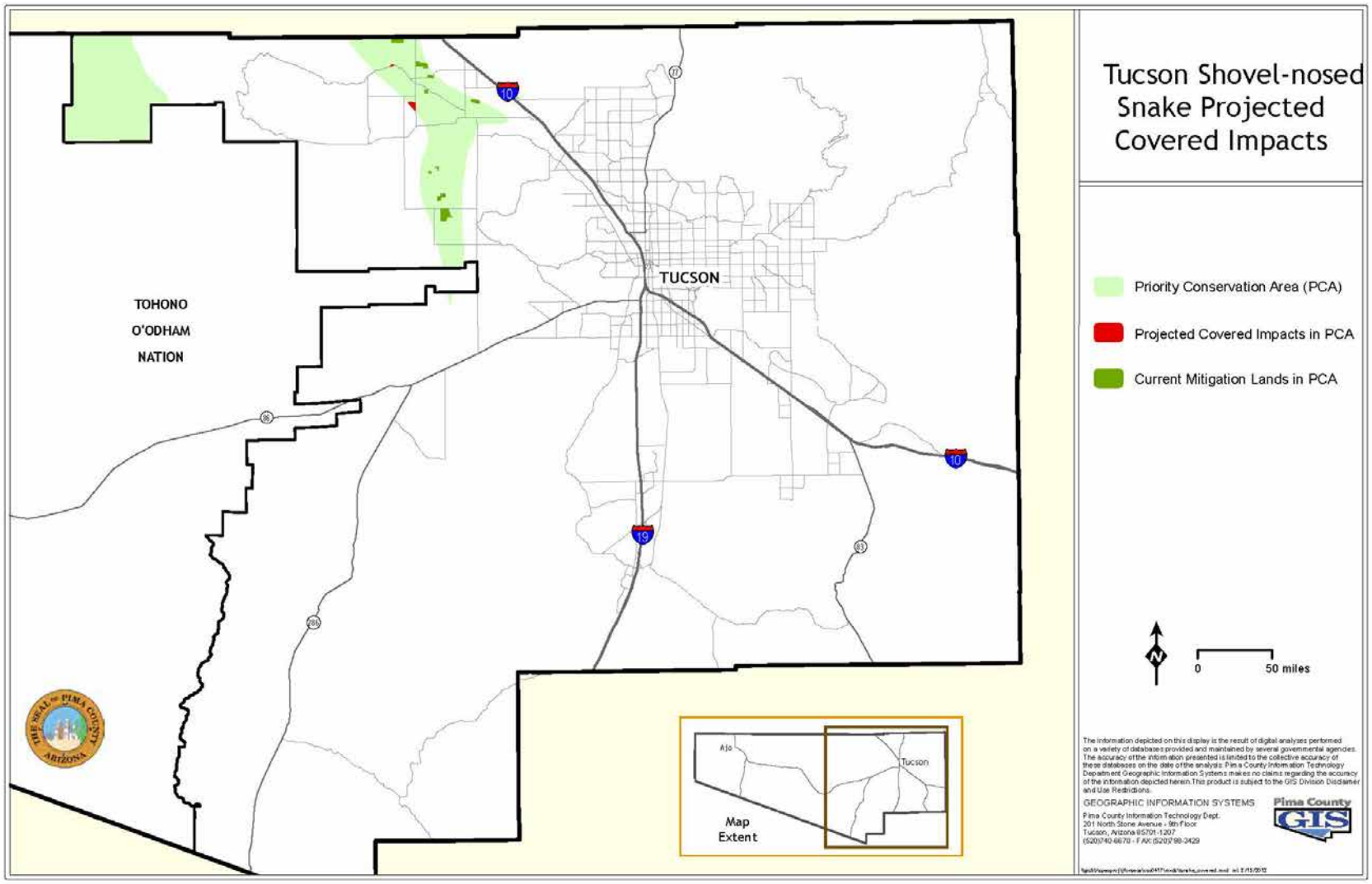


Figure A-32. Map of projected impacts and mitigation for the Tucson shovel-nosed snake.

Invertebrates

Talussnails (*Sonorella* spp.)

Conservation Status

Endangered Species Act Status: One species (*S. eremita*), was proposed for listing as an Endangered species, but the proposal was withdrawn because a Conservation Agreement was developed. The Sonoran talussnail (*S. magdalenensis*) was the subject of a substantial 90-day finding in 2012 as a result of a petition to list under the ESA in which the USFWS declared that protection may be warranted. The Rosemont talussnail (*S. rosemontensis*) was recently found not to warrant species status (Hoffman et al. 2012).

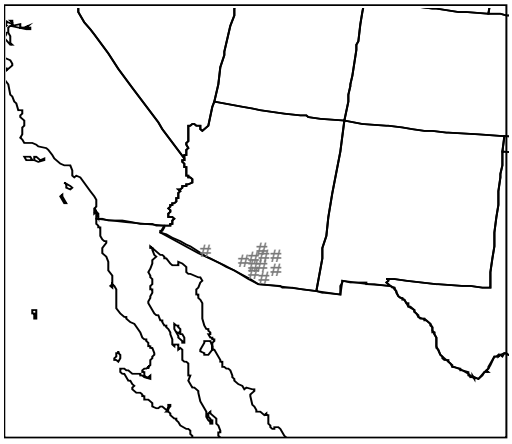
State: None.

Other: None.

Rankings: Most of these species should be G1 or G2; and S1 or S2.

Distribution and Trend

All available evidence supports the hypothesis that all of the localized taxa are relicts of previously widespread taxa isolated by repeated episodes of isolation and dispersal during repeated climate changes in the distant past (McCord 1994; Terkanian 1999). Current distribution is probably not different from historic distribution, but there has been no known systematic search effort in approximately 30 years, and some species may be extinct. Some that were described by Pilsbry and Ferris in 1915 and 1918 were not relocated by Miller in the 1960s and 70s during efforts to re-survey historical collection sites (Bequaert and Miller 1973). The total range of most of the known species is less than the land occupied by one moderate-sized house.



In Pima County, as in the rest of the genera's distribution, this diverse genus of rock snail is usually found in loose masses or "slides" of coarse broken volcanic or limestone rock known as talus. Evidence of talussnails has been found in a number of Pima County-owned and leased properties, including Bar-V Ranch, Colossal Cave Mountain Park, and Old Hayhook Ranch. Many different species are known to occur in Pima County, at a variety of elevations:

Species Name	Known Location(s) in Pima County
Papago talussnail *(Sonorella ambigua)*	Black Mtn, San Xavier District
San Xavier talussnail *(S. eremita)*	Mineral Hill; San Xavier District
Total Wreck talussnail *(S. imperatrix)*	Total Wreck Mine vicinity
Empire Mountain talussnail *(S. imperialis)*	Empire Mtns
Sonoran talussnail *(S. magdalenensis* syn. *tumamocensis)*	Cerro Colorado; Roskruge; S. Tucson Mtns; N. Santa Ritas, Tumamoc Hills
Pungent talussnail *(S. odorata)*	Head of Alder Canyon; Old Dan's Gulch below Marble Peak; Soldier Camp; Bear Wallow
Posta Quemada talussnail *(S. rinconensis)*	Rincon Mountains
Las Guijas talussnail *(S. sitiens)*	Las Guijas Mtn
Santa Catalina talussnail subspecies *(S. sabinoensis tucsonica)*	Tucson Mtns Wild Pig Amphitheater
Santa Catalina talussnail subspecies *(S. sabinoenis buehmanensis)*	Buehman Canyon
Tortolita talussnail *(S. tortillita)*	Tortolita Mtns.
Santa Rita talussnail *(S. walkeri)*	Santa Rita Mountains

Habitat

All *Sonorella* species live in isolated, undisturbed areas of rocks, generally on limestone, mostly, if not exclusively, on north-facing or trending slopes, usually near hilltops or in rocky canyons (Pilsbry and Harris 1915; Pilsbry 1918; Terkanian 1999).

Current and Potential Threats

General: The total known and likely range of many of these species is very small and is isolated from any other potential habitat. Relatively minor perturbations of the habitat may result in changes that impact the snails. These species are thought to be particularly sensitive to potential global climate change (Terkanian 1999).

Existing and potential pest species: None are currently known for these animals, and none are likely to be problematic.

Threat mechanism: Minor to major disruption of habitat by road building, development, or other land uses. Recent increases in the spread of buffelgrass and the associated impacts of fire and desiccation may also be impacting this species.

Management Needs

General: Locating, examining, and documenting the currently existing populations and determining the most appropriate methods of management are the most pressing needs.

Management Needs

General: Locating, examining, and documenting the currently existing populations and determining the most appropriate methods of management are the most pressing needs.

Current protective measures: Some populations are within protected lands, and most are difficult of access. Pima County's Hillside Ordinance may minimize loss of habitat. Some habitat in the Tucson Mountain Park is protected by a reversionary clause under the Recreation and Public Purposes Act. The San Xavier talussnail is protected through a Conservation Agreement.

Corridor and migratory needs: None are known, and the concept is probably irrelevant for these species.

Key relationships: There may be key interdependencies with some species of fungi which are utilized as a food source.

Existing monitoring and research programs: No known monitoring and research programs exist for these species.

Projected PCA Habitat Loss and Mitigation

Acres of habitat projected to be lost due to Covered Activities (Figure A-33): 0.1 ac (per species).

Acres of mitigation habitat within the current portfolio of conservation lands: NA.

Determination of Incidental Take

Pima County anticipates that take of all species of talussnails will be very difficult to detect because the species spend almost all of their time underground and because natural events (runoff, floods, decomposition, etc.) may remove, bury, or destroy dead or injured individuals, making them difficult to detect.

However, incidental take in the form of harm, harassment, and mortality is anticipated from the impacts of covered activities on the species' habitat that results from land clearing (principally trail building), increased human activity, and indirect impacts such as subsequent erosion, invasive species, and desiccation. Therefore, Pima County will use acres of modeled habitat impacted by covered activities (estimated to be 0.1 acre per species) as a surrogate for the incidental take of talussnails. Effects to habitat can result in the following impacts to the talussnails: abandonment of talus habitat due to noise, activity, etc.; being forced into suboptimal habitat; increased predation and desiccation; increased erosion and sedimentation affecting life history requirements; starvation and reduced reproductive output due to reduced habitat quality; habitat fragmentation preventing or reducing the ability of species to move, disperse, or migrate to meet life history needs; etc.

Management and Conservation Commitments

Pima County will pursue the following management action and conservation commitment for talussnails:

- Talus deposits should be identified in rapid assessments for preserve management purposes, and prioritized for survey efforts.
- Management plans for County reserves that include talus deposits should recommend specific measures to avoid and minimize disturbances from County activities. Discretionary projects under Pima County control may not be routed across potentially occupied habitat.
- If buffelgrass management is needed on occupied talus deposits in County-controlled mitigation lands, best management practices should be developed first, in consultation with mollusk experts.
- Requests from outside agencies for right-of-way and grading permits should be reviewed for potential habitat impacts. Further investigations of potentially suitable habitat will be undertaken, where feasible, inclusive of focused surveys and support for confirmation of species taxonomy.
- Continued adherence with protected peaks and ridges standards in the County code (Hillside Ordinance) as described in Chapter 4.
- If state or Federal agencies permit an activity on County-controlled mitigation lands over which Pima County has no jurisdiction, Pima County will request avoidance, inclusive of donation of property rights on remaining habitat and taxonomic studies.
- Map talus deposits on the urban periphery.
- Develop avoidance and minimization measures that apply to utility construction across talus deposits.
- Pima County and BLM will evaluate the potential for talussnail occurrences located on BLM Recreation and Public Purposes Act lands.
- Implement monitoring as described in Appendix N, including recording and entering incidental observations in the Covered Species Information Database as well as the submission of photo vouchers with coordinates to the U of A Natural History Museum, when possible.

Appendix B. Description of Methodology Employed to Calculate Mitigation Obligations and Allocate Mitigation Credits

I. Calculating Mitigation Obligations for Covered Activities

1. Computation of Take for Covered Activities.

The incidental take to be mitigated under this permit is comprised by public and private impacts covered by the permit. Private impacts shall be based on the acreage of the area to be covered as determined through the Opt-out and Opt-in provisions. Public impacts shall be calculated based on the ground-disturbing Capital Improvement Projects occurring outside the Built Environment GIS layer.

a. Computation of Take for Opt-out Area of Coverage - For individual, single-dwelling residential lots where the owner elected for coverage under the permit (see Section 3.4 in the main text of the MSCP for details), Pima County shall provide mitigation from within its portfolio of fee and/or leased lands for the entire parcel or set of parcels affiliated with the issued building permit regardless of the amount of grading. (If a more efficient method becomes available in the future that allows Pima County to more precisely determine the area to be graded and hence, the area of take for this type of Covered Activity, Pima County may propose to implement that more efficient methodology, if approved by USFWS as an amendment to the permit.)

b. Computation of Take For Opt-in Area of Coverage - For residential subdivisions and non-residential development where the owner elects coverage under the permit, Pima County shall provide mitigation from within its portfolio of fee and/or leased lands for the area to be graded as authorized by a site construction or building/site construction permit.

c. Computation of Take for Public Impacts—Pima County shall mitigate for the areas altered by the Capital Improvement Projects that are located outside the Built Environment GIS layer. The areas of ground disturbance outside the built environment that was altered by the project shall be based on the areas identified in final plans, inclusive of temporary construction easements, but excluding any areas of natural cover that received protection during construction. The Built Environment layer may be adjusted periodically by Pima County to reflect new mines, completed CIP projects, and other projects that resulted in removal of natural cover.

2. Computation of Annual Mitigation Obligations.

Computations of take and fulfillment of mitigation obligations shall occur annually based on the total acres of take as determined above within a given annual time period.

a. For each Covered Activity as defined above, Pima County shall determine the acreage of each CLS designation which applies to the area to be covered under the permit. Pima County shall then multiply the acres of each CLS designation by the applicable mitigation ratio(s) specified in the permit.

b. If the area to be covered under the permit, or any portion thereof, lies outside the geographic boundary of Pima County, then Pima County shall use the ratio for the nearest neighboring CLS category.

c. The sum of the resulting information shall be used to determine annual mitigation obligations (in both acres and CLS designations) that are owed for Covered Activities that occurred within that annual time period.

d. As part of the 10-year program reviews, conduct a habitat mitigation equivalency analysis for individual species as discussed in MSCP Section 4.3.3. such that a 1:1 ratio of acres of habitat loss:acres of mitigation can be maintained for each covered species. See below for reallocation of mitigation locations.

e. Reallocation of Mitigation--Protection for take and the requirement to provide mitigation are only effective during the active time frame of the permit and when take occurs within the permit area. Under these conditions, internal reviews by Pima County of such take relative to the permit area and covered activities may result in adjustments to the annual take calculations. For instance, if an area of private land take was annexed by another jurisdiction and was no longer subject to County building or site construction permit requirements prior to take actually occurring, Pima County may subtract the value of the annexed area of take from the County's mitigation ledger, even if it was previously mitigated. Mitigation land that was encumbered as a result of take that did not comply with the terms of the incidental take permit may be re-allocated to offset other habitat loss under the permit. Mitigation locations may also be adjusted to maintain the minimum equivalency conservation ratio for individual species. Such adjustments shall be reported in the annual report.

II. Allocation of Credits to Mitigate for Covered Activities

The annual mitigation obligation may be fulfilled by allocating credits on one or more types of Mitigation Lands. Mitigation Lands are fungible, that is, any combination of Mitigation Lands can be used to satisfy the obligation of a given impact, and that

combination may change over time, so long as the annual obligation is met in the aggregate. Credits are allocated based on acreage and CLS designations of Mitigation Lands. Pima County, will—where feasible—seek mitigation acres in higher-value CLS categories (Biological Core, Important Riparian Areas, and Special Species Management Areas) for impacts in Multiple Use Management Areas, Agriculture, and Outside CLS categories. . The potential maximum amount of mitigation credit varies by type as shown in Table 4.5 and further elaborated below.

1. Mitigation Lands Owned in Fee Title by Pima County or Regional Flood Control District

   One hundred percent of the potential mitigation acres are available for allocation. One acre of a CLS designation of this Mitigation Land type will offset one acre of the same CLS designation of the annual mitigation obligation.

   Example: 100 acres of Biological Core Management Area of Mitigation Land owned in fee will mitigate for 100 acres of Biological Core Management Area or any lower CLS category of the annual mitigation obligation.

2. Mitigation Lands within Private Developments (see Table 4.5)

In general, seventy-five percent of the potential mitigation acres are available for allocation. One acre of a CLS designation of this Mitigation Land type will offset only seventy-five percent of one acre of the same CLS designation of the annual mitigation obligation.

Example: 100 acres of Biological Core Management Area of Privately-owned Mitigation Land will mitigate for 75 acres of Biological Core Management Area or any lower CLS category of the annual mitigation obligation.

With USFWS approval, one hundred percent of the potential mitigation acres in private developments as described in Table 4.5

3. Mitigation Land Leased from State Trust

Mitigation credit for stewardship of State Trust land will be *prorated* for the 30-year Permit Period depending on the stewardship level (SL in Table 4.5) and when it is implemented. Two examples will illustrate different scenarios.

In the first example, a parcel maintains the same stewardship level, but the land is only held for a third of the Permit Period, in this case for 10 years (either because the parcel added in the last 10 years of the Permit Period or because the lease is lost during the Permit Period). This parcel would receive 8.25% mitigation credit (i.e., $25\% \times 0.33 = 8.25\%$).

The second example illustrates mitigation credit calculation for a parcel that moves from one stewardship level (Table 4.5) to another. In this example, a 50-acre parcel that is designed as SL1 on Permit Year 1, but which is awarded Level 2 on year 11 and maintains SL2 through Permit Year 30 (i.e., SL2 would be for 2/3 of the permit duration) would be awarded 20.8 acres of mitigation credit for that parcel:

$$\left(\left[25\% \times 1/3\right] + \left[50\% \times 2/3\right]\right) \times 50 acres = 20.8 acres$$

Appendix C. Maeveen Marie Behan Conservation Lands System conservation guidelines and mitigation ratios under the SDCP

Mitigation ratios follow the same format: acres conserved:acres developed. Note that mitigation ratios in this table differ from the mitigation ratios for MSCP mitigation (see Section 4.3.1 in the MSCP).

CLS Category	Mitigation ratio	Conservation guideline
Important Riparian Area (IRA)	4:1	At least 95 percent of the total acreage of lands shall be conserved in a natural or undisturbed condition. Every effort should be made to protect, restore, and enhance the structure and functions of IRAs, including their hydrological, geomorphological, and biological functions. Areas within an IRA that have been previously degraded or otherwise compromised may be restored and/or enhanced. Such restored and/or enhanced areas may contribute to achieving the 95 percent conservation guideline for IRAs.
Biological Core Management Areas	4:1	Land-use changes may occur through a combination of on- and/or off-site conservation inside the Biological Core Management Area or Habitat Protection Priority Areas. For purposes of this policy, Habitat Protection Priority Areas are areas referenced and mapped as part of the 2004 Conservation Bond Program. Development shall be configured in the least sensitive portion(s) of the property. Area(s) of undisturbed natural open space will be configured to include on-site conservation values and preserve the movement of native fauna and pollination of native flora across and through the landscape. Natural open space on individual lots is driven by minimum lot size requirements for the pertinent zoning district. Land use and management within these areas shall focus on the preservation, restoration, and enhancement of native biological communities. Land uses appropriate for these areas must retain and improve conditions for on-site conservation values, preserve the movement of native fauna and pollination of native flora across and through the landscape, and preserve landscape integrity. A transfer of development rights may be used in order to secure County-controlled mitigation lands.
Multi-use Management Areas	2:1	Land-use changes may occur through a combination of on- and off-site conservation inside the Multiple Use Management Area or any more protective category of the CLS, including Habitat Protection Priority Areas. Development shall be configured in the least sensitive portion(s) of the property. Area(s) of undisturbed natural open space will include on-site conservation values and facilitate the movement of native fauna and pollination of native flora across and through the landscape. Land use and management goals within these areas shall focus on balancing land uses with conservation, restoration, and enhancement of native biological communities. Land uses appropriate for these areas must facilitate the movement of native fauna and pollination of native flora across and through the landscape, maximize retention of on-site conservation values, and promote landscape integrity. Additional conservation exceeding 66⅔ percent will be encouraged through the use of development-related incentives and may utilize undisturbed natural open space on individual lots (driven by minimum lot size requirements for the pertinent zoning district). A transfer of development rights may be used in order to secure lands utilized for mitigation, restoration, and/or enhancement purposes.
Special Species Management Areas	4:1	Acreage of lands within this designation shall be conserved as undisturbed natural open space and will provide for the conservation, restoration, or enhancement of habitat for the affected Special Species (cactus ferruginous pygmy-owl, southwestern willow flycatcher, and Mexican spotted owl). As such, land use changes may occur through a combination of on- and off-site conservation inside the Special Species Management Area. Development shall be configured in the least sensitive portion(s) of the property. Area(s) of undisturbed natural open space will be configured to facilitate the movement of the relevant Special Species through the landscape and will include those on-site conservation values essential to survival of the relevant Special Species. A transfer of development rights may be used in order to secure County-controlled mitigation lands.

CLS Category	Mitigation ratio	Conservation guideline
Scientific Research Areas	NA	Scientific Research Areas should continue to be managed for the purpose of scientific research on the environment and natural resources. Scientific research activities should minimize any long-lasting impacts that may affect adjacent or nearby CLS lands. Any land-use changes subject to Pima County jurisdiction should achieve the conservation goals of the underlying CLS category.
Agriculture Inholdings within CLS	0	Intensifying land uses of these areas will emphasize the use of native flora, facilitate the movement of native fauna and pollination of native flora across and through the landscape, and conserve on-site conservation values when they are present. Development within these areas will be configured in a manner that does not compromise the conservation values of adjacent and nearby CLS lands.
Critical Landscape Connections	NA	Land-use changes in these broadly defined areas should protect existing biological linkages. Where they occur, barriers to movement of native fauna and flora should be removed and fragmented corridors of native biological communities should be restored. Opportunities to remove barriers and restore corridor connectivity may arise as part of other, non-land use related activities (e.g., new construction for or upgrade of infrastructure services). Such opportunities should be pursued. High priority shall be given to identifying, preserving, and re-establishing the connection between native biological communities.

Appendix D. Draft Pima County MSCP Implementing Agreement.

PUBLIC DRAFT

IMPLEMENTING AGREEMENT

BETWEEN

U. S. FISH AND WILDLIFE SERVICE AND

PIMA COUNTY AND PIMA COUNTY REGIONAL FLOOD CONTROL DISTRICT

FOR THE

PIMA COUNTY MULTIPLE-SPECIES CONSERVATION PLAN

LOCATED IN

PIMA COUNTY, ARIZONA

DECEMBER 2015

TO ESTABLISH A PROGRAM OF AVOIDANCE, MINIMIZATION, AND MITIGATION FOR SPECIES IN PIMA COUNTY, ARIZONA AND SELECT LANDS IN ADJACENT COUNTIES

1.0 PARTIES

The parties to this implementing Agreement ("Agreement") are Pima County, Arizona, a political subdivision of the State of Arizona and the Pima County Regional Flood Control District, a political taxing subdivision of the State of Arizona (collectively the "County") and the United States Fish and Wildlife Service (the "Service").

2.0 RECITALS AND PURPOSES

2.1 Recitals. The parties entered into this agreement in consideration of the following facts:

2.1.1 Pima County's Multiple-Species Conservation Plan (MSCP) Permit Area has been determined to provide, or potentially provide, habitat for the following listed species: Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*), Huachuca water umbel (*Lilaeopsis schaffneriana* ssp. *recurva*), yellow-billed cuckoo (*Coccyzus americanus*), Lesser long-nosed bat (*Leptonycteris curasoae yerbabuena*), Gila topminnow (*Poeciliopsis occidentalis occidentalis*), Gila chub (*Gila intermedia*), Chiricahua leopard frog (*Lithobates chiricahuensis*), Northern Mexican gartersnake (*Thamnophis eques megalops*), and Southwestern willow flycatcher (*Empidonax traillii extimus*).

2.1.2 Pima County's MSCP Permit Area has been determined to provide, or potentially provide, habitat for the following unlisted species: Birds: Abert's Towhee (*Melozone aberti*), Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*), Rufous-winged sparrow (*Aimophila carpalis*), Arizona Bell's vireo (*Vireo bellii arizonae*), Swainson's hawk (*Buteo swainsoni*), and Western burrowing owl (*Athene cunicularia hypugaea*); Plants: Needle-spined pineapple cactus (*Echinomastus erectocentrus* var. *erectocentrus*), and Tumamoc globeberry (*Tumamoca macdougalii*); Mammals: Mexican long-tongued bat (*Choeronycteris mexicana*), Western red bat (*Lasiurus blossevillii*), Western yellow bat (*Lasiurus xanthinus*), California leaf-nosed bat (*Macrotus californicus*); Pale Townsend's big-eared bat (*Corynorhinus townsendii pallescens*), and Merriam's mouse (*Peromyscus merriami*); Amphibians: lowland leopard frog (*Lithobates yavapaiensis*); Reptiles: Tucson shovel-nosed snake (*Chionactis occipitalis klauberi*), Groundsnake (valley form) (*Sonora semiannulata*), Giant spotted whiptail lizard (*Aspidoscelis stictogramma*), Desert box turtle (*Terrapene ornata luteola*) and Sonoran desert tortoise (*Gopherus morafkai*); Fishes: Desert sucker (*Catostomus clarki*), Sonoran sucker (*Catostomus insignis*), and Longfin dace (*Agosia chrysogaster*); Invertebrates: talussnail species (*Sonorella eremita, S. ambigua; S. imperatrix, S. imperialis, S. magdalensis syn. tumamocensis; S. odorata; S. rinconensis; S. sabinoensis buehmanensis; S. sabinoensis tucsonica, Sonorella walkeri, S. sitiens, and S. tortillita*).

2.1.3 The County has developed a Habitat Conservation Plan for the proposed incidental take permit under Section 10 of the Endangered Species Act. That Habitat Conservation Plan is titled the "Pima County Multi-Species Conservation Plan" ("MSCP").

2.1.4 The Service has developed an environmental impact statement to address the effects of issuing an incidental take permit to the County, and has completed its National Environmental Policy Act obligations in compliance with agency guidelines.

2.1.5 The County has worked cooperatively with the Service to develop a series of measures described in the MSCP, to avoid, minimize, and mitigate to the maximum extent practicable the effects of take on covered species incidental to the County's covered activities.

2.2 Purpose. The purpose of this agreement is to guide implementation of the terms of the MSCP.

3.0 DEFINITIONS

Terms defined and used in the MSCP and the Endangered Species Act (ESA) have the same meaning when used in this Agreement, except the following terms used in this Agreement have the following meanings:

3.1 "Conservation Plan" means the habitat conservation plan prepared by the County and submitted under the title of Multi-Species Conservation Plan.

3.2 "Covered activities" means those activities described in Chapter 3 of the MSCP, including activities undertaken by the County on Mitigation Land Interests (mitigation/conservation activities), pre-construction, construction and maintenance activities undertaken by County (capital improvement projects), and certain private development activities permitted by the County as described in Chapter 3.

3.3 "Covered Species" means species adequately covered in the MSCP per section 10 of the ESA, and identified in Sections 2.1.1 and 2.1.2 of this Agreement.

3.4 "Listed species" means a species (including a subspecies, or a distinct population segment of a vertebrate species) that is listed as endangered or threatened under the ESA.

3.5 "Maeveen Marie Behan Conservation Lands System (MMB-CLS)" or "CLS" means the biological reserve system design adopted as the Regional Environmental Element of the County's 2001 Comprehensive Plan Update and any subsequent revisions. The MMB-CLS guides the County's discretionary land-use decisions as they relate to Covered Activities and establishes a higher standard for avoidance, minimization and mitigation for projects located therein. The MMB-CLS also provides the underpinnings to the County's selection of lands secured for mitigation under the permit.

3.6 "Mitigation Land" means those lands, leases, or rights held by the County and committed to the Service as compensation for impacts of covered activities under the Section 10 permit. They consist of either (a) the acres of County land and any appurtenant rights described in a recorded, perpetual conservation easement, and for which the County manages and monitors for the purposes of compensating for the covered activities under the terms of the MSCP, or (b) the State Trust land for which County holds a grazing lease and manages and monitors for the purposes of compensating for the covered activities under the terms of the MSCP, or (c) the acres of private land that are retained as natural open space through development approvals and which have been set aside for the conservation of Covered Species and are managed and monitored pursuant to Chapters 5 and 6 of the MSCP, respectively, or (d) acres of former Federal land conveyed to the County in fee through the Recreation and Public Purposes Act or through exchange which the County manages and monitors for

the purposes of compensating for covered activities under the permit, or (e) other rights owned by the County which are used for the purposes of compensating for covered activities, and recorded for that purpose in the County Recorder's Office.

3.7 "Participant" means those property owners who voluntarily solicit protections afforded by the Pima County MSCP and who fulfill certain requirements.

3.8 "Permit" means the incidental take permit issued by the Service to the County pursuant to Section 10(a)(1)(B) of the ESA.

3.9 ."Permit Area" means the Pima County Section 10 Permit Area consisting of approximately 1,400,000 acres in Pima County, Cochise County, and Pinal County, Arizona as described in Chapter 3 of the MSCP.

3.10 "Unlisted species" means a species (including a subspecies, or a distinct population segment of a vertebrate species) that is not listed as endangered or threatened under the ESA. The term "unlisted species" includes both candidate species and other species of concern.

4.0 OBLIGATIONS OF THE PARTIES

4.1 Obligations of the County. The County will fully and faithfully perform all obligations assigned to it under this agreement, the permit, and the MSCP.

4.1.2. Interim obligations upon a finding of unforeseen circumstances. If the Service makes a finding of unforeseen circumstances, during the period necessary to determine the nature and location of additional or modified mitigation, the County will avoid contributing to appreciably reducing the likelihood of the survival and recovery of the affected species.

4.2 Obligations of the Service. Upon approval of a final MSCP and final EIS, the Service will issue the County a permit under Section 10(a)(1)(B) of the ESA, authorizing incidental take by the County of each listed covered species resulting from covered activities on covered lands.

4.2.1 Permit coverage. The permit will identify all covered species. The permit will take effect for listed covered species at the time the permit is issued. The permit will take effect for an unlisted covered species upon the listing of the species.

4.2.2. Section 7 Considerations. When performing Section 7 consultations under the Clean Water Act or other Federal laws, the Service will consider the permit and actions related to the implementation of the MSCP.

4.2.3 Revisions of ordinances and guidelines relating to the MSCP. USFWS will review any modifications of environmental ordinances or guidelines identified as avoidance and minimization measures in Chapter 4 of the MSCP within 45 days and

confer with County to determine if Pima County remains in compliance with the terms of the permit identified under Chapter 7, Changed Circumstances.

5.0 HABITAT CONSERVATION PLAN INCORPORATION

Pursuant to the provisions of Section 10(a)(1)(B) of the ESA, the County has prepared a Habitat Conservation Plan entitled the "Pima County Multi-Species Conservation Plan" ("MSCP") and submitted it to the Service with a request that the Service issue a Permit to allow Covered Species to be incidentally taken within the Permit Area as depicted and described in Chapter 3 of the MSCP. The MSCP proposes a mitigation program for the subject Covered Species and their habitats.

In the event of any direct contradiction between the terms of this Agreement and the MSCP, the terms of the Permit control.

6.0 TERM

6.1 Initial Term. This Agreement and the MSCP will become effective on the date that the Service issues the Permit. This agreement, the MSCP and the Permit will remain in effect for a period of 30 years from issuance of the Permit.

6.2 Notwithstanding paragraph 6.1, the Parties agree and recognize that once the Covered Species have been incidentally taken and their habitat modified pursuant to the MSCP, the take and habitat modification will be permanent. It is therefore the intention of the Parties that the provisions of the MSCP and of this Agreement regarding the establishment and maintenance of mitigation lands as habitat for the Covered Species will be permanent and extend beyond the term of this Agreement, to the extent permitted by law and recorded in conservation easements or other legally enforceable instruments.

7.0 FUNDING

7.1 The County will expend funds as may be necessary to carry out its obligations under the MSCP. The County must notify the Service if the County's funding resources have materially changed, including a discussion of the nature of the change, from the information provided in Chapter 8 of the MSCP.

8.0 MONITORING AND REPORTING

8.1 Planned periodic reports. The County will submit an annual report describing its activities and an analysis of whether the terms of the MSCP were met for the reporting period, as specified in Section 9.1.1 of the MSCP. The County will also submit a comprehensive report every 10 years, as specified in Section 9.1.2 of the MSCP.

8.2 Other reports. The County will provide, within 30 days of being requested by the Service, any additional information in its possession or control related to implementation

of the MSCP that is requested by the Service for the purpose of assessing whether the terms and conditions of the permit and the MSCP, including the MSCP's adaptive management plan, are being fully implemented.

8.3 Certification of reports. All reports will include the following certification from a responsible official who supervised or directed preparation of the report:

> I certify that, to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of this report, the information submitted is true, accurate, and complete.

8.4 Monitoring by Service. The Service may conduct inspections and monitoring in connection with the permit in accordance with their regulations. (See 50 C.F.R. §§ 13.47, 220.47.)

9.0 ADAPTIVE MANAGEMENT

9.1 County-initiated adaptive management. The County will implement the adaptive management provisions in Chapter 6 of the MSCP when changes in management practices are necessary to achieve the MSCP's biological objectives, or to respond to monitoring results or new scientific information. The County will make the changes without awaiting notice from the Service, and will report to the Service on any actions taken pursuant to this section.

9.2 Service-initiated adaptive management. If the Service determines that one or more of the adaptive management provisions in the MSCP have been triggered and that the County has not changed its management practices in accordance with Chapter 6 of the MSCP, the Service will so notify the Parties and will direct the County to make the required changes. Within 30 days after receiving the notice, the responsible Party will make the required changes and report to the Service on its actions. The changes are provided for in the MSCP, and hence do not constitute unforeseen circumstances or require amendment of the permit or MSCP, except as provided in this section.

9.3 Reductions in mitigation. The County will not implement adaptive management changes that may result in less mitigation than provided for covered species under the original terms of the MSCP, unless the Service first provides written approval. The County may propose adaptive management changes by notice to the Service, specifying the adaptive management modifications proposed, the basis for them, including supporting data, and the anticipated effects on covered species, and other environmental impacts. Within 120 days of receiving the notice, the Service will approve the proposed adaptive management changes, approve them as modified by the Service, or notify the County that the proposed changes constitute permit amendments that must be reviewed under Section 11.2 of this agreement.

9.4 No increase in take. This section does not authorize any modifications that would result in an increase in the amount and nature of take, or increase the impacts of take, of covered species beyond that analyzed under the original MSCP and any

amendments. Any modification must be reviewed as a permit amendment under Section 11.2 of this agreement.

10.0 LAND TRANSACTIONS

10.1 Acquisition of land by the County. Nothing in this agreement, the MSCP, or the permit limits the County's right to acquire additional lands, including additional mitigation land interests. Any activities on acquired land will be covered by the permit if it meets the requirements of covered activities in the MSCP and is located in the Permit Area.

10.2 Disposal of mitigation land by the County. The County's transfer of ownership or control of mitigation land will require prior approval by the Service except that transfers of mitigation land may be processed as minor modifications in accordance with subsection 11.2 if the Service concurs that:

(a) The land will be transferred to an agency of the Federal government and, prior to transfer, the Service has determined that transfer will not compromise the effectiveness of the MSCP based on adequate commitments by that agency regarding management of such land; or

(b) The land will be transferred to a non-Federal entity that has entered into an agreement acceptable to the Service (e.g., an easement held by the state fish and wildlife agency with the Service as third-party beneficiary) to ensure that the lands will be managed in such a manner and for such duration so as not to compromise the effectiveness of the MSCP; or

(c) The land will be transferred to a non-Federal entity that, prior to completion of the land transaction, has agreed to be bound by the MSCP as it applies to the transferred land and has obtained an incidental take permit following normal permit procedures covering all species then covered by the County's permit.

11.0 MODIFICATIONS AND AMENDMENTS

11.1 No Amendment Needed. The Parties acknowledge that the Permit Area within the jurisdiction of Pima County will change over the term of the permit. None of the following changes shall require amendment of the permit as long as the changes are reported in the annual report to the Service with the County's description of how the changes will be addressed with regard to compliance with the MSCP:

(a) Removal of Permit Area by annexation, or

(b) Addition to Permit Area by acquisition by the County if described in Chapter 3 of the MSCP, or

(c) Reduction of Permit Area by disposal by the County of land, water, or land or water interests not associated with mitigation lands as described in Section 10.2 of this agreement.

11.2 Minor modifications

(a) Any party may propose minor modifications to the MSCP or this agreement by providing notice to all other parties. That notice will include a statement of the reason for the proposed modification and an analysis of its environmental effects, including its effects on operations under the MSCP and on covered species. The parties will use best efforts to respond to proposed modifications within 60 calendar days of receipt of such notice. Proposed modifications will become effective upon all other parties' written approval. If, for any reason, a receiving party objects to a proposed modification, it must be processed as an amendment of the permit in accordance with subsection 11.3. The Service will not propose or approve minor modifications to the MSCP or this agreement if the Service determines that such modifications would result in operations under the MSCP that are significantly different from those analyzed in connection with the original MSCP, adverse effects on the environment that are new or significantly different from those analyzed in connection with the original MSCP, or additional take not analyzed in connection with the original MSCP.

(b) Minor modifications to the MSCP and this Agreement processed pursuant to this subsection may include but are not limited to the following:

> (1) corrections of typographic, grammatical, and similar editing errors that do not change the intended meaning;
>
> (2) correction of any maps or exhibits to correct errors in mapping or to reflect previously approved changes in the permit or MSCP;
>
> (3) minor changes to survey, monitoring, or reporting of parameters or protocols if not already covered in Changed Circumstances; and
>
> (4) Other types of modifications, such as described in Section 10.2, that are minor in relation to the MSCP, that the Service has analyzed and agreed to, and on which the public has had an opportunity to comment.

(c) Any other modifications to the MSCP or this Agreement will be processed as amendments of the permit in accordance with subsection 11.2 of this section.

11.2 Amendment of the Permit. The permit may be amended in accordance with all applicable legal requirements, including, but not limited to, the ESA, the National Environmental Policy Act, and the Service's permit regulations. The party proposing the amendment will provide a statement of the reasons for the amendment and an analysis of its environmental effects, including its effects on operations under the MSCP and on Covered Species.

12.0 REMEDIES, ENFORCEMENT, AND DISPUTE RESOLUTION

12.1 In general. Except as set forth below, each party has all remedies otherwise available to enforce the terms of this agreement, the permit, and the MSCP.

12.2 No monetary damages. No party is liable for damages to any other party or other person for any breach of this agreement, any performance or failure to perform a mandatory or discretionary obligation imposed by this agreement or any other cause of action arising from this agreement.

12.3 Injunctive and temporary relief. The parties acknowledge that the Covered Species are unique and that their loss as species would result in irreparable damage to the environment, and that, therefore, injunctive and temporary relief may be appropriate to ensure compliance with the terms of this agreement.

12.4 Enforcement authority of the United States. Nothing contained in this Agreement is intended to limit the authority of the United States government to seek civil or criminal penalties or otherwise fulfill its enforcement responsibilities under the ESA or other applicable law.

12.5 Dispute resolution. The parties recognize that disputes concerning implementation of, compliance with, or termination of this agreement, the MSCP, and the permit may arise from time to time. The parties agree to work together in good faith to resolve such disputes, using the informal dispute resolution procedures set forth in this section, or such other procedures upon which the parties may later agree. However, if at any time any party determines that circumstances so warrant, it may seek any available remedy without waiting to complete informal dispute resolution.

12.5.1 Informal dispute resolution process. Unless the parties agree upon another dispute resolution process, or unless an aggrieved party has initiated administrative proceedings or suit in Federal court as provided in this section, the parties may use the following process to attempt to resolve disputes:

(a) The aggrieved party will notify the other parties of the provision that may have been violated, the basis for contending that a violation has occurred, and the remedies it proposes to correct the alleged violation.

(b) The party alleged to be in violation will have 30 calendar days, or such other time as may be agreed, to respond. During this time it may seek clarification of the information provided in the initial notice. The aggrieved party will use its best efforts to provide any information then available to it that may be responsive to the inquiries.

(c) Within 30 calendar days after the response was provided or was due, representatives of the parties having authority to resolve the dispute will meet and negotiate in good faith toward a solution satisfactory to all parties, or will establish a specific process and timetable to seek a solution.

(d) If any issues cannot be resolved through negotiations, the parties will consider non-binding mediation and other alternative dispute resolution processes and, if a dispute resolution process is agreed upon, will make good faith efforts to resolve all remaining issues through that process.

13.0 MISCELLANEOUS PROVISIONS

13.1 No partnership. Neither this agreement nor the MSCP makes or may be deemed to make any party to this agreement the agent for or the partner of any other party.

13.2 No Federal or State Contract. Notwithstanding any language to the contrary in this Agreement, this Agreement is not intended to create, and shall not be construed to create an enforceable contract between the Service and the County under Federal or state law with regard to the Permit. The sole purposes of this agreement as between the Service and Pima County are to clarify the Parties' mutual obligations and responsibilities under the MSCP and describe the processes the parties intend to follow to ensure the successful implementation of the MSCP in accordance with the Permit. This Agreement is not, nor shall it be construed as, a Federal rule, regulation, or final Federal action.

13.3 Notices. Any notice permitted or required by this agreement must be in writing, delivered personally to the persons listed below, or will be deemed given five (5) days after deposit in the United States mail, certified and postage prepaid, return receipt requested and addressed as follows, or at such other address as any party may from time to time specify to the other parties in writing. Notices may be delivered by facsimile or other electronic means, provided that they are also delivered personally or by certified mail. Notices must be transmitted so that they are received within the specified deadlines.

Assistant Regional Director
United States Fish and Wildlife Service
[Street Address]
[City, State, Zip Code]

County Administrator, Pima County
130 West Congress
Tucson, AZ 85701

Chief Engineer, Pima County Regional Flood Control District
97 E. Congress St.
Tucson, AZ 85701

13.4 Availability of funds. Implementation of this Agreement and the MSCP by the Service is subject to the requirements of the Anti-Deficiency Act and the availability of appropriated funds. Nothing in this Agreement will be construed by the Parties to

require the obligation, appropriation, or expenditure of any money from the U.S. treasury. The parties acknowledge that the Service will not be required under this Agreement to expend any Federal agency's appropriated funds unless and until an authorized official of that agency affirmatively acts to commit to such expenditures as evidenced in writing. The parties acknowledge that County's obligations under this agreement are limited by A.R.S. §42-17106.

13.5 Duplicate of Originals. This Agreement may be executed in any number of duplicate originals. A complete original of this Agreement will be maintained in the official records of each of the Parties.

13.6 Third Party Beneficiaries. Without limiting the applicability of the rights granted to the public pursuant to the provisions of 16 U.S.C. § 1540(g), this Agreement does not create any right or interest in the public, or any member thereof, as a third party beneficiary, nor does it authorize anyone not a Party to this Agreement to maintain a suit for personal injuries or property damages pursuant to the provisions of this Agreement. The duties, obligations, and responsibilities of the Parties to this Agreement with respect to third parties remain as imposed under existing Federal or State law.

13.7 Relationship to the ESA and Other Authorities. The terms of this Agreement are governed by and construed in accordance with the ESA and other applicable laws. In particular, nothing in this Agreement is intended to limit the authority of the Service to seek penalties or otherwise fulfill its responsibilities under the ESA. Moreover, nothing in this Agreement is intended to limit or diminish the legal obligations and responsibilities of the Service as an agency of the Federal government.

13.8 References to Regulations. Any reference in this Agreement, the MSCP, or the Permit to any regulation or rule of the Service is deemed to be a reference to the regulation or rule in existence at the time an action is taken. Any reference in this Agreement, the MSCP, or the Permit to any regulation or rule of the County is deemed to be a reference to the regulation or rule in existence at the time an action is taken.

13.9 Applicable Laws. All activities undertaken pursuant to this Agreement, the MSCP, or the Permit must be in compliance with all applicable State and Federal laws and regulations.

IN WITNESS WHEREOF, THE PARTIES HERETO have executed this Implementing Agreement to be in effect as of the date last signed below.

BY Regional Director Date_____
United States Fish and Wildlife Service
[City, State]

_____

BY Chairperson Date_____

Pima County Board of Directors
Pima County Regional Flood Control District
Tucson, AZ

_____

BY Chairperson Date_____
Pima County Board of Supervisors
Tucson, AZ

_____

Appendix E. Capital improvement projects that will be covered under Pima County's Section 10 Permit.

Many impacts projected are in the existing built environment; impacts to areas of natural vegetation outside the built environment are approximately 1,800 acres.

Project	Location	Department	Acres
Fairground Infrastructure Improvements	PC Fairgrounds	Facilities Management	4.9
Shooting Sports Program Site Improvements	Southeast Regional Park, Tucson Mountain Park, Northwest Site (To Be Determined)	Natural Resources, Parks, and Recreation	1.5
Flowing Wells Branch Library	Flowing Wells - Ruthrauff, Romero and Wetmore	Facilities Management	7.9
Arizona Sonora Desert Museum - Education Facility Phase III	2021 N. Kinney Rd., Tucson	Facilities Management	0.5
Pima Air and Space Museum - Cold War Hangar	6000 E. Valencia Rd. , Tucson	Facilities Management	7.9
Eckstrom-Columbus Library Expansion and Remodeling	4350 E. 22nd. St.	Facilities Management	1.0
Archaeological Site Acquisitions, Marana Mound	N. of Cochise Canyon Trail, E. of Interstate 10, W. of CAP Canal in Marana	Office of Sustainability	7.9
Steam Pump Ranch Rehabilitation	10901 N. Oracle Rd., Oro Valley, AZ	Office of Sustainability	7.9
Archaeological Site Acquisitions, Cocoraque Butte	P#208-48-0060 T14S, R10E, Section 8	Office of Sustainability	7.9
Site Interpretation/Preservation, Los Morteros	Along Silverbell Rd. North of Linda Vista Blvd in Marana P#226-03-033A & 226-03-0340 T12S,R12E Section 7	Office of Sustainability	7.9
Vail Area Historic Sites	13105 E. Colossal Cave Rd., Vail, AZ	Office of Sustainability	7.9
Sahuarita Branch Library	725 W. Via Rancho (303-06-045B)	Facilities Management	8.0
Green Valley Government Center Master Plan Implementation	301 W. Camino Casa Verde, Green Valley	Facilities Management	8.0
Benson Highway Park Development & Land Acquisition	directly west of S. Country Club Road and adjacent to and south of Benson Hwy., east of Tucson Blvd	Natural Resources	8.0
Coronado Middle School Athletic Fields Upgrades	3410 East Wilds Road	Natural Resources	8.0
George Mehl Family Foothills Park	4001 E. River	Natural Resources	8.0
New Tucson Girl's and Boy's Chorus Building	3605 N. Edith Blvd.	Natural Resources	8.0
Rillito Racetrack Conversion	4502 N. 1st. Ave., Tucson	Natural Resources	8.0
Yaqui Park Community Center	I-10 and I-19 Junction	Natural Resources	8.0
Flowing Wells Junior High	4545 N. La Cholla Blvd.	Natural Resources	8.0
Canoa Ranch Historic Interpretive Center (Parks and CR Project)	Approximately 45 miles south of Tucson off I-19 at Canoa Ranch exit and on east side of highway	Natural Resources	8.0
Flowing Wells High School	3725 N. Flowing Wells Road	Natural Resources	8.0
James D. Kreigh Park Updates	23 W Calle Concordia, 1/10 mile west of North Oracle, north side of Calle Concordia	Natural Resources	8.0
Lawrence Park Improvements	6777 S. Mark Road	Natural Resources	8.0

Project	Location	Department	Acres
Robles Community Park	Ajo Road, 1/2 mile south on Sasabe Road	Natural Resources, Parks, and Recreation	5.0
Southeast Regional Park (Esmond Station Regional Park)	141-17-011A	Natural Resources, Parks, and Recreation	8.0
Ted Walker Park Sporting Dog Training Site	6775 N Casa Grande Hwy.	Natural Resources	8.0
Avra Valley Watchable Wildlife Site	W. of San Joaquin Rd. & S of Bopp Rd.	Natural Resources	0.2
BAJA Seniors Sports Complex	East on Whitehouse Canyon Road and south on Camino de la Canoa	Natural Resources	12.0
Flowing Wells, Kino and Other Swimming Pool Renovations	Kino Pool, 2805 E Ajo Way	Natural Resources	8.0
Green Valley Performing Arts/Learning Center III	120 W. Continental Rd. Green Valley	Natural Resources	8.0
JVYC/Ochoa Gym (South Tucson Request)	Southwest corner of 25th Street and S. 6th Avenue	Natural Resources	8.0
Lawrence Community Center and Swimming Pool	6777 S. Mark Road	Natural Resources	4.0
Lawrence Hiaki Pathway (Pascua Yaqui)	Bounded by Jeffery Road on N, Mark Road on W, Los Reales on S, Camino de Oeste on E	Natural Resources	8.0
West Valencia Branch Library	138-25-6210 (Cardinal south of Valencia)	Facilities Management	8.0
Ajo Community Golf Course	North Ajo Well Road, Ajo	Natural Resources	2.0
Freedom Park Adult Learning Center	4800 block of East 29th Street between Swan and Craycroft	Natural Resources	8.0
Corona Foothills Middle School and Sycamore Elementary School Sports Fields Improvements	16701 South Houghton Road, Vail	Natural Resources	8.0
Old Vail Middle School Sports Fields Improvements	13299 E. Colossal Cave Road, Vail	Natural Resources	8.0
Flowing Wells District Park Expansion	T13S, R13E, Section 16 South Bank of Rillito, East of Shannon	Natural Resources	8.0
Pima County Animal Care Center (PACC) Improvements	4000 N. Silverbell Rd.	Facilities Management	5.0
Hohokam Community Sports Fields and Hohokam Park	NE Corner of Camino de Oeste and Los Reales	Natural Resources	8.0
Altar Valley Watershed Restoration Project	South of AZ286 along Brawley and Altar Wash complex	Natural Resources	5.0
Site Interpretation/Preservation, Pantano	Pantano Railroad Stop	Office of Sustainability	8.0
Site Interpretation/Preservation, Dakota Wash	Dakota Wash	Office of Sustainability	8.0
Site Interpretation/Preservation, Honey Bee	Honey Bee	Office of Sustainability	8.0
Site Interpretation/Preservation, Coyote Mountains	Coyote Mountains	Office of Sustainability	8.0
Indoor Sports Complex Curtis Park - formally Kino Regional Park	5542 N Shannon Rd (Shannon north of Curtis Rd)	Natural Resources	8.0
Kory Laos Freestyle Memorial BMX Park	5542 N Shannon Rd (Shannon north of Curtis Rd)	Natural Resources	8.0
PC Southeast Regional Park (Fairgrounds) - Horse Racing Facility	Houghton Road and Dawn Road, South of I-10	Natural Resources	8.0
Reclaimed Water to Protect Cienega Creek	Cienega Creek/Rincon Creek Reclaimed Line Extension	Regional Flood Control	2.0
Art of the American West - Tucson Art Museum	North Wing of the Pima County Old Courthouse	Facilities Management	0.1
Pima Community College Health Education Campus	2800 E. Ajo Way	Facilities Management	8.0

Project	Location	Department	Acres
Pima County Softball Tournament and Recreation Park	SW Corner of Ina Road and I-10 (Former Sports Park)	Natural Resources	0.5
Tucson Children's Museum - New Museum	West of I-10 in the Rio Nuevo museum complex	Facilities Management	5.0
LSB - Asbestos Abatement and Fire Sprinklers	Legal Services Building	Facilities Management	8.0
Colossal Cave Mountain Park	16721 E. Old Spanish Trail, Tucson	Facilities Management	2.0
Santa Cruz River: Rillito and Community Development Confluence	214-01-024B	Regional Flood Control	0.5
Catholic Comm Services - Sahuarita-Green Valley Clinic	Dot at Inter section of I-19 & Duval Mine Road	Facilities Management	2.0
Catholic Comm Services - Vail Area Clinic	141-17-011A	Facilities Management	8.0
Eastside Government/Community Ctr: Library, Park, Sheriff	141-17-011A	Facilities Management	274.1
Catholic Comm Services - Quincy Douglas Center	1575 East 36th Street 85713	Facilities Management	8.0
Joyner-Green Valley Library Renovation and HVAC	601 North La Canada Drive	Facilities Management	8.0
Davis Monthan Approach Corridor Open Space Acquisitions	141-11-003J	County Administration	8.0
Ajo Curley School Gym & Town Plaza	Ajo Curley School	Office of Sustainability	8.0
Joint Municipal and Justice Courts Facility	Stone Avenue across from Public Works	Facilities Management	8.0
Habitat Protection Priorities & Associated Lands	Not Defined, Many Locations	County Administration	8.0
Floodprone and Riparian Land Acquisition (Combined w/ FC52 and PR219)	Not Defined, Many Locations	Regional Flood Control	0.5
Historic Fort Lowell Park - Master Plan Implementation	2900 N. Craycroft Road	Office of Sustainability	8.0
Dunbar School Rehabilitation	325 W 2nd St	Office of Sustainability	8.0
Performing Arts Rehabilitation	408 S 6th Av	Office of Sustainability	8.0
One Stop Career Center	Not Defined	Facilities Management	8.0
Theresa Lee and Tuberculosis Clinic Relocation	Not Defined	Facilities Management	2.0
Elections Equipment	Not Defined	Facilities Management	8.0
Affordable Housing Program	Not Defined, Many Locations	Community Development	8.0
Neighborhood Reinvestment Program	Not Defined, Many Locations	Community Development	8.0
Pima County Comprehensive Housing Center	Not Defined	Community Development	8.0
Model Airplane Parks	Not Defined, Many Locations	Natural Resources	8.0
Arizona Velodrome Center - Kino Campus	Udall Park	Natural Resources	8.0
River Park Acquisitions and Development Countywide	Not Defined, Many Locations	Natural Resources	0.5
Public Natural Park Trail Access	King Canyon Trailhead	Natural Resources	0.2
Public Natural Park Trail Access	AZ Trail at Sahuarita Trailhead	Natural Resources	0.3
Public Natural Park Trail Access	Pistol Hill Trailhead	Natural Resources	0.3
Public Natural Park Trail Access	Chalk Mine Rd Trailhead	Natural Resources	0.5
Public Natural Park Trail Access	Robles Pass Trails Park Staging Area	Natural Resources	0.3
Public Natural Park Trail Access	Lawrence Hiaki Pathway	Natural Resources	0.5
Flowing Wells, Kino and Other Swimming Pool Renovations	Flowing Wells Pool, 4545 N La Cholla Bl	Natural Resources	8.0
Various Trailhead Parking/Staging	Kennedy Park West: End of W Starr Pass Bl East End Of E Broadway	Natural Resources	0.2
Various Trailhead Parking/Staging	Kennedy Park West End Of W Starr Pass BlEast End Of E Broadway Bl	Natural Resources	0.2

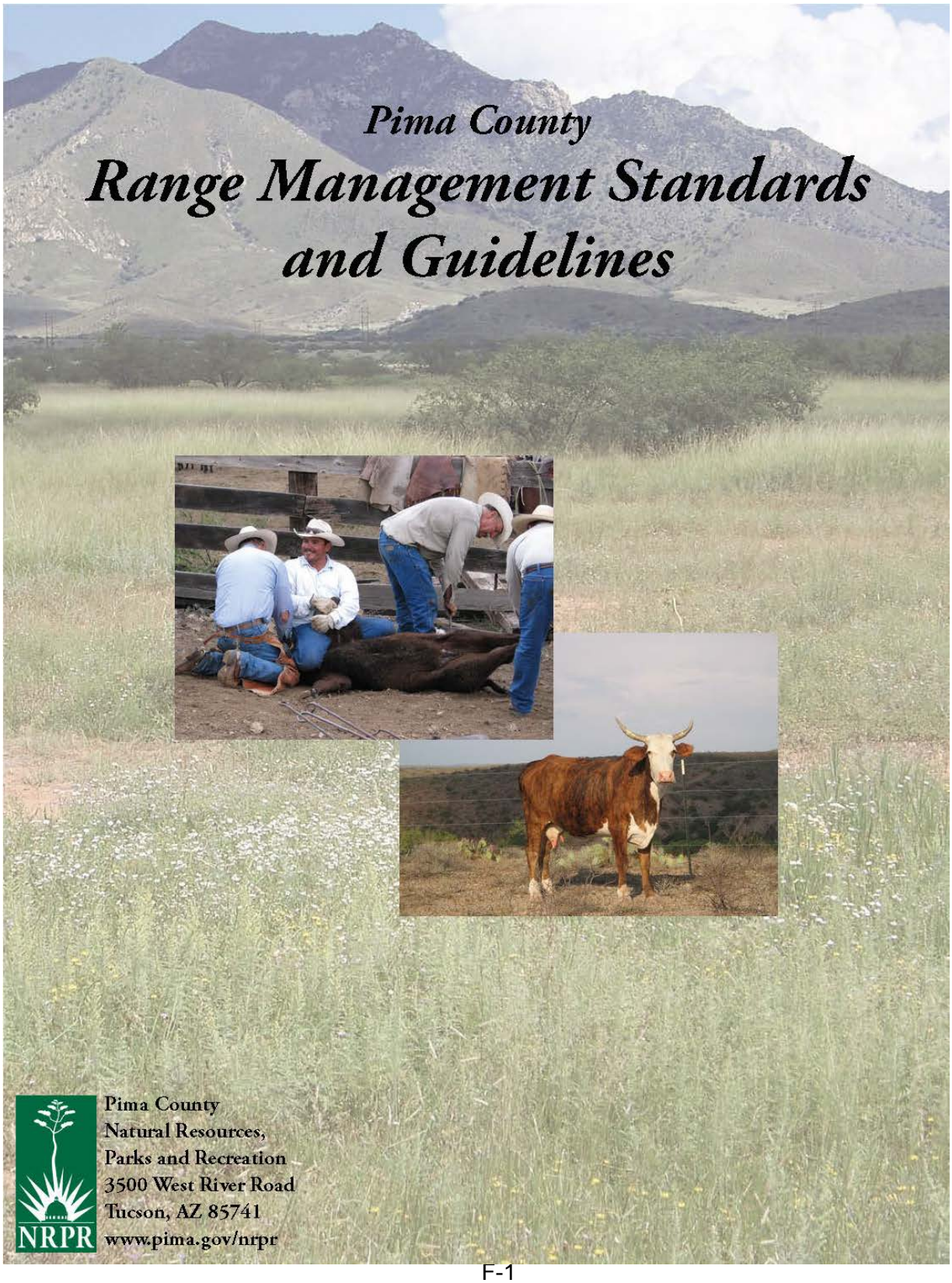
Project	Location	Department	Acres
Santa Cruz River Community Park-Menlo Park (COT)	East Bank North Of W Ajo Wy	Natural Resources	32.6
Rillito Park at Columbus Boulevard District Park	3600 N Columbus Bl	Natural Resources	31.6
Yaqui Park Improvements A	39th St To 40th St 10th Av To 12th Av	Natural Resources	3.9
Southeast Regional Park/Shooting Range	305010070 (current) 30501009A0 (future)	Natural Resources	5.1
Dan Felix Memorial Park - Pegler Wash	River Road and Camino de la Tierra	Natural Resources	13.9
Bicycle Lane on Sahuarita Road	Along both sides of the three-mile stretch of Sahuarita Road from the west Town boundary to the east Town boundary.	Natural Resources	18.0
Arroyo Chico (COT)	Along Arroyo Chico Wash from Country Club to Campbell.	Natural Resources	6.7
Catalina Community Park	15300 N. Lago Del Oro Parkway	Natural Resources	30.1
Northside Community Park (COT)	1090 E. River Road	Natural Resources	3.1
Divided Urban Pathway Mountain Ave-First Ave	Rillito South bank between First and Mountain	Natural Resources	0.6
Udall Park Expansion		Natural Resources	10.1
Southeast Regional Park/Shooting Range	305010070 (current) 30501009A0 (future)	Natural Resources	6.5
Various Trailhead Parking/Staging (Kennedy Park trailhead)	W Ajo HY, west of La Cholla	Natural Resources	2.5
George Mehl Foothills Park		Natural Resources	1.9
Mission View Wash	Park Avenue at I-10 to 36th Street	Regional Wastewater	11.9
SS6.03 Santa Cruz Interceptor, Phase III		Regional Wastewater	7.0
Old Nogales Hwy Capacity improvements		Regional Wastewater	30.6
North Rillito Relief Project 2		Regional Wastewater	4.3
North Rillito Relief Project 3		Regional Wastewater	3.4
Roger Treatment Plant Demo		Regional Wastewater	54.4
Water Reclamation Facility Site		Regional Wastewater	29.1
Water Reclamtion Campus		Regional Wastewater	21.0
North Rillito Relief Project		Regional Wastewater	7.7
Prince Rd. & I-10 ADOT Sewer Modifications	Prince Rd at I-10	Regional Wastewater	1.3
Sabino Creek Pump Station		Regional Wastewater	8.3
Haystack Mountain		Sherriff	0.0
Tumamoc (FM 2)		Sherriff	0.0
Valencia Standpipe		Sherriff	0.0
Rincon Valley FS 1 (Fire		Sherriff	0.1
Arivaca\Ruby Road		Sherriff	0.1
Golder Ranch Fire Station		Sherriff	0.1
FM2.13 Arizona Sonora Desert Museum - Gray Water	2021 North Kinney Road	Facilities Management	29.6
FM2.13 Arizona Sonora Desert Museum - Gray Water	2021 North Kinney Road	Facilities Management	10.2
Green Valley Government Center Master Plan Implementation	601 La Canada Dr., Green Valley, AZ	Facilities Management	11.0
New Pima County Nursing Home and add Adult Day Care	Kino Campus Ajo Way/County Club - 10-20 acre	Facilities Management	14.9
Pima County Community College Healthcare Campus	Kino Campus, 2800 E Ajo Way	Facilities Management	5.1

Project	Location	Department	Acres
Fairgrounds Infrastructure Improvements	11500 S Houghton Rd	Facilities Management	209.2
Southern Arizona Cart Club	11700 S Harrison Rd	Facilities Management	8.4
Primary and Specialty Physician Care Site Expansion (Brain Inst)	2800 E Ajo Way	Facilities Management	14.8
Kino Sports Complex Northside Maintenance Facility	No Site - Ajo Way/Country Club - 1acre+/-	Facilities Management	1.0
One Stop Career Center	No Site W/SW Tucson - 2.5 acre+/-	Facilities Management	2.5
Catholic Comm. Serv - Sahuarita-Green Valley Clinic	No Site - Sahuarita / GV AZ - 2 acre+	Facilities Management	2.0
Northwest Regional Justice Center	No Site - NW of La Cholla / Orange Grove - 15-20 acre	Facilities Management	20.0
Catholic Comm. Services - Quincy Douglas Center	No Site Kino Blvd at 36th - 2 acre+	Facilities Management	2.0
Tucson Children's Museum	Rio Nuevo W of I-10	Facilities Management	2.5
Green Valley Performing Arts/ Learning Center III	W of Continental Rd, Green Valley, AZ	Facilities Management	20.0
Freedom Park Adult Learning Center	No Site - Freedom Park 4800 block of E 29th 2-5 acre	Facilities Management	2.5
ATLANO Anza trail		Office of Sustainability	2.0
DOT-06 Magee Road: La Canada Drive to Oracle Road (PC-RTA-12)	Magee Road: La Canada Drive to Oracle Road	Transportation	22.1
DOT-23 Thornydale: Cortaro Farms to Linda Vista	Thornydale: Cortaro Farms to Linda Vista	Transportation	27.2
DOT-32 Kolb Road: Sabino Canyon Rd to Sunrise Dr	Kolb Road: Sabino Canyon Rd to Sunrise Dr	Transportation	36.8
DOT-44 Orange Grove Road: Corona Dr to Oracle Rd (Phase 1)	Orange Grove Road: Corona Dr to Oracle Rd (Phase 1)	Transportation	35.3
DOT-53 Old Tucson-Nogales Hwy - Summit	South Old Nogales Highway, North of Old Vail Connection Road to East Suncrest Drive	Transportation	17.8
Silverbell RD at Blanco/Brawley Washes	Silverbell RD at Blanco/Brawley Washes	Transportation	3.0
Railroad Overpass: Ruthrauff Road (PC-RTA-09)	Railroad Overpass: Ruthrauff Road	Transportation	330.2
Magee Road/Cortaro Farms Road: Mona Lisa to La Canada (Stage I) (PC- RTA-07)	Magee/Cortaro Farms Road: Magee/La Cholla Intersection	Transportation	25.6
Madera Canyon Rd at Medium Wash	Madera Canyon Rd at Medium Wash	Transportation	0.8
Colossal Cave Rd: Acacia School to Old Vail Road	Colossal Cave Rd: Acacia School to Old Vail Road	Transportation	10.1
DOT-18 Cortaro Farms Rd: Camino de Oeste to Thornydale (PC Portion)	Cortaro Farms Rd: Camino de Oeste to Thornydale	Transportation	26.3
DOT-29 Houghton Road: Interstate 10 to Tanque Verde Rd (COT-RTA-32)	Houghton Road: I-10 to Tanque Verde Road	Transportation	231.0
DOT-31 Tanque Verde Road: Catalina Highway to Houghton Road (PC-RTA-27)	Tanque Verde Road: Catalina Highway to Houghton Road	Transportation	30.7
DOT-50 Kinney Road: Ajo Way to Bopp Road	Kinney Road: Ajo Way to Bopp Road	Transportation	11.8
La Canada Drive: Ina Road to River Road (PC-RTA-11)	La Canada Drive: Ina Road to River Road	Transportation	49.8
Magee Road/Cortaro Farms Road: Corridor Study & Thornydale Road to Mona Lisa (Stage III)(PC-RTA-07)	Magee Road/Cortaro Farms Road: La Canada Drive to Thornydale Road	Transportation	65.5

Project	Location	Department	Acres
DOT-58 Kino Parkway Overpass at 22nd Street	Kino Parkway Overpass at 22nd Street	Transportation	12.8
La Cholla Boulevard: Tangerine Road to Magee Road (PC-RTA-04)	La Cholla Blvd. from Tangerine Road to Magee Road	Transportation	90.4
La Canada Drive: Ina Road to Calle Concordia (PC-RTA-11)	La Canada Drive: Ina Road to Calle Concordia	Transportation	44.4
Valencia Road: Mt. Eagle Road to Ajo Highway (PC-RTA-23)	Valencia Road: Mt. Eagle Road to Ajo Highway	Transportation	32.0
Valencia Road: Wade Road to Mt. Eagle Road (PC-RTA-21)	Valencia Road: Wade Road to Mt. Eagle Road	Transportation	27.3
DOT-20 La Cholla Boulevard: River Road to Ruthrauff Road (PC-RTA-10)	La Cholla Boulevard: River Road to Ruthrauff Road	Transportation	13.6
Valencia Road, Alvernon to Kolb-RTA #24	Valencia Road, Alvernon to Kolb	Transportation	78.3
Kolb and Valencia Intersection Improvement	T15A, R15E, Sec 07,08	Transportation	288.4
Ina Road at Oracle Road Intersection	T13S R13E	Transportation	72.1
Tres Rios del Norte (USACOE Study)	SCR W Cortaro Farms Rd To W Sunset Rd	Regional Flood Control	403.6
Santa Cruz River: Paseo de Las Iglesias Restoration (USACOE Study)	SCR: San Xavier Rd To Downtown Tucson	Regional Flood Control	503.1
Arroyo Chico Detention Basin (USACOE)	Broadway Bl & Park Av To East Of Plummer Ave	Regional Flood Control	51.3
FC5.06 Santa Cruz River Flood Control, Erosion Control and Linear Park, Ajo to 29th St	Santa Cruz River: W Silverlake Dr to W Ajo Wy	Regional Flood Control	106.3
FC5.10 Canada del Oro River Park, Thornydale to Magee	Canada Del Oro: N Thornydale Rd To W Magee Rd	Regional Flood Control	31.0
Diablo Village Regional Detention Basins	T15S, R12E, west 1/2 Sec 16	Regional Flood Control	100.3
Santa Cruz River Continental Ranch Remediation	Section 22, T 12S, R 12E - Santa Cruz River	Regional Flood Control	59.1
Pantano Wash: Kolb Executive Park Bank Protection	Latitude-32.241923, Longitude-110.842510	Regional Flood Control	0.0
Pantano Wash:Speedway to Tanque Verde	Lat 32.242118, Lon-110842357	Regional Flood Control	0.0
Pantano Wash Kenyon to 22nd St		Regional Flood Control	0.7
Pantano Wash Golf Links Extension		Regional Flood Control	0.7
Pantano Wash - Rillito to Tanque Verde		Regional Flood Control	0.7
TRDN/Community Development Ecosystem Restoration		Regional Flood Control	0.7
Sahuarita/Green Valley Grade Controls		Regional Flood Control	0.7
Santa Cruz/Rillito/Community Development Confluence		Regional Flood Control	0.7
Santa Cruz River - Los Reales to Drexel		Regional Flood Control	0.7
Green Valley Drainageways 3,6,9,13,17		Regional Flood Control	0.7
Carmack Wash at Magee Rd		Regional Flood Control	0.7
Rollercoaster wash at Rudasill		Regional Flood Control	0.7

Project	Location	Department	Acres
SS6.05 Tanque Verde Interceptor: Craycroft to Tucson Country Club		Regional Wastewater	2.1
TV Creek: Sabino Canyon to Craycroft (USACOE)		Regional Flood Control	113.4
Madera Canyon at Florida Canyon Wash		Transportation	0.8
First Avenue: Orange Grove Road to Ina Road (PC-RTA-13)		Transportation	17.3
Sunset Road: Silverbell Road to I-10 to River Road (PC-RTA-08)		Transportation	8.0
Valencia Road: Mark Road to Wade Road (PC-RTA-21)		Transportation	115.7
ATOITP-Anza Trail		Office of Sustainability	96.6
Julian Wash Linear Park (COT)		Regional Flood Control	65.3
Curtis Park Skateboard Park and Improvements		Regional Flood Control	8.2
Brandi Fenton Memorial Park Phase II Environmental Ed Center		Regional Flood Control	8.5
Ajo Detention Basin		Regional Flood Control	52.4
Old Vail Corridor		Transportation	330.2
Alvernon-Swan Bypass Corridor		Transportation	221.2
Valencia Corridor		Transportation	438.0
Wilmot Corridor		Transportation	312.1
Kolb Corridor		Transportation	293.3
Country Club Corridor		Transportation	138.5
Golf Links Corridor		Transportation	312.0

Appendix F. Ranch management standards and guidelines.



Introduction

The Sonoran Desert Conservation Plan (SDCP) is a locally developed, long-term vision for protecting the natural and cultural heritage of Pima County. The Plan seeks to combine short-term actions to protect and enhance the natural environment with long-range planning to ensure that the natural and urban environments not only coexist but develop an interdependent relationship, where one enhances the other. The biological goal of the Plan is to protect the full range of plants and animals native to the region by maintaining ecosystem functions.

Ranch conservation is one of the six primary elements of the SDCP. Ranching conserves large areas of open space and wildlife habitat that might otherwise be developed. By virtue of the extensiveness of ranching as a land use and the ongoing stewardship provided by ranchers, ranching in many areas of Pima County is uniquely suited to preserve natural, unfragmented open space, wildlife habitats, and the land's basic natural and cultural resource values.

Eastern Pima County has over 1.4 million acres of land classified as grazing lands, of which over one million of these acres could potentially be developed into urban use in the future. Current ranch operations put annual livestock numbers at about 20,000 animals in 2009. Most ranches in Pima County are still family-owned enterprises. Current fragmentation of ranch lands is greatest within a twenty-five mile radius of Tucson where increasing land values and development pressure have resulted in ranches being converted into urban uses.

Through the ranch conservation element of the SDCP and the associated Multi-species Conservation Plan (MSCP) expected outcomes include:

- The metropolitan urban boundary is better defined;
- The heritage and culture of the west and early Pima County are preserved;
- An important traditional industry is maintained to support a diversified local economy;
- Watersheds and water resources are conserved and protected;
- The natural landscape can be conserved as a working landscape to provide open space, wildlife corridors, and habitat needed to maintain sustainable and diverse ecosystems;
- The landscape will balance traditional uses such as grazing with other uses such as recreation, preservation of cultural resources, habitat enhancement and restoration, control of invasive species, and the conservation and/or preservation of specific species and habitats identified as sensitive.

As a part of the SDCP land conservation strategy, the County has purchased numerous ranch properties over the past decade. With the passage of the 2004 Habitat Protection Priority Bond program, the acquisition of large working ranches has increased significantly. As of early 2010, the County owns or has committed to acquire fifteen working ranches exceeding 51,000 acres of private fee land as well as the grazing leases on over 191,000 additional acres. The Natural Resources, Parks and Recreation (NRPR) Department is responsible for

managing these open space properties. All ranches purchased (with the exception of the A7 Ranch, which as of 2010 is operated by Pima County staff) are independently operated, generally by the previous owners, who own the cattle, manage the ranches day to day and are responsible for operational costs under terms of a Management Agreement. Ranch operators have entered into third-party agreements with the County to conduct operations on County property and on grazing leases held by the County under the conditions outlined in the Management Agreement. This strategy relieves the County of operational and maintenance expenses on the ranches while directing the ranching operation in an ecologically sustainable manner. The County maintains all authority for ultimate decision making regarding property uses, timing and intensity.

The NRPR Department manages the properties with the intent of achieving sustainable uses of natural resources and maintaining functionally healthy habitat for both wildlife and livestock. The County uses methods developed by the United States Department of Agriculture (USDA), Agricultural Research Service, Natural Resources Conservation Service (NRCS), the United States Department of Interior, Bureau of Land Management (BLM), and the University of Arizona (UA) to inventory rangeland resources, assess rangeland and riparian health, and monitor rangeland and riparian conditions and trends. These techniques will be utilized to guide ranch and grazing management decisions.

Pima County Ranch Land Vision

The County's vision is to manage ranch properties to achieve sustainable use of natural resources and consistency with habitat needs for implementation of a MSCP by maintaining functionally healthy habitats for both wildlife and livestock.

Standards

The County will use three standards to maintain healthy rangelands on its ranch properties. These standards become the goals for the desired conditions of rangelands (plant communities, soils/sites and ecological processes). The standards are measurable and attainable, and comply with Federal, State and County statutes, policies and directives applicable to land ownerships found on County-owned ranches.

1. Rangeland plant communities will be managed to provide adequate cover to protect soils from accelerated erosion and promote proper hydrological function.
2. Rangelands will be managed for diverse native plant communities which exhibit the appropriate plant functional groups (life-forms) and annual productivity for the ecological sites present.
3. Rangelands and riparian areas will be managed to optimize ecosystem health and condition, and for habitats that support diverse native wildlife, fish, and plant populations.

Guidelines

The County will use seven guidelines to manage grazing on its ranches. Guidelines are management approaches, actions and practices necessary to achieve desired rangeland condition goals. Guidelines identify and apply methods to control grazing land use; they are developed and applied to achieve desired conditions within site capability and they can be adjusted over time.

1. Stocking rates will be established to balance livestock numbers with forage plant production. Permitted numbers may remain the same but stocking rates can change yearly to match changing forage and water supplies.
2. Appropriate grazing systems (methods of grazing and resting pastures) will be employed to allow plant forage species to recover from grazing, reproduce and accumulate soil cover (foliar, basal and litter).
3. Utilization levels of key forage species will be used as guidelines for achieving sustainable use of renewable forage resources. Forage utilization will be managed to achieve target levels of 35-40% or less use of the current year's growth of selected key forage species consistent with a conservative grazing regime[1] [2]. If necessary these levels may be adjusted depending on pasture conditions or to meet specific management objectives.
4. Practices such as fencing (using Arizona Game and Fish Department (AGFD) wildlife-friendly standards), improving available water supplies, range seeding, shrub management and prescribed burning may be used as indicated by monitoring plant community response to applied management.
5. Adaptive management will be used to make grazing management decisions each year. This process employs a strategy of:
   a. Applying management throughout the year (with record keeping);
   b. Monitoring plant communities (in the fall of each year), grazing use, and precipitation;
   c. Assessment of results using an interdisciplinary approach;
   d. Using the assessment to plan and/or modify grazing management decisions for the coming year and determine the need to modify and implement appropriate practices;
   e. Recognizing that results of monitoring that cannot be explained by assessment of the data (vegetation, climate and grazing use) may indicate research needs that can be addressed through a committee of rangeland experts.
6. Habitat will be managed to provide for ecosystem health and the maintenance of diverse populations of native plant, fish and wildlife species. Grazing plans will balance stocking rates and pasture rotations with maintaining or actively improving rangeland habitats for native species. Management tools such as wildlife-friendly fencing and year-round water drinkers may be utilized to enhance these habitats. Water tanks and troughs should contain wildlife escape ramps, if needed. Depending on management activities, strategies for rehabilitation or restoration projects will be evaluated and integrated into ranch plans on a case-by-case basis.
7. Special wildlife habitat features (caves, mines, rock outcrops, springs, seeps, etc.) will be identified and considered during implementation of management actions, and conserved and/or enhanced through appropriate actions to maintain their unique habitat values.

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[1] Smith, L., G. Ruyle, J. Maynard, S. Barker, W. Meyer, D. Stewart, B. Coulloudon, S. Williams, and J. Dyess, 2005, Principles of obtaining and interpreting utilization data on Southwest rangelands, University of Arizona Cooperative Extension AZ1375, 14pp.

[2] Holechek, J. L., M. Thomas, F. Molinar, and D. Galt. 1999. Stocking desert rangelands: what we've learned. Rangelands 21:8–12.

Rangeland Inventory

The County will conduct an inventory of all the County-owned ranches. This inventory will consist of mapping all cultural improvements (houses, corrals, roads, fences, water developments, etc.) with information such as names, pasture size, scale and legends on the land on a comprehensive map base. Information

will also be obtained where possible on historic/prehistoric resources that could be significantly impacted by grazing or other resource management activities. Inventory data will be collected in and/or converted into digital format for inclusion into the Pima County Geographic Information Services Division library, and cultural data will be recorded with the Arizona State Museum. Rangeland resources will be delineated using established data management techniques.

Pima County-owned and leased rangelands lie within one or more of three environmental/geographic regions: the Upper Sonoran Desert, the Semi-desert Grasslands, and the Mexican Oak Savannah. In Arizona, these regions correspond to Major Land Resource Areas (MLRAs)[3] in which soils that are alike in their ability to produce vegetation are grouped together into units called "Ecological Sites". An ecological site is defined as a distinctive kind of land with specific physical characteristics (soil, slope, landform, etc.) and processes (erosion, fire, hydrology, etc.) that differs from other kinds of land in its ability to produce a distinctive variety and amount of vegetation. Ecological sites are described with written narratives of the site's physical characteristics, soils and historic climax plant community. They are the recommended basic unit of rangeland classification and are suitable for mapping at a land management scale. Ecological site descriptions are published by NRCS and are available at the USDA Ecological Site Information System website[4]. The County will use established procedures for mapping and delineating ecological sites as described in the NRCS National Range and Pasture Handbook[5].

The "Soil Survey of Pima County, Eastern Part" is completed and available online for all private, State Trust and Tribal lands east of the Tohono O'odham Nation[6]. Because soil mapping units are generally correlated to ecological sites, soil polygons in conjunction with on-site field truthing can be used to create ecological site delineations, and to identify soil-moisture and temperature regimes within MLRAs.

- MLRA 40-1 is the Upper Sonoran Desert region in Arizona and is characterized by a precipitation regime of 10-13 inches annually, elevations ranging from 2,000 feet above mean sea level (FAMSL) to 3,200 FAMSL, soils in the typic-aridic soil-moisture regime and thermic soil-temperature regime. Twenty ecological sites have been described in this zone.

[3] USDA, Land Resource Regions and Major Land Resource Areas of the United States, the Caribbean, and the Pacific Basin, U.S. Department of Agriculture Handbook 296 (2006)

[4] http://esis.sc.egov.usda.gov

[5] USDA NRCS, 2003, National Range and Pasture Handbook. Grazinglands Technology Institute, Revision 1 December 2003 (http://www.glti.nrcs.usda.gov/technical/publications/nrph.html).

[6] USDA, NRCS, 2003, Soil Survey of Pima County, Arizona, Eastern Part (http://soildatamart.nrcs.usda.gov).

- MLRA 41-3 is the Semi-desert Grassland region in southern Arizona, characterized by a precipitation zone of 12-16 inches annually, elevations from 3,200 to about 4,500 FAMSL and soils in the ustic-aridic soil-moisture and thermic soil-temperature regimes. Twenty ecological sites have been described in this zone.
- MLRA 41-1 is the Mexican Oak Savannah region in southern Arizona and is characterized by a 16-20 inch precipitation zone, elevations above 4,500 FAMSL and an aridic-ustic soil-moisture regime and-thermic soil-temperature regime. Fourteen ecological sites have been described in this zone.

NRCS ecological site descriptions also include information related to commonly encountered plant communities, which will enable determination of the current ecological status or condition of a specific site by comparing the present-day characteristics of the plant community to the potential that is described in the ecological site description[7]. "State and Transition" models describe succession of plant communities in arid regions like Arizona and may provide future guidance in further determining realistic vegetation management objectives[8].

Assessments

The County will use two assessment techniques to evaluate the health and functionality of rangelands and riparian areas. These techniques are qualitative (i.e., depend upon professional judgment). They require considerable training and will be done in an interdisciplinary fashion. The assessments are not monitoring techniques and will not be used to measure progress towards meeting goals. They are tools to be used for educational and communication purposes and to help identify problems and set priorities for both monitoring and management.

1. Rangeland Health is a qualitative assessment that will be used to rate 17 indicators that affect the three primary attributes of the rangeland ecosystem being evaluated: site and soil stability, hydrologic function, and biotic integrity of the plant community[9]. Rangeland health assessments will be performed on ecological sites during the initial inventory process and at monitoring locations to determine the status or function of these ecosystem attributes. Subsequent assessments will be performed prior to lease renewals. A preponderance of evidence will be used to determine if the evaluated rangeland ecosystem attributes are healthy, at risk, or unhealthy[10].

[7] Task Group on Unity in Concepts and Terminology, 1996, New concepts for assessment of rangeland condition, Journal of Range Management, 48: 271-282.

[8] Bestelmeyer, B.T., J.R. Brown, et al., 2003, Development and use of state-and transition models for rangelands, Journal of Range Management, 56(2): 114-126

[9] Pellant, Pyke et al., 2005, Interpreting Indicators of Rangeland Health – Version 4 (http://www.blm.gov/nstc/library/techref.htm).

[10] Reference area information to assist in the use of this technique have been developed by NRCS for major ecological sites in places such as un-grazed or lightly grazed exclosures on the Santa Rita Experimental Range.

2. Riparian Proper Functioning Condition is a qualitative assessment that addresses questions which examine the hydrology, vegetation, and erosion/deposition processes of a riparian area[11] [12], although this assessment does not identify the cause of a resource problem. Proper functioning condition assessments will be performed on riparian reaches with similar channel characteristics on all riparian areas encountered during the initial inventory process, and at any riparian monitoring location. Subsequent assessments will be performed prior to lease renewals. A summary determination will be made for each area being evaluated: either proper functioning condition, functional "but at risk", or non-functioning.

Monitoring

Rangeland monitoring will implement fixed (permanent) plots placed in strategic areas (key areas) in pastures. These key areas usually represent a dominant ecological site and are in areas receiving average grazing use[13]. Where possible, both a grazed area and an un-grazed (exclosure) control area on the same ecological site will be monitored. The use of an un-grazed control site will help separate grazing effects from climatic effects on plant communities. At all plot locations photo points will be established and seasonal rainfall recorded twice each year for winter (October through May) and summer precipitation (June through September) thus obtaining records for cool and warm seasons. Existing plots that are found to be unproductive in providing useful data or prove excessively difficult to access may be moved to more favorable locations to maximize monitoring efforts. All monitoring plots, new or existing, will be evaluated for whether their data accurately reflects local field conditions prior to any long-term time commitment.

Vegetation monitoring will utilize several techniques to determine trends and to assess progress towards meeting County rangeland management objectives. These techniques include:

1. Plant Frequency Sampling[14] – Frequency is the number of times a plant species is present in a given number of sample quadrats of uniform size placed repeatedly across a stand of vegetation. It is expressed as a percentage of total placements and reflects the probability of encountering a particular species at any location within the stand. The sensitivity of frequency data to density and dispersion make frequency a useful parameter for monitoring and documenting changes in plant communities. It is useful for monitoring vegetation changes over time at the same locations or for comparisons of different locations. The presence of annual plants is directly correlated to habitat suitability for some wildlife; therefore, annual species are recorded as well as perennials. Species-specific data are more useful when using the ecological site guides to compare the current vegetation community to the potential natural community. Plant frequencies are com-

[11] BLM, 1998, A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas, TR 1737-15.

[12] BLM, 1999, A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lentic Areas, TR 1737-16.

[13] USDA NRCS (National Resources Conservation Service), 2003, National Range and Pasture Handbook, Grazinglands Technology Institute, Revision 1 December 2003 (http://www.glti.nrcs.usda.gov/technical/publications/nrph.html).

[14] Ruyle, G. B., Ed., 1997, Some methods for monitoring rangelands and other natural area vegetation, Report 9043, University of Arizona, Cooperative Extension Service, Tucson, Arizona

pared to frequencies from previous years to identify changes and help determine trend. Binomial confidence intervals will be used to identify changes in frequencies that signify meaningful departures from normal sampling variation. A 40 centimeter square quadrat size, and 200 quadrats located along paced transects as recommended by range scientists at the UA is considered the ideal standard and will yield important data related to plant species diversity, plant functional groups and trend in individual plant species.

2. Point cover[15] – Points of cover will be sampled on each transect to measure soil ground cover, with 600 to 800 points being considered an ideal number by range scientists. These measurements include bare soil, plant basal cover, gravel/rock cover, litter cover and cover of cryptogamic plants (algae, mosses and lichens). Soil cover is one of the principle factors affecting soil erosion. Point cover is gathered concomitant with frequency data.
3. Fetch[16] – Fetch is a measurement of the fragmentation or patchiness of cover, which is directly related to acceleration of soil erosion. Fetch is measured as the distance from a point on a transect to the nearest perennial grass or shrub base. Asymmetry is calculated using the formula: (maximum-median)/(median-minimum), where the median, minimum, and maximum values come from the collective dataset of individual fetch measurements from a transect. As asymmetry (longer fetch distances increase relative to the shortest fetch distances) increases, fragmentation of cover increases and erosion can accelerate. Asymmetry values exceeding 10 are indicative of soil erosion beyond natural levels. This measurement is most applicable to grassland sites and communities with over 2% basal or ground cover, and will not be used on desert sites with less cover.
4. Dry Weight Rank[17] – Composition by weight is probably the best measure of the relative abundance of a plant species in a community. In each quadrat (the same quadrat used in frequency measurements) the 3 species having the highest yield on a dry matter basis are visually estimated. These species are ranked 1-3 with the highest yielding species getting a rank of 1. This measure of the plant community yields plant species composition (by annual production) and allows the comparison of the present-day plant community on a site to the potential or the desired plant community described in the ecological site description. This comparison is expressed numerically as the similarity index.
5. Comparative Yield[18] – This method will be used for estimating above ground biomass production. Reference quadrats are chosen, representing the range in dry weight of vegetative standing crop or yield expected to be commonly encountered during sampling. The current production in these (usually five, 40-centimeter square) quadrats is clipped and weighed (grams air-dry). Results from sample quadrats are then compared to the reference quadrats and rated. The summary yields a standing crop of biomass in pounds per acre on an air dry basis. This measure can be used to compare production of the present day plant community to that shown on the ecological site description for a normal, above average or below average rainfall year.
6. Utilization measurements – Utilization is a measure of the percent of the current year's growth, by weight, that has been removed from a forage plant by grazing, browsing or trampling. Utilization levels (expressed as a percentage) are used as guidelines to assist in achieving plant community objectives[19]. Utilization is determined[20] at the end of the planned grazing period, or at the end of the

[15] Ibid

[16] D. Robinett (personal email communication to I. Rodden, January 11, 2009).

[17] Ruyle, G. B., Ed., 1997, Some methods for monitoring rangelands and other natural area vegetation, Report 9043, University of Arizona, Cooperative Extension Service, Tucson, Arizona

[18] Ibid

[19] Smith, L., G. Ruyle, J. Maynard, S. Barker, W. Meyer, D. Stewart, B. Coulloudon, S. Williams, and J. Dyess, 2005, Principles of obtaining and interpreting utilization data on Southwest rangelands, University of Arizona Cooperative Extension AZ1375, 14pp.

[20] BLM, Interagency Technical Reference 1734-3, 1996, Utilization studies and residual measurements.

grazing season (February for summer forage crop, June for spring forage crop) if grazed year-round. In years where a spring forage crop is lacking, year-round utilization may be gauged prior to the summer rains. Utilization is measured on one or more key forage species selected at each key area. During the grazing period or season, estimates of utilization and use patterns can be used to adjust stocking rates, if needed. Utilization estimates based on forage produced to time of estimate during a growing season should be identified as "seasonal utilization" and usually will have a different guideline percentage than utilization based on current annual growth. If grazing in one year or season results in utilization in excess of the guidelines, then the current plan may be adjusted or revised to allow recovery of that particular pasture in the subsequent year. Actual utilization data can be used with vegetation monitoring and rainfall amounts to assess trends in various attributes of the plant community and soil cover[21].

Ranch Planning

Pima County rangelands fall within the geographic area of the Tucson Field Group for Coordinated Resource Management (CRM). The group is the local arm of the Arizona CRM group consisting of representatives from NRCS, BLM, AGFD, United States Forest Service, Arizona State Land Department, local Natural Resource Conservation Districts, and Arizona Cooperative Extension. The local group meets each summer to develop plans for interagency ranch planning and monitoring efforts in the coming year.

Within this framework Pima County will develop a Coordinated Resource Management Plan (CRMP) for each of its ranch properties as time and resources permit. The CRMP will include a grazing component with an assessment of rangeland resources (ecological sites, cultural features, etc.), current rangeland conditions, and goals. Adaptive management will utilize monitoring results in a feedback loop each year to develop and modify grazing plans. The CRMP will establish a collaboration model for the managers, ranch operators, natural resource agencies and the public to work together to achieve common conservation goals for the land. Pima County does not, however, relinquish its authority for overall management decisions made on County-owned and/or leased properties.

The CRMP process brings together a team of local area experts to share programmatic needs and conservation strategies that support the SDCP program goals on ranch properties. Draft CRMP plans will be available for public review and comment and will be posted on the Natural Resource Division portion of the Pima County Natural Resources, Parks and Recreation website at www.pima.gov/nrpr.

CRMP Goals

1. Establish stocking rates, timing, frequency, and duration of grazing that are consistent with utilization guidelines.

[21] Holechek, JL., Pieper, RD., and Herbel, CH., 2004, Range Management: Principles and Practice, 5th edition, Pearson Prentice Hall, New Jersey, 607 pages.

2. Attain a stable or positive trend over time in rangeland conditions (vegetative, soils, productivity).
3. Utilize grazing systems that shall allow for sufficient plant growth, reproduction and residual cover to protect soils from accelerated erosion.
4. Adjust stocking rates to account for variation in precipitation and forage production.
5. Practice cooperative management and collaboration with ranch operators, other agencies and the public.
6. Maintain public access to and across the ranch properties where public health/safety and negative impacts to wildlife or wildlife habitat are not an issue.

Ranch Management Action Strategies

1. Identify property boundaries and legal access.
2. Map ranch roads, boundaries, pastures, improvements (and document condition of improvements), and water sources. Install signs to clearly communicate ranch roads and boundaries.
3. Identify ecologically sensitive areas and the management needs of these areas.
4. Determine percentage of ranch lands that livestock can utilize (noting sensitive areas, slope and distance from water, or important wildlife habitats).
5. Compile and review historical stocking and utilization rates, precipitation records, fire regimes, and other factors that contributed to the current resource conditions.
6. Consult with AGFD Wildlife Managers to identify wildlife resources and requirements on ranch lands.
7. Identify riparian areas and assess the function and ecological condition of each.
8. Inventory ecological sites and identify current ecological status (health) or condition.
9. Analyze all of the above information and develop a coordinated resource management plan.
10. Select key areas and establish rain gauges, photo points and monitoring transects with a paired ungrazed control plot where possible. (Monitoring efforts will be repeated every year for an initial three year baseline assessment and biennially at a minimum thereafter.)
11. Evaluate alternative methods to manage grazing. (Select and apply one.)
12. Utilize an adaptive management model to incorporate the yearly assessment of monitoring results into a process of developing annual grazing plans, adjustment of stocking rates, and determining the need for practices or research (to help explain unknowns). (Research findings should be incorporated back into the system as available.)
13. Develop fire management plans with the agency responsible for fire management decisions. (Develop maps showing areas that would benefit from fire and provide them to the agency to guide managers if a natural fire starts.)
14. Evaluate other legal or illegal uses and/or impacts on ranch properties (e.g. camping, hunting, off-road vehicle use, or border issues) and develop strategies to enhance, address or mitigate negative impacts where possible. Mitigation actions should be compatible with existing ranch management plans.

Terms used in this report can be found and described in the "Glossary of terms used in range management", 4th edition. Glossary Update Task Group (1998). T. Bedell. Denver, Society for Range Management.

Optimal Timeline for Annual Evaluation of Grazing Practices for Each Ranch

ACTION	TIMELINE
Evaluate pasture utilization levels	February or June
Annual monitoring and photos at key areas	September to November
Twice annual recording of precipitation at key areas	May and September
Operator submits suggested revisions based upon the assessment of monitoring results	September
Review and assess current year's data, monitoring analyses, goals and objectives, and completed or new projects or concerns	November
NRPR Review Panel reviews the operator's changes and makes decisions for the next year	December
Operator meets with the NRPR Review Panel to discuss proposed use for the coming two years	December
Review a summary of monitoring and pasture utilization data to date with ranch operator, so stocking rate adjustments, if apparent, can be initiated with fall livestock work schedule	November to January
Decisions made on the approved stocking rate	March
Additional on-the-ground stocking rate adjustments, if necessary	January to June

Appendix G. Land absorption, habitat impact, and mitigation analysis.

Model developed by Mike List, Julia Fonseca, Cory Jones, Mark Probstfeld, and Sherry Ruther.

Overview: Urban growth projections utilize land absorption modeling to estimate how landscapes might change as a result of an increasing human population. The growth projection scenario used for estimating habitat impacts was developed by a public-private team of planners and engineers during the City-County Water Study (Stantec Inc. et al. 2009), then modified for this study to assess a shorter and varied time horizon. Then the impacts within the Permit Area from the growth model were combined with the impacts from future Capital Improvement Program projects for the 30-year term of the MSCP. This combined result was then intersected with species habitats to measure habitat impacts. Figure A-33 summarizes the methods used and CLS mitigation was calculated as shown in Figure A-34.

The resulting impacts are a projection of where Covered Activities might occur. Projections are for US Fish and Wildlife's analytical purposes. The projections are not for use in parcel-specific determination of permit coverage, nor will they represent areas of actual habitat take. Actual locations of take by Covered Activities will be tracked and reported to USFWS annually, based on what land is actually developed in the permit area under the County's incidental take permit.

Urban Growth Projection: The projection of urban growth we used for habitat impacts was consistent with what was called the "status quo" growth scenario in the City-County Water Study (Stantec Inc. et al. 2009). The defining characteristic of the "status quo" growth scenario is that new growth in the suburbs occurs at 2,500 people per square mile, a relatively low metropolitan population density that is consistent with current patterns of growth in the Tucson area. More information is available about the development of the "status quo" growth scenario in Stantec Inc. et al. (2009).

Since 2009, additional growth scenarios have been developed as part of Imagine Greater Tucson. These scenarios are based on a higher population and a longer time frame than the 30-year term we used. Also, IGT planning scenarios assume a much higher population density. If the region is able to achieve higher urban densities (i.e., requiring higher densities in planned communities and/or implementing transit oriented development), then the predicted habitat impacts for the 30-year term of the permit would be fewer than represented here.

Our analysis also excluded consideration of future annexation patterns. Annexations could reduce the total long-term impacts of urban development within Pima County's permit area. We excluded western Pima County from the growth model *a priori* because there is no basis (i.e., specific population projections and refined GIS data) to

project future development there. Development opportunities in western Pima County are largely

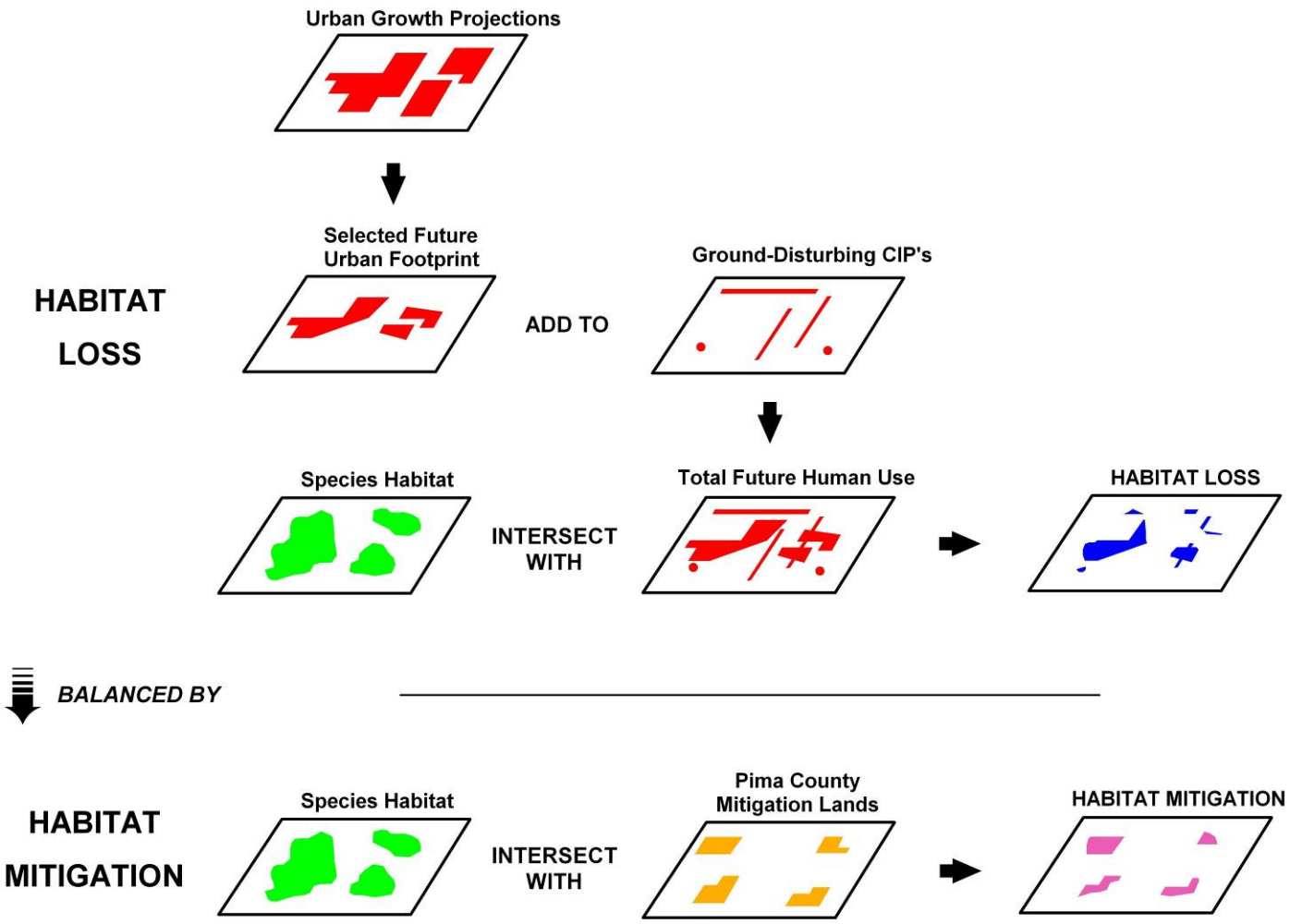

Figure A-33. Schematic representation of the methods used to calculate habitat loss and habitat mitigation (illustration by Mike List).

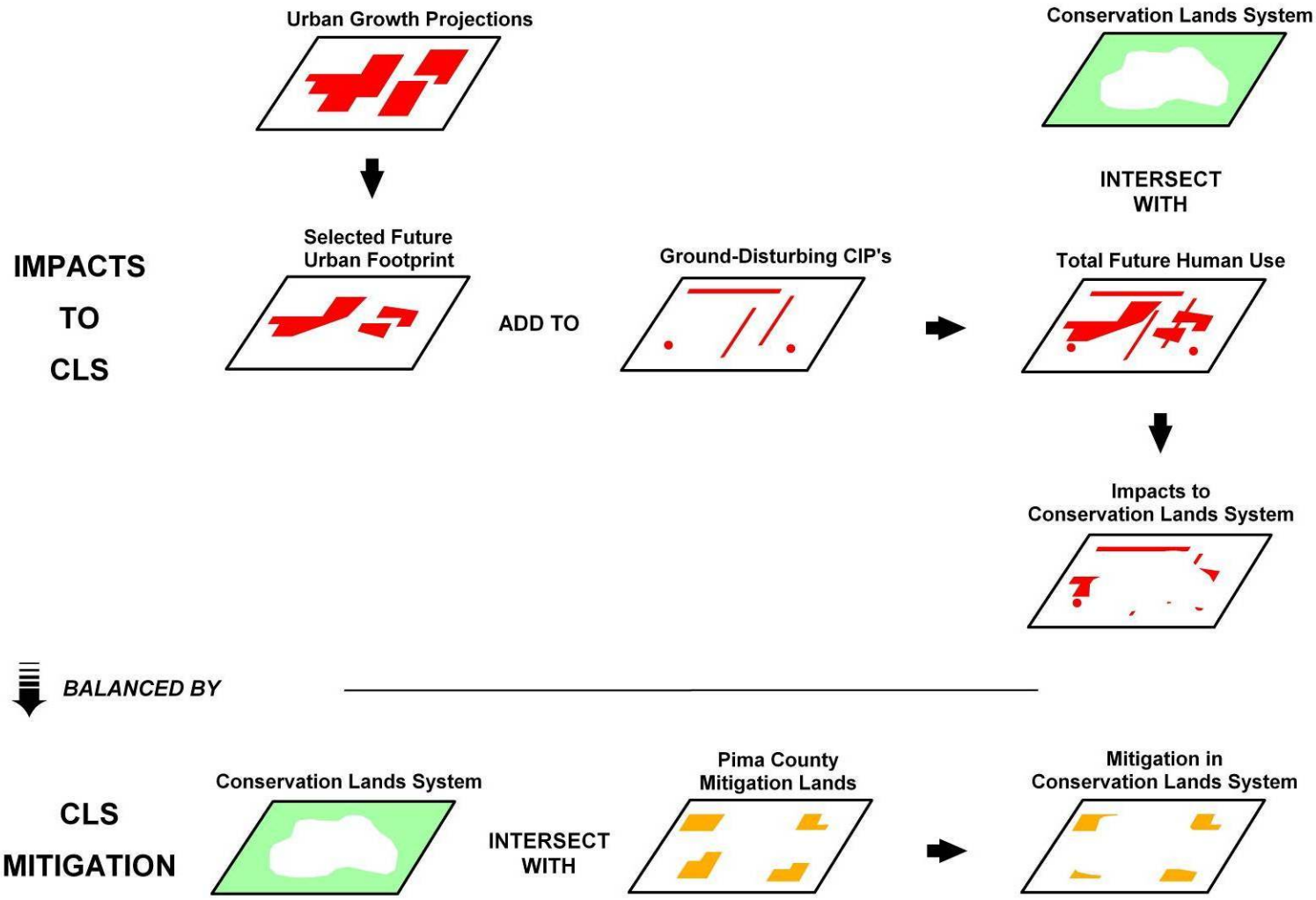

Figure A-34. Schematic representation of the methods used to calculate CLS impacts and mitigation (illustration by Mike List).

limited to infilling the built environment on private lands in the isolated, low density communities of Ajo, Why, and Lukeville.

For our purposes, assumptions were needed to predict population growth at 10-year increments, and to differentiate Covered Activities from other impacts in the Permit Area. Because of the changes in Covered Activities, we departed from methods described in Fonseca et al. (2009), which were the basis for habitat impacts in the Draft 5 MSCP.

We obtained population projections from the Arizona Department of Economic Security (2008) for the years 2020, 2030, and 2040. These projections were used in conjunction with an urban form classification developed for the City-County Water Study. New population allocated by the land absorption model was 559,477. This GIS layer divides eastern Pima County into four urban form units (urban core, core suburbs, expanding suburbs, and exurbs) and many sub-units (e.g., exurbs - lot split low density). Each urban form unit dictates a unique population density, ranging from 4,500 people per square mile in the urban core to 300 people per square mile in portions of the exurbs. The urban form boundaries were drawn using elements of the Pima County Comprehensive Plan and the City of Tucson General Plan in conjunction with data on current population density as well as subdivision and annexation history. The urban form layer was overlain with the past ten years of residential building permits, and the resulting ratios of permits by urban form were applied to the population projections. In this fashion, land absorption was "spread around" at varying population densities based on dynamics particular to eastern Pima County.

A definition of the current built environment per the Pima Association of Government's latest land use model (2008) was used as the starting point for adding new urban growth. This is different than the Draft 5 MSCP calculation for the 2008 built environment, which was based solely on Pima County data. Road rights-of-way (ROW) were not included in the built environment.

Constraints to future land absorption were as chosen by the City-County Water Study Committee. For this model we stipulated that urban growth would not occur:

- in the existing built environment, except non-mapped infill in the urban core/core suburbs,
- in areas of greater than 25% slope,
- in areas of existing mines/quarries,
- in areas of floodways,
- on Federal or tribal lands except BLM disposable land outside CLS,
- in existing or proposed preserves of any kind,
- on Tucson Water municipal lands and wellfields,
- on active landfills,
- on golf courses,
- within road rights-of-way,
- in public parks
- in cemeteries

- in DM/TIA approach and departure corridors.

Most land absorption occurred in the suburbs, which were divided into four urban form sub-units. The City-County study recognized both planned and unplanned residential suburban development (Stantec Inc. et al. 2009). Planned development was defined using information from Comprehensive Plan Amendments, State Trust discussions, and other GIS data. Planned development included unbuilt *and* partially built communities. At 2020, we assumed that the only State Trust Land available to absorb growth was located within planned communities. In the subsequent timeframes, State Trust Land was released to development throughout the rest of the suburbs, but not in any of the exurbs.

Suitability for future development was developed in consultation with the City-County Water Study, and in consideration of recent trends in development. Suitability was assumed to improve with proximity to:

- Existing, committed, and planned road and transit infrastructure,
- Existing potable water infrastructure,
- Top single-site employers,
- Existing sewage conveyance and treatment infrastructure,
- Recent (2003-2008) building permits and house sales,
- Current built environment,
- Municipal parks and selected trailheads,
- High-performing school districts,
- Areas not deemed "high stress."

Note, these variables were weighted in terms of influence through a match pairs comparison exercise (i.e., Analytical Hierarchy Process) completed by the team of engineers and planners.

Population is "absorbed" by the most suitable 30-meter cell (equivalent to approximately 1/5 acre). The cell size was determined by the slope grid used for urban growth constraints. The cells with the highest development suitability scores were iteratively chosen until each population projection per urban form unit per timeframe was satisfied. The 2020 land absorption projections were added to the existing built environment to yield a new development constraint, and so on through the next two ten-year increments.

Covered Activities

Covered activities modeled included private development and County capital Improvements. As defined in the MSCP, covered private development consists of Type 1 grading permits, subdivisions and development plats. For the purpose of analysis, we assumed that ~33,000 acres would be available for private impacts, with ~1,800 acres for the County's known capital improvements.

Staff reviewed all capital improvements projects identified by contributing departments of Pima County. Projects which would likely be completed before the MSCP permit is

issued were not analyzed. All road projects are considered covered, but only repaving and other projects confined to existing built rights-of-way were not modeled. Only capital improvement projects in the Permit Area and causing ground-disturbance outside the built environment were modeled as potential habitat impacts.

The cells of projected urban growth within planned communities within the City-County model in the Permit Area were selected to represent the potential location of Covered Activities. Selections occurred up to the ceiling of approximately 33,000 acres for covered private activity. Growth that occurred in planned communities represented the bulk of Covered Activities in this model. About 7,200 acres of the cells of growth were distributed in areas that were rezoned between 2002 and 2009.

Habitat Losses

Habitat losses were modeled using the sum of covered private development activities and capital projects, intersected with each of the species' habitat. We assumed that nearly all of the capital improvement projects would be completed in the first 20 years. For covered private development, the assumptions about the slow release of State Trust land to the private sector results in most of the pre-permit rezonings and extant planned communities being developed in the first 20 years.

Habitats were defined using all Priority Conservation Areas 1 through 4 defined by experts (Environmental Planning Group 2001). Two species, the desert tortoise and Tumamoc globeberry, do not have PCAs and therefore we used habitat suitability models for these species. The desert tortoise model used was the "bedrock plus" model developed by Julia Fonseca with review by the Marana Technical Biological Team and others. The Tumamoc globeberry model used was the potentially suitable habitat model developed by RECON and others during the Sonoran Desert Conservation Plan.

Occurrences of talussnails are too localized to model.

Habitat Mitigation

To analyze how mitigation compensates for species' habitat loss, we used a projection of mitigation lands that Pima County expects to acquire with existing funding plus existing County-controlled mitigation lands, previously described in the *Pima County Mitigation Lands* report (Connolly and Fonseca 2009). Lands located outside Pima County were analyzed, but in nearly all cases, PCAs or habitat models do not extend into these areas at the present time. Thus these lands were not analyzed for habitat mitigation. Outside of the County boundary, Pima County owns approximately 1,700 acres of Mitigation Land, and leases approximately 9,600 acres outside Pima County boundaries.

Uncertainties related to actual future habitat losses and thus habitat mitigation obligations under the Section 10 (a) permit are discussed in *Habitat Mitigation in the Pima County Multiple Species Conservation Plan* (Fonseca 2009).

Waters of the US impacts

We prepared an effects analysis for the programmatic consultation on covered activities that have a Section 7 nexus through Section 404 of the Clean Water Act. This effects analysis is a subset of the MSCP impact analysis.

Under Section 404, "Waters of the US" are delineated on a project-by-project basis by the applicant using methods and guidelines outlined and approved by the Corps. However, for a regional analysis such as this, some assumptions were necessary to estimate the location and magnitude of potential future impacts on WUS that might occur in the proposed project area due to MSCP covered activities. Pima County Regional Flood Control District prepared a table representing the average, assumed channel widths based on a range of watercourse size and their associated discharge values, as well as typical Ordinary High Water Mark characteristics used to identify potential WUS in approved preliminary jurisdictional delineations within various sized watercourses. The WUS were identified by varying channel widths based on flow accumulation modeling for watersheds greater than 25 acres, based on USGS digital elevation models for rural areas, and LiDAR for the metropolitan area.

The resulting representation of "waters" was intersected with the 36,000 acres of MSCP covered impacts. The result of this operation was then intersected with species models. Other impacts examined for the effects analysis included critical habitat, perennial or intermittent streams, and Outstanding waters as defined by the State of Arizona. We also used a GIS layer that represented many but not all of the constructed channels maintained by the Pima County Regional Flood Control District to look at the location of these impacts in relation to areas that might already be disturbed.

Appendix H. Lands that have been acquired or leased by Pima County and which will be used for MSCP mitigation.

For a complete description of most properties including resources and reasons for purchase, see Pima County (2011) and Fonseca and Jones (2009).

Preserve	Owner	Land Tenure	Acres
A-7 Ranch	Pima County	Fee simple	6,747.9
A-7 Ranch	State of Arizona	Grazing lease	34,218.3
Ajo	Pima County	Fee simple	1,397.4
Amadon	Pima County	Fee simple	38.2
Arivaca open space	Pima County	Fee simple	122.1
Arthur Pack Regional Park	Pima County	Fee simple	281.2
Avra - I-10	Pima County	Fee simple	46.7
Bar V Ranch	Pima County	Fee simple	1,765.5
Bar V Ranch	State of Arizona	Grazing lease	12,134.6
Baxter	Pima County	Fee simple	26.0
Bear Creek Ranch	Pima County	Fee simple	17.8
Bee	Pima County	Fee simple	160.2
Big Wash Rehabilitation	Pima County	Fee simple	146.7
Bingham Cienega Natural Preserve	Pima County	Fee simple	267.9
Brawley Wash/ Manville-Garcia	Pima County	Fee simple	395.8
Buckelew Properties	Pima County	Fee simple	1,015.5
Buckelew Properties	State of Arizona	Grazing lease	2,514.0
Buehman Canyon	Pima County	Fee simple	2,286.0
Canoa Ranch	Pima County	Conservation easement	84.3
Canoa Ranch	Pima County	Fee simple	4,697.3
Chilton Ranch	Pima County	Fee simple	163.2
Cienega Corridor	Pima County	Fee simple	1,686.9
Cienega Creek National Preserve	Pima County	Fee simple	4,267.0
Clyne Ranch	Pima County	Fee simple	956.7
Cochie Canyon	Pima County	Fee simple	286.0
Colossal Cave Mountain Park	Pima County	Fee simple	780.7
Dakota Wash	Pima County	Fee simple	23.0
Diamond Bell Ranch	State of Arizona	Grazing lease	29,856.0
Dos Picos	Pima County	Fee simple	55.8
Doucette	Pima County	Fee simple	22.0
Drainageway	Pima County	Fee simple	292.5
Drewes	Pima County	Fee simple	9.8
Elephant Head sec.15 mit. lands (Easely)	Pima County	Fee simple	162.9
Empirita Ranch	Pima County	Fee simple	2,787.9
Estates at Old Dpanish Trail	Property owner	Conservation easement	98.3
FLAP Properties (various locations)	Pima County	Fee simple	1,805.6
Hartman & Cortaro	Pima County	Fee simple	49.0
Heater	Pima County	Fee simple	0.4
Joshua Tree II	Pima County	Fee simple	39.6
King 98 Ranch	Pima County	Fee simple	1,039.1
King 98 Ranch	State of Arizona	Grazing lease	3,291.1
Linda Vista/Patrick Property	Pima County	Fee simple	9.3
Los Morteros	Pima County	Fee simple	106.8
Lower Santa Cruz Replenishment	Pima County	Fee simple	104.6
Madera Highlands	Pima County	Fee simple	373.3
Malcolmson Donation	Pima County	Fee simple	73.8

Preserve	Owner	Land Tenure	Acres
Marana Cottonwoods	Pima County	Fee simple	72.5
Marley	Pima County	Fee simple	6,389.5
M Diamond	State of Arizona	Grazing lease	9584.0
M Diamond	Pima County	Fee simple	604.0
Nunez	Pima County	Fee simple	19.3
Oracle Ridge	Pima County	Fee simple	1,173.3
Park	Pima County	Fee simple	40.2
Poteet	Pima County	Fee simple	74.7
Rancho Seco	Hooker Associates	Conservation easement	477.1
Rancho Seco	Pima County	Fee simple	9,576.8
Rancho Seco	State of Arizona	Grazing lease	21,659.1
Reid Property	Pima County	Conservation easement	4.0
Reid Property	Pima County	Fee simple	3.3
Rocking K expansion	Pima County	Fee simple	104.0
Ruddick	Pima County	Fee simple	14.6
San Domingo flood-prone area	Pima County	Fee simple	14.0
Sands Ranch	Pima County	Fee simple	5,219.8
Section 404 or Pima County riverine	Pima County	Fee simple	728.7
Segurson donation	The Nature Conservancy	Fee simple	150.8
Six Bar Ranch	Goff	Conservation easement	40.0
Six Bar Ranch	Pima County	Fee simple	3,309.3
Six Bar Ranch	State of Arizona	Grazing lease	10,267.8
Sopori Ranch	Pima County	Fee simple	4,471.6
Sopori Ranch	State of Arizona	Grazing lease	10,935.4
South Wilmot LLC	Pima County	Fee simple	35.5
Southeast Regional Park	Pima County	Fee simple	52.8
Starr Pass Resorts easements	Pima County	Conservation easement	103.1
Susan North	Pima County	Fee Simple	9.0
Sweetwater Preserve	Pima County	Fee simple	188.4
Tang	Pima County	Fee simple	40.1
Tanque Verde & Houghton Partners LLC	Pima County	Fee simple	77.7
Tanque Verde Creek	Pima County	Fee simple	216.6
Terra Rancho Grande	Pima County	Fee simple	72.1
Tortolita Mountain Park	Pima County	Fee simple	796.1
Tortolita Mountain Park Expansion	Pima County	Fee simple	1,418.0
Treehouse	Pima County	Fee simple	6.3
Trico	Pima County	Fee simple	96.6
Trico Marana	Pima County	Fee simple	72.4
Tucson Mountain Park biological corridor	Pima County	Fee simple	9.9
Tucson Mountain Park	Pima County	Fee simple	2,437.6
Tucson Mountain Park mitigation area	Pima County	Fee simple	42.5
Tucson Mountain Park, 36th Street corridor	Pima County	Fee simple	228.7
Tumamoc	Pima County	Fee simple	277.0
Wal-mart conservation easement	Pima County	Conservation easement	0.9
Walden	Pima County	Fee simple	447.3
Wexler property	Pima County	Fee simple	15.2
Total			**208,282**

Appendix I. Generic ranch management agreement.

PIMA COUNTY
NATURAL RESOURCES, PARKS AND RECREATION DEPARTMENT
Ranch Management Agreement

This Ranch Management Agreement ("Agreement") is made by and between Pima County, by and through its Natural Resources, Parks and Recreation Department, a political subdivision of the State of Arizona ("County ") and XX Cattle Company, L.L.C. (a ficticious company to illustrate a generic ranch management agreement), an Arizona limited liability company ("Manager").

RECITALS

WHEREAS, County owns certain real property in Pima County, Arizona, more particularly described in Exhibit A (not attached to this appendix); and

WHEREAS, County acquired its interest in the Property in a transaction prior to or contemporaneous with the establishment of this Agreement; and

WHEREAS, County and Manager acknowledge that the Property currently remains in a relatively undisturbed, natural state, has ecological, open space, cultural and historic values, and provides natural habitat for native plants and wildlife (collectively the "Resource Values"); and

WHEREAS, the Property has historically been operated primarily as a livestock ranching operation and County is committed to property management as a sustainable ranching operation which fosters abundant and diverse native flora and fauna, clean air, clean water and stable soils, providing for potential economic return; and

WHEREAS, County and Manager share the goal of preserving the biological resources on the Property and permitting land uses that are compatible with the conservation of significant ecological values; and

WHEREAS, County and Manager are further interested in preserving the working ranching landscape in the County; and

WHEREAS, County has acknowledged its commitment to protecting and preserving natural areas, open space and working landscapes through the adoption of the Sonoran Desert Conservation Plan; and

WHEREAS, the voters of Pima County have endorsed implementation of the Sonoran Desert Conservation Plan by passage, at a special election held on May 18, 2004, of certain bond measures permitting the issuance of general obligation bonds to fund the

acquisition of working landscape open space (see Questions 1, 2, and 4 of Pima County Ordinance 2004-18); and

WHEREAS, Manager is familiar with the Property and has experience with existing conditions of the Property; and

WHEREAS, this Management Agreement benefits the County by relieving it of the financial costs and burdens of physically managing and operating the Property using County employees;

NOW, THEREFORE, for valuable consideration, the receipt and sufficiency of which are hereby acknowledged by the parties, and in exchange of the mutual covenants, terms, conditions and restrictions contained herein, and pursuant to the law of the State of Arizona, the parties hereto agree as follows:

AGREEMENT

1. Description of the Property. Manager shall provide management services for the Property as identified in Exhibit A, and shall not be required to pay any fees to the County with respect to Manager's use, occupancy and management of the Property.

2. Term and Renewal. This Agreement shall be for a term of Fifteen (15) years and shall commence on the date the Agreement is certified by the Pima County Clerk of the Board. County and Manager shall have the option to extend the term of this Agreement for two additional five (5) year periods, upon mutual written agreement.

3. Management Objectives.

3.1. Manager shall use the Property subject to the terms and conditions of this Agreement and shall exercise commercially reasonable efforts to use the Property in accordance with County's resource management objectives (the "Management Objectives") listed below in the order of priority:

3.1.1. Protect, preserve, and enhance natural plant and wildlife communities of the Property

3.1.2. Rehabilitate degraded vegetation and wildlife habitats where possible and economically feasible

3.1.3. Manage wildfire hazards to the Property and adjoining private and public lands by managing vegetative fuels

3.1.4. Make judicial use of water resources associated with the Property

3.1.5. Provide for the safety of Manager's invited and noticed visitors to the Property

3.1.6. Report the occurrence of identified adverse resource impacts resulting from undocumented immigrant travel and associated law enforcement activities

3.2. County and Manager mutually agree that the provisions of this Agreement shall be interpreted conservatively so as to ensure that natural resource management and protection of Resource Values take precedence over

grazing and revenue generation. Notwithstanding any other provision of this Agreement, the County shall have the right, in its reasonable discretion, to limit or exclude grazing on portions of the Property from time to time, and for any period of time, so long as the reduction is justified using commonly acceptable range management principles.

4. Resource Management Plan

4.1. Drafting Plan. Manager agrees to comply with the terms and conditions of a Coordinated Resource Management Plan (the "Management Plan") to be developed cooperatively between County and Manager with the assistance of state and Federal natural resource management agencies. Such Management Plan shall include, but not be limited to, a livestock grazing plan, access plan, natural resource and biological resource protection plan, and any other elements necessary to protect the Resource Values and achieve the County's Management Objectives for the Property. Upon the execution of this Management Agreement, County and Manager shall meet and review any existing grazing and management plans. County may, in its reasonable discretion, request changes or alterations in those plans for resource protection purposes. County shall have discretionary authority to approve and adopt the final Management Plan. The Management Plan shall, by this reference, be incorporated and adopted herein.

4.2. Annual Resource Condition Assessment. County and Manager shall meet at least annually to evaluate the Property's resource conditions to determine whether the Management Plan is appropriate for existing conditions or needs to be modified. Should the County require a modification to the Management Plan, including but not limited to the exclusion of grazing from all or certain areas of the Property the County and Manager may consult with other natural resource agency representatives if the Manager does not concur with such a requirement. The parties may agree to a compromise based on that consultation, although County shall retain, in its sole discretion, the right to limit or exclude grazing from certain areas of the Property. If the Management Plan is changed, the County shall give Manager written notice of the change and the time required for the removal of the livestock.

5. Use of Property.

5.1. Cattle Grazing. Manager may use the Property for open pasture cattle grazing and associated ranching and related operations, including the use and grazing of horses used in such ranching operations, in accordance with the Management Plan. Cattle grazing shall be limited to cattle, and shall not include other livestock such as sheep, horses, llamas or exotic breeds on the property without the express written permission of the County. Manager shall be permitted to pasture horses in specific areas agreed to by the County and for durations and during times of the year that do not result in adverse impacts on the Resource Values.

5.2. Associated Activities. Manager may also use the Property for all activities normally associated with ranching operations, in accordance with the Management Plan.

5.3. No warranties or representations. County makes no warranties or representations to Manager as to the suitability of the Property for grazing.

5.4. Use consistent with County's rights. Manager understands and agrees that the Property shall be managed and operated in such a manner as to protect the biological resources of the Property and the possibility exists that such management objectives and natural conditions may limit, restrict, or otherwise impact the location and number of cattle permitted to graze on the Property. Manager further understands and agrees that Manager's use of the Property shall be consistent with the mission of the Sonoran Desert Conservation Plan, the conditions of the 2004 Bond measure and any amendments and the Management Objectives set out herein. Manager further understands and agrees that Manager's use is subject to County's primary rights to operate the Property for the benefit of the public and the public interest.

5.5. No other Uses. Any other uses of the Property are subject to the prior written approval of the County, not to be unreasonably withheld, conditioned or delayed.

5.6. Damage and Repairs. Manager shall be responsible for damage to the Property or its Resource Values caused by its intentional, reckless, or negligent conduct, or the intentional, reckless, or negligent conduct of its agents, employees or contractors. Manager shall not be responsible for repairing any damages caused by the negligence of the County or its agents, employees or contractors, unless Manager shares responsibility for that damage, in which event Manager shall be responsible for the proportion of damages that were caused by Manager. In the event of damage caused by third parties, Manager shall be responsible only for repairing damage to the ranching infrastructure on the portion of the Property that Manager is using to conduct its ranching operations.

6. Grant Projects.

6.1. County agrees to cooperate as a participating agency for any grant applications Manager might seek for the Property that enhance the Property's Resource Values or advances the County's Management Objectives, provided:

6.1.1. Manager obtains prior approval of the County Administrator and Board of Supervisors for the grant application.
6.1.2. Manager agrees to be bound by the terms and conditions of the grant agreement if awarded.

6.1.3. Manager shall not be permitted to assert as in-kind matches labor, resources, or other assets of the County without the County's prior written approval for such assertion.

6.1.4. Manager retains all obligations and assumes any liability that may be incurred as a result of an early termination of this Agreement by Manager.

6.2. Manager agrees to reasonably cooperate with County, at no cost to Manager, for any grant applications County might make with respect to the Property.

7. Repair and Maintenance of Improvements

7.1. Repairs and Improvements. Manager shall keep all improvements on the Property used by Manager (other than roads) in functional condition, suitable for the purpose(s) for which they have been installed, including corrals, fencing, water storage tanks, water lines, wells, pumps, and pressure systems. Manager shall keep all roads on the Property in the condition in which they exist as of the date hereof, unless Manager elects to maintain and improve the roads under Section 7.2. below. Manager alone shall bear the cost for any and all repair and maintenance work related to improvements and facilities needed for Manager's ranching operation on the Property. County shall not be obligated to make any improvements or repairs to the Property whatsoever and County shall not be entitled to require Manager to make any improvements upon the Property whatsoever or repairs to any currently inoperative or obsolete facilities or equipment upon the Property whatsoever. All improvements and major repairs shall be approved by the County at the initial planning stage, which approval shall not be unreasonably withheld, conditioned or delayed.

7.2. New structures or roads. Manager shall not construct any new structures or roads on the Property without the prior written approval of the County (not to be unreasonably withheld, conditioned or delayed) as to site location and design. Manager may be required to seek cultural resource clearance of the location before engaging in any earth moving activity. Manager shall comply with all applicable Federal, state and local building codes and ordinances for any structure or road constructed on the Property by Manager. All costs for any such construction shall be borne solely by the Manager. Manager shall be permitted but is not required to maintain existing roads, at Manager's sole expense, including grading, filling, and otherwise maintaining the roads in passable condition. Such permission does not include paving any roads on the Property without the prior written approval of the County.

7.3. Garbage and Waste. Manager shall arrange for the storage and disposal of all garbage and waste materials according to applicable law at its sole cost and expense. Manager shall remove garbage, trash and non-toxic or hazardous waste to a legal dumpsite no less than twice a year. Manager shall be responsible for handling and disposing of garbage and waste in such a manner as to prevent the production of offensive odors and the

attraction of rodents and other vermin. Manager shall not use existing dumpsites on the property for permanent waste disposal.

7.4. Hazardous Wastes. All toxic and hazardous materials resulting from Manager's operations under this Agreement shall be removed to a legal dumpsite off the Property at Manager's sole cost and expense. Manager, at Manager's sole cost and expense, shall remedy any hazardous or potentially hazardous condition occurring on or after the effective date of this Agreement by or under the direction of Manager within 30 calendar days of written or oral notice by County's officers, agents or employees or by any Federal, state, or local regulatory agency having jurisdiction (or if more than 30 days are required to complete such remedy, such additional amount of time as may be reasonably necessary, so long as Manager commences the remedy within the initial 30-day period and maintains a reasonable completion schedule). At the discretion of County's officers, agents or employees, Manager shall stop work or any activities related to the hazardous materials that create a hazardous or potentially hazardous condition until Manager cures such hazardous or potentially hazardous condition. As used in this Agreement, the term "Hazardous Material" shall mean any substance or material which has been determined by any state, Federal or local governmental authority to be capable of posing a risk of injury to health, safety and property including all of those materials and substances designated as hazardous or toxic by any other governmental agency now or hereafter authorized to regulate materials and substances in the environment.

8. Utilities. Manager shall contract directly with the appropriate public utility for all water, gas, electricity, portable phones or telephone service, garbage, and sewage, or other utility or service furnished to or used by Manager in its discretion during the term of this Agreement at Manager's sole cost and expense. Manager shall indemnify and hold harmless County from and against any charge for the installation, connection, maintenance, and furnishing of all utilities, meters and services required by Manager. Manager shall provide for the extension of any utility service or distribution lines (water, gas, electricity, portable or telephone, garbage, sewage, or other) that are required to serve the Property at Manager's sole cost and expense. Manager shall comply with all applicable government mandated water and energy conservation programs in fulfilling its obligations of this Agreement. In the event the installation of utilities shall involve any earth disturbing or view shed impacts, Manager shall first obtain County's approval for such activities, which approval shall not be unreasonably withheld, conditioned or delayed. County shall not be liable for any damages resulting from any failure to furnish or delay in furnishing any utility service, whether water, gas, electricity, portable or-telephone, garbage, sewage or other.

9. Vehicle Travel. Manager's trucks, or other approved vehicles, shall be used in a manner which is consistent with the Management Plan. Only such off-road travel shall be allowed as reasonably necessary to conduct ranch operations. Travel

through washes with wheeled, motorized vehicles shall be restricted to essential needs for ranch operations.

10. Managers Acceptance Of Property. Manager and County each hereby accepts the buildings, improvements, and any equipment on the Property in their existing condition. No representation, statement, or warranty (express or implied) has been made by or on behalf of County or Manager as to such condition or as to the use that may be made of such property. In no event shall County be liable for any defect in such property or for any limitation on its use.

11. Cattle, Ranch Equipment and Personal Property. Manager shall provide any and all equipment and personal property, including tools, machinery, and supplies necessary for the ranching activities authorized under this Agreement. Manager shall be responsible for the cost of repairing or replacing all such items as needed. County shall not assume responsibility for any damage or cost or expenses to Manager's ranch equipment or personal property incurred during activities on the Property.

12. Prohibited Uses.

12.1. Natural Resources. Except as specifically permitted hereunder, Manager is strictly prohibited from removing any trees, cacti, shrubs, gravel, rock, sand, minerals or cultural artifacts from the Property. Manager shall disturb no wildlife habitat, biological, cultural, geological, scenic, historical or archaeological site or resource, commit no waste of any kind, nor in any manner substantially change the contour or condition of the Property. Subject to the intent and limitations of this Section 12, Manager shall be permitted to use sand and gravel from the Property at locations on the Property approved by the County, in quantities reasonably necessary to enable Manager to maintain roads and corrals on the Property; provided Manager complies with all applicable laws and regulations.

12.2. Noise. Manager shall not install, use, or permit the installation or use upon the Property of any public address equipment, television equipment, radio, loudspeaker, or other equipment or device producing noises that can be heard outside the immediate area of the Ranch headquarters/residence area except as reasonably necessary to conduct ranch operations and maintenance. This shall not be deemed to prohibit the use of equipment that is necessary to fix ranch equipment or improvements on the property, provided that the noise is minimized to the extent reasonably possible.

12.3. Water Pollution. Manager shall comply promptly with any regulations, conditions, or instructions affecting the activity authorized if and when issued by Federal, state, interstate or local government water pollution control agency having jurisdiction to abate or prevent water pollution. Manager shall not discharge any substances which will contaminate streams or other bodies of water or otherwise become a public nuisance. Such regulations, conditions or instructions in effect or prescribed by the Federal, state or local

government or contained herein are made a condition of this Agreement. Such prohibition does not pertain to controlling cattle waste in streams, streambeds or watercourses, or bodies of water, unless water quality measures have been taken or installed to prevent cattle from entry into such streams, streambeds, water courses, ponds or water bodies.

12.4. No Explosives. Manager's use of explosives on the Property is strictly prohibited.

12.5. Hunting. Manager shall not post any of the Property against public entry for hunting without prior written approval of County. Predator control activities on the Property shall be approved by the County prior to any actions being taken by Manager.

13. Water Rights.

13.1. Permitted Uses of Water. Manager may, at its own cost and expense, utilize water from the Property to the extent permitted by law and by County's water rights associated with the Property, including, without limitation, water from [select] resources. County assumes no responsibility to Manager for any water shortage from the source or sources of water or from any source whatsoever; nor does County warrant the quality or quantity of water obtained from any source.

13.2. Water Limited to Cattle Ranching. Use of water by Manager shall be limited to the amount required to operate its cattle ranching operation **consistent with ranch management purposes hereunder** utilizing conservation standards and methodologies.

13.3. Water Testing. County reserves the right to enter the Property at regular intervals to test the quality of the water and, further, to curtail use of potable water by Manager from wells or springs on the Property in the event the water exceeds contaminant level standards established by the Arizona Department of Environmental Quality.

14. Right Of Entry.

14.1. General. County reserves the right during the term of this Agreement to enter the Property at any reasonable time or times, for the purpose of inspection, consultation with Manager, making repairs or improvements, water quality testing, posting notices and for all other lawful purposes.

14.2. Resource Management. County and its designees shall have the right to enter the Property for the purpose of monitoring or conducting research on the Resource Values on the Property. Such entry by County shall not interfere with Manager in carrying out regular grazing operations that Manager has the right to perform under the terms of this Agreement.

14.3. Prior Notice. County shall, whenever feasible, provide Manager with two (2) business day's notice of its intent to enter any residences upon the Property. Such notice shall be given to Manager at the numbers and/or address identified below in Section 26.7.

14.4. Public Access. Manager may not post No Trespassing signage on County lands or block access to property or adjacent public lands without prior written permission of the County.

15. Native Plants and Cultural Resources. Manager shall comply with the provisions of the Arizona Native Plant Law (A.R.S. § 3-901 et seq. or any successor statutes) and with Arizona laws relating to archaeological discoveries (A.R.S. § 41-841 et seq. or any successor statutes). Manager shall not disturb any cacti or other protected native plants nor disturb any ruins, burial grounds, or other archaeological sites.

16. Undocumented Immigrants and Squatters. Within a reasonable period of time Manager is encouraged to provide the County with information on undocumented immigrant and associated law enforcement activity on the Property, as well as off-road vehicle travel, trash accumulation, abandoned vehicles, wildcat dumping, and the existence of squatters, particularly where Resource Values are being adversely impacted. In no event is Manager responsible for remedying any such impacts, although Manager and the County may consult and agree to mutually acceptable remediation or mitigation methods.

17. Mining Activity. Manager shall report to the County any change in activity level, location or other notable conduct by mining claimants on the Property. Manager is not obligated to take any action or contact mining claimants for any reason pursuant to this provision.

18. Taxes.

18.1. Obligation for Taxes. Manager shall pay before delinquent all personal property taxes, assessments and fees levied on Manager by reason of its operations on the Property pursuant to this Agreement.

18.2. Contest of Tax. If Manager wishes to contest or review by appropriate legal or administrative proceedings any tax or other charge specified under the provisions of this Section in good faith, Manager shall give County written notice of its intent to do so at least ten (10) calendar days before the delinquency of such tax or charge, or within the applicable time period allowed by law. Manager may withhold payment of the tax being contested only if nonpayment is allowed during the pendency of such proceedings without the foreclosure of any tax lien or the imposition of any fine or penalty. The failure to pay any tax or charge within forty-five (45) calendar days of Manager's receipt of written notification of the amount due shall constitute default, and the obligation to pay the same shall survive the end of this Agreement.

18.3. Tax Indemnification. Manager agrees to indemnify and hold harmless County, and County's officers, agents and employees from and against any liability, loss, or damage resulting from such contest or proceeding or from any tax or charge required to be paid by Manager, from any other sums imposed thereon, and from any proceedings to enforce the collection of any tax or charge for which Manager may be liable. Manager shall not permit any lien to attach to its interest in the Property or in this Agreement.

19. Indemnity and Hold Harmless.

19.1. County not Liable. County shall not be liable at any time for loss, damages, or injury to the person or property of any person at any time, arising directly or indirectly out of (i) any act of Manager or of anyone holding under Manager; (ii) the occupancy or use of the Property by the Manager; or (iii) any adverse and unsatisfactory state or condition of the Property caused by Manager's livestock grazing and ranching operations during the term of this Agreement. County shall not be liable for any loss of profits or business opportunity losses that Manager may incur for any reason, including interruption of business or termination of this Agreement.

19.2. Indemnification of County. The Manager shall indemnify, defend, and hold harmless the County, its officers, agents and employees from any claim, liability, loss, or damage arising out of, or in connection with, performance of ranching operations upon the Property under this Agreement by Manager, its agents, employees, or subcontractors, except to the extent that such claim, liability, loss, or damage was caused by the negligent or intentionally wrongful acts or omissions of personnel employed or contracted by the County, or by any activities on the Property of the general public. The foregoing indemnification obligation shall survive the termination of this Agreement.

19.3. Indemnification of Manager. County shall indemnify, defend and hold harmless the Manager, its officers, agents and employees from any claim, liability, loss, or damage, to the extent suffered or incurred by Manager as a direct result of a negligent or wrongful act of the County or personnel employed or contracted by the County. The foregoing indemnification obligation shall survive the termination of this Agreement.

20. Insurance.

20.1. Insurance Coverage. Manager shall maintain the following insurance during the term of this Agreement:

20.1.1. Commercial General Liability. Coverage shall be at least as broad as ISO form CG 00 01 in an amount not less than $2,000,000.00, covering the Property, endorsed to include County as an additional insured with coverage at least as broad as ISO form CG 20 10.

20.1.2. Commercial General Automobile Liability. Coverage shall be at least as broad as ISO form CA 00 01 in an amount not less than

$1,000,000.00 for vehicles actually used in the operations at the Property (as compared to used for simple commuting).

20.1.3. Workers' Compensation. Statutory limits, with Employers' Liability coverage in an amount not less than $1,000,000.00 per injury, illness, or disease.

20.2. Changes to Insurance Requirements. County retains the right to reasonably increase the limits or types of coverage from time to time as determined in the best interests of County by Pima County Risk Management.

20.3. Injury Reports. Manager shall provide to County a report listing any incident involving injury to persons or damage to property occurring at the Property within two (2) business days of any such incident. If any such injury to persons requires emergency medical treatment, Party shall contact County within one (1) business day of such incident. County shall have the right to investigate any incident involving injury to persons or property occurring at the Property and Party shall provide County with all information available to Party about such incident.

20.4. Insurance Certificates. Manager shall provide County with current certificates of insurance which shall show County as an additional insured where required. All certificates of insurance must provide for guaranteed thirty (30) days written notice of cancellation, non-renewal or material change.

20.5. Waiver of Subrogation. Each party waives its claims and subrogation rights against the other for losses typically covered by property insurance coverage.

21. Manager not an Employee or Agent. It is understood and agreed that Manager, in the performance of this Agreement, is not an agent or employee of County, and that this Agreement is not intended to and shall not be construed to create the relationship of agent, servant, employee, partnership, joint venture, or association. No participant or applicant for participation in Manager's grazing operation, no officer or employee of Manager, no person engaged by Manager to administer or operate its grazing operation shall be construed to be an employee of County for any purpose, including tort claims. Nor shall any person obtain any right to employment, retirement, or other benefits that accrue to employees or officers of the County.

22. Assignment or Sublicense. Manager shall not assign this Agreement or any interest in it, nor allow any person other than Manager and its agents, contractors and employees to occupy or use any part of the Property, without first obtaining County's written consent, not to be unreasonably withheld, conditioned or delayed. Manager shall fully disclose to County the qualifications, experience, and financial ability of any proposed assignee/submanager for such an assignment or sublicense ("the Consent Disclosure"). Manager acknowledges that it has been selected to manage the Property due to its unique qualifications, and that County may reasonably withhold its consent to a proposed assignment or sublicense. County's consent to

one assignment, sublicense, or use shall not be consent to any subsequent assignment, sublicense, occupancy, or use by another person. Any unauthorized assignment or sublicense shall be void. Manager's interest is not assignable by operation of law without County's written consent. If Manager requests the County's consent to an assignment or subcontract, the County shall deliver any objections in writing to Manager within thirty (30) days after receipt of Manager's written request for consent (the "Consent Request"). The Consent Request shall include the Consent Disclosure. If the County does not disapprove of the proposed assignment or subcontract within that thirty (30) day period, then the matter shall be placed on the next available Board of Supervisor's agenda (based on the normal deadline for submittal of agenda items) for consideration.

23. Default.

23.1. Default. If Manager violates any of the terms and conditions of this Agreement, County may give Manager written notice of the specific violation.

23.2. Termination for Default. If, within sixty (60) days after written notice of the violation, Manager has failed to commence corrective action or shown acceptable reason therefor, County has the right immediately, or at any time thereafter prior to any cure by Manager, to terminate this Agreement, take back possession of the Property (including all buildings and improvements thereon), and pursue all remedies legally available.

23.3. Liability for Breach. Termination for default shall not excuse Manager from any liability for damages for breach of contract, but in no event shall Manager be liable for special, consequential or punitive damages.

23.4. Entry for Mitigation. In the event County reasonably determines that activities or actions by Manager have adversely impacted the Property, its improvements, or its Resource Values, County shall, in addition to its right to declare Manager in default and terminate this Agreement, as provided above, be entitled to enter the Property for the purpose of mitigating damages and recover from Manager the cost of such Manager-caused damage and corrective action.

24. Restoration and Surrender of Premises.

24.1. Vacating Property. Upon expiration or earlier termination of this Agreement for any reason, Manager shall vacate the Property and surrender peaceable possession of it to the County. Manager shall promptly remove its personal property, and repair any damage or injury to the Property or to any of its buildings, structures, or improvements and restore the Property to the condition as existed when Manager first took possession of the Property under this Agreement, reasonable wear and tear and casualty damage excepted. Continued possession and use of the Property by the Manager is prohibited and shall be deemed a trespass for which County may seek all appropriate civil and criminal remedies.

24.2. Personal Property. If an early termination occurs, for any of the reasons set forth in Section 25 below, Manager shall remove all personal property and livestock from the Property as soon as practicable but in no event later than sixty (60) calendar days after notice of the termination (unless County extends this time period, in writing). If Manager fails to remove all personal property and livestock within the time specified, County may, at its sole discretion, take possession of the personal property and livestock and offer the property and livestock for sale at public auction, or otherwise dispose of the property and livestock according to applicable law.

25. Termination. This Agreement may be terminated early as follows: (1) by either party upon a default of any covenant or term hereof by the other party pursuant to Section 23 above; (2) for conflict of interest as provided in Section 26.15; (3) for non-appropriation of funds pursuant to Section 26.17; (4) by Manager for any reason or for no reason and Manager shall thereafter be fully relieved and released of and from all future duties and responsibilities under this Agreement, for no payment of consideration of any kind to or from County or Manager (this shall not be deemed to relieve Manager of any liability for past acts); and (5) by County if it determines in its reasonable discretion that the Management Objectives of the Property will be adversely impacted by continuation of the Agreement and upon the approval of the County Board of Supervisors. If the County determines to terminate this Agreement under option (5) above, the County shall first contact the Manager in writing describing the reason for the contemplated termination and shall then meet with Manager to determine if the parties can find a mutually acceptable means to eliminate the adverse impact to the Management Objectives without terminating the Management Agreement.

26. Miscellaneous.

26.1. Attorney's Fees. If either party brings any action or proceeding in court to enforce any provision of this Agreement or for damages because of an alleged breach of any provision of this Agreement (except as may otherwise be specified in this Agreement), the prevailing party shall be entitled to receive from the losing party the amount the court determines to be reasonable attorney's fees for the prevailing party.

26.2. Binding Effect. The covenants and agreements contained in this Agreement shall bind the respective successors, assigns, heirs, and legal representatives of the parties.

26.3. Non-discrimination. Both parties shall comply with State Executive Order 99-4, if applicable, and all other applicable Federal and state laws, rules and regulations, including the Americans with Disability Act.

26.4. Entire Agreement. This Agreement and any attached exhibits or addendum set forth all covenants, agreements, conditions, and understandings between County and Manager concerning the Property. There are no

covenants, agreements, conditions, or understandings, either oral or written, between the parties other than those set forth in the Agreement.

26.5. Compliance With Law. At Manager's sole cost and expense and before the start of permitted activities, Manager shall comply with all applicable Federal, state, county or municipal statutes, ordinances, regulations, orders, or directives of a governmental agency, as such statutes, ordinances, regulations, orders, or directives now exist or may later provide, concerning the use and safety of the Property. Manager shall obtain all permits which may be required by public agencies, including, but not limited to, the United States Army Corps of Engineers, Arizona State Land Department, and Arizona Game and Fish Department, having jurisdiction over the activities of Manager and comply with all conditions and requirements set forth in the permits issued by such agencies. Manager's failure to procure any such permit or comply with any such regulation or law shall be a default under this Agreement (one which cannot be "cured" pursuant to Section 23).

26.6. Modification. Provisions of this Agreement may be modified, waived, or added to only by an instrument in writing signed by both parties.

26.7. Notices. Notices relating to this Agreement or under the unlawful detainer statutes of Arizona shall be in writing and shall be delivered personally, sent by United States mail, first class postage prepaid, facsimile, electronic mail, or by private messenger or courier service to the addresses below:

Any change in address shall be communicated by written notice to the other party and delivered according to this section. A communication by any method permitted under this section shall be effective when actually received.

26.8. Personal Liability. No personal liability shall attach to any County officer or employee for any financial obligation to be performed under this Agreement.

26.9. Remedies Cumulative. All remedies conferred on County and Manager by this Agreement and by law shall be deemed cumulative, and no one remedy shall be deemed to be exclusive of the other or of any other remedy conferred by this Agreement or by law.

26.10. Severability. If any provision of this Agreement or any specific application shall be deemed to be invalid or unenforceable, the remainder of this Agreement or the application of the provision in other circumstances shall not be affected, and each provision of this Agreement shall be valid and enforceable to the fullest extent permitted by law.

26.11. Surrender of Property. No act by County, its elected officials, officers, agents, or employees during the term of this Agreement shall be deemed an acceptance of a surrender of the Property.

26.12. Text to Prevail Over Headings. The captions and section headings appearing in this Agreement are included for convenience only and do not in any way limit or amplify the terms or provisions of this Agreement.

26.13. Waiver. Waiver by County or Manager of any breach of any term, covenant or condition shall not be deemed to waive the same term, covenant or condition on a future occasion. Neither County nor Manager shall waive any covenant, term, or condition of this Agreement unless the waiver is in writing and signed by the party making the waiver.

26.14. Conflict of Interest. This Agreement is subject to cancellation pursuant to A.R.S. Section 38-511.

26.15. Limitations. Nothing in this Agreement shall be construed as limiting or expanding the statutory responsibilities of County in performing functions beyond those granted to it by law or as requiring County to expend any sums in excess of its appropriations.

26.16. Non-Availability of Funds. This Agreement shall be subject to available funding, and nothing in this Agreement shall bind County to expenditures in excess of funds authorized by the Pima County Board of Supervisors for purposes outlined in this Agreement. This Agreement may be terminated if for any reason, there are not sufficient appropriated and available monies for the purpose of maintaining the County's obligations under this Agreement. In the event of such termination the County shall have no further obligation whatsoever to Manager and Manager shall have no further obligation whatsoever to the County, except for the indemnities which are specifically stated herein to survive termination hereof.

26.17. Landlord Tenant Act not Applicable. This Agreement is for the provision of management and operation services by Manager to County and is not subject to the provisions of the Arizona Landlord Tenant Act, A.R.S. Section 33-301 et seq.

26.18. Counterparts. This Agreement may be executed in counterparts, each of which shall be deemed an original. This Agreement may be executed and delivered by a facsimile transmission of a counterpart signature page hereof

26.19. Legal Arizona Workers Act Compliance.

26.19.1. Manager hereby warrants that it will at all times during the term of this Contract comply with all Federal immigration laws applicable to Manager's employment of its employees, and with the requirements of A.R.S. § 23-214 (A) (together the "State and Federal Immigration Laws"). Manager shall further ensure that each subcontractor who performs any work for Manager under this contract likewise complies with the State and Federal Immigration Laws.

26.19.2. County shall have the right at any time to inspect the books and records of Manager and any subcontractor in order to verify such party's compliance with the State and Federal Immigration Laws.

26.19.3. Any breach of Manager's or any subcontractor's warranty of compliance with the State and Federal Immigration Laws, or of any other provision of this section, shall be deemed to be a material breach of this Contract subjecting Manager to penalties up to and including suspension or termination of this Contract. If the breach is by a subcontractor, and the subcontract is suspended or terminated as a result, Manager shall be required to take such steps as may be necessary to either self-perform the services that would have been provided under the subcontract or retain a replacement subcontractor, (subject to County approval if MWBE preferences apply) as soon as possible so as not to delay project completion.

26.19.4. Manager shall advise each subcontractor of County's rights, and the subcontractor's obligations, under this Article by including a provision in each subcontract substantially in the following form: "Manager hereby warrants that it will at all times during the term of this contract comply with all Federal immigration laws applicable to Manager's employees, and with the requirements of A.R.S. § 23-214 (A). Manager further agrees that County may inspect the Manager's books and records to insure that Manager is in compliance with these requirements. Any breach of this section by Manager will be deemed to be a material breach of this contract subjecting Manager to penalties up to and including suspension or termination of this contract."

26.19.5. Any additional costs attributable directly or indirectly to remedial action under this Article 27.19 shall be the responsibility of Manager.

26.20. Scrutinized Business Operations. Pursuant to A.R.S. § 35-397, Manager hereby certifies that it does not have scrutinized business operations in Iran or Sudan. The submission of a false certification by contractor may result in action up to and including termination of this Agreement.

Appendix J. Restrictive covenant template for Mitigation Land Owned in Fee Simple by Pima County or Pima County Regional Flood Control District.

This particular version is drafted for County-owned land, and would need to be adapted for use on District-owned land.

RESTRICTIVE COVENANT

This Restrictive Covenant is made by Pima County, a political subdivision of the State of Arizona, in favor of the Pima County Regional Flood Control District, a political taxing subdivision of the State of Arizona.

Background and Purpose

On Month Day, 2016, the United States Fish and Wildlife Service issued a permit to the County for the incidental take of threatened and endangered species caused by specific, lawful activities within Pima County. To direct the mitigation of these incidental takes and ensure compliance with the permit, the County has established its Multi-Species Conservation Plan. Objectives of the Multi-Species Conservation Plan include managing mitigation lands to prioritize conservation of Covered Species and their habitats, prevent landscape fragmentation, and support species establishment or recovery.

The County owns real property described as _____(the "Property"), and recorded in Book ___of Maps ____ at Page___ [or at sequence number] in the Office of the Pima County Recorder, as more fully described in Exhibit A attached. The Property contains significant undisturbed natural open space that the County wishes to preserve and protect for the mitigation of incidental take covered by the County's incidental take permit.

The County and District intend this Restrictive Covenant to prohibit uses of the Property that would impair or interfere with the mitigation efforts of the County, except for any pre-existing uses, primarily ranch or recreation, as shown on aerial photographs dated 2015.

Therefore, the County and District agree this Restrictive Covenant assures the Property will be forever preserved as natural open space for the conservation of natural habitat for wildlife, the protection of rare and unique native plants and animals, and the scenic enjoyment of the general public.

1. Nature of Restrictive Covenant

1.1 This Restrictive Covenant runs with the Property and binds the County and its successors and assigns.

1.2 This Restrictive Covenant remains in perpetuity unless released by mutual written consent of the County and District with the concurrence of the U. S. Fish and Wildlife Service.

1.3 Except as otherwise provided in this Restrictive Covenant, the Restrictions remain in effect notwithstanding any future annexation of any portion of the Property by a municipality.

1.4 This Restrictive Covenant may not be amended or modified except upon mutual written agreement of the County and District and written concurrence from the U.S. Fish and Wildlife Service.

1.5 This Restrictive Covenant may be enforced by _____ as a third party beneficiary.

2. The County's Covenants

Except where the County determines a use or activity on the property is necessary to retain, restore, or enhance the mitigation of incidental take covered by the County's permit, the following uses of the Property are prohibited:

2.1 Development of the Property, including subdividing or lot splitting of the Property.

2.2 Construction or placement of new or additional buildings or structures on the Property. Construction of agricultural outbuildings or recreational development that do not degrade the Property's mitigation value are allowed, provided they are consistent with other provisions of the Multi-species Conservation Plan.

2.3 Alteration of the ground surface or natural vegetation except as may be needed for ranch or trail-based recreational uses if such alterations are consistent with other provisions of the Multi-species Conservation Plan.

2.4 Severance of water rights appurtenant to the Property including the (transfer encumbrance, lease and sale of water rights.

2.5 Impoundment, diversion or alteration of any natural watercourse unless for species enhancements or maintenance of the Property's mitigation values.

2.6 Development of, or the granting of, access, rights-of-way or easements for new roads or new utilities, including telecommunications facilities, except where County has no discretion to prohibit the utility activity.

2.7 Filling, excavation, dredging, mining, drilling, exploration, or extraction of minerals, hydrocarbons, soils, sand, gravel, rock, or other materials on or below the surface of the Property.

2.8 Storage, accumulation or disposal of hazardous materials, trash, garbage, solid waste or other unsightly material on the Property.

2.9 Introduction of non-native fish or amphibians or other non-native animals to or from catchments, tanks, springs, or creeks. Other non-native species that might adversely affect the mitigation of permitted activities are also prohibited except for the purposes of supporting existing ranching operations, if any, and limited to those areas identified that have historically been devoted to the growing of such species, as shown on 2015 aerial photographs.

2.10 Storage and use of biocides and chemical fertilizers except for residential and agricultural purposes. Aerial application of biocide or other chemical is prohibited except where County and District concur that it is an appropriate and necessary management technique to promote the

recovery and re-establishment of native species, or to reduce threats to ecosystem structure and function.

2.11 Pumping of water from existing diversions for purposes other than on-site residential, wildlife, recreational, habitat enhancement and agricultural uses associated with livestock grazing on the Property. Increases in the pumped amounts of surface or subsurface water as allowed by the Arizona Department of Water Resources are not permitted without joint approval from the County and District and concurrence from the U.S. Fish and Wildlife Service.

2.12 Installation of underground storage tanks for petroleum or other polluting substances, except for already existing or permitted septic tanks.

2.13 Confinement of livestock where animals are permanently located in enclosures and the majority of their feed supplied from outside sources. This includes feeder cattle, dairy, pig, poultry, and exotic animal farm operations.

2.14 Commercial enterprises inconsistent with the objectives of the County's Multi-Species Conservation Plan, excluding farming and ranching as provided in this Restrictive Covenant. The County and District may jointly approve commercial enterprises, other than farming or ranching, that provide for ecotourism or wildlife-related recreation provided that it is consistent with the goals and objectives of the MSCP and does not degrade the Property's mitigation value.

2.15 Temporary residential use for mobile homes, travel trailers, tent trailers, self-propelled recreational vehicles and like structures or vehicles, except as needed to support the protection or enhancement of the Property's mitigation value.

2.16 Paving of roads using asphalt or concrete except where required by the County ordinance.

2.17 Any modification of the topography of the Property through the placement of soil, dredging spoils, or other material, except for those uses permitted under this document, or to reduce soil erosion or to protect public health, safety and welfare.

2.18 Off-road vehicular travel except to facilitate permitted activities on the Property.

2.19 Removal of natural, mineral, or cultural resources that is not authorized by County.

3. The District's Right to Enforce.

3.1 The District may enforce this Restrictive Covenant against the County and its successors and assigns.

3.2 The District has the right to enter upon the Property at reasonable times in order to monitor the County's compliance with, and to enforce the terms of, this Restrictive Covenant. The District must provide at least seven calendar days' notice to the County prior to entering upon the Property.

3.3 The District is liable for any injuries to its employees or agents occurring on the Property in the course of its duties pursuant to this Restrictive Covenant which are not directly or indirectly the result of acts or omissions of the County, or the County's employees, agents, successors and assigns.

3.4 If the District determines that the County is in breach of the terms of this Restrictive Covenant, the District must give written notice to the County of such breach and demand corrective action sufficient to cure the breach and, where the breach involves injury to the Property resulting from any activity inconsistent with the purpose of this Restrictive Covenant, to restore the portion of the Property so injured. If the County fails to cure the breach within 30 days after receipt of such notice, or under circumstances where the breach cannot reasonably be cured within a 30 day period, fails to begin curing such breach within the 30 day period, or fails to continue diligently to cure such breach until finally cured, the District may bring an action at law to enforce the terms of this Restrictive Covenant or to enjoin the breach by temporary or permanent injunction, and to recover any damages to which it may be entitled for breach of the terms of this Restrictive Covenant or injury to any protected uses or mitigation, including damages for any loss, and to require the restoration of the Property to the condition that existed prior to the injury.

3.5 Nothing contained in this Restrictive Covenant can be construed to entitle the District to bring any action against the County for any injury to or change in the Property resulting from causes beyond the County's control including unforeseeable acts of trespassers, fire, flood, storm, drought, pests, natural earth movement, vegetative disease, or resulting from any action taken by the County under emergency conditions to prevent, abate, or mitigate significant injury to the Property resulting from such causes.

4. Costs

The County retains all responsibilities and will bear all costs and liabilities of any kind related to the ownership, operation, upkeep, and maintenance of the Property. The County remains solely responsible for obtaining any applicable governmental permits and approvals for any activity or use which is undertaken in accordance with all applicable Federal, state, and local laws, regulations, and requirements.

5. General Provisions

5.1 The laws and regulations of the State of Arizona govern this Restrictive Covenant, and any disputes. Any action relating to this Restrictive Covenant must be brought in a court of the State of Arizona in Pima County.

5.2 Unless the context requires otherwise, the term "including" means "including but not limited to."

5.3 Each provision of this Restrictive Covenant stands alone, and any provision of this Restrictive Covenant found to be prohibited by law is ineffective only to the extent of such prohibition without invalidating the remainder of this Restrictive Covenant.

5.4 Any notice given under this Restrictive Covenant must be in writing and served by delivery or by certified mail upon the other party as follows:

If to the County:
Office of Sustainability and Conservation
Pima County Public Works
201 N Stone Ave, 6th Floor
Tucson, Arizona 85701

If to the District:
Pima County Flood Control District
Attn: Director
97 East Congress
Tucson, Arizona 85701

or such other address as any party from time to time designated by written notice to others.

5.5 This instrument sets forth the entire Agreement of the County and District with respect to this Restrictive Covenant.

The County and District have executed this Restrictive Covenant by their duly authorized representatives.

Pima County **ATTEST:**

Board of Supervisors

_____ _____

Chairperson Clerk of the Board

_____

Date

Pima County Flood Control District

Board of Directors **ATTEST:**

_____ _____

Chairperson Clerk of the Board

_____

Date

Approved as to form: Approved as to form:

_____ _____

Deputy Pima County Attorney Deputy Pima County Attorney for the District

Appendix K. Conservation Easement template for private ranch lands.

This has been—and will continue to be—used for easements held by Pima County on private ranch lands.

GRANT OF CONSERVATION EASEMENT AND TRANSFER OF DEVELOPMENT RIGHTS

THIS CONSERVATION EASEMENT is made this ____ day of _____, 20__, by _____, ("Grantor"), in favor of Pima County, a political subdivision of the State of Arizona, ("County" or "Grantee") (collectively, the "Parties"), pursuant to A.R.S. § 33-271, et. seq.

In consideration of the mutual covenants contained herein, Grantor hereby voluntarily grants and transfers to County a conservation easement (the "Easement"), in perpetuity, over and across the property described in Exhibit X (the "Property"; not included in this appendix), which Easement shall run with the land and shall bind the Grantor and County in perpetuity, subject to the terms and conditions contained herein. Further, as a part of this Easement, Grantor hereby transfers to County all development rights (except as specifically reserved herein) that are now or hereafter allocated to, implied, reserved or inherent in the Property, and the Parties agree that such rights are terminated and extinguished, and may not be used on or transferred to any portion of the Property as it is now or hereafter may be bounded or described, or to any other property adjacent or otherwise, nor used for the purpose of calculating permissible residential density or development intensity of the Property or any other property.

1. PURPOSE. The Parties agree that it is the purpose of this Easement to: (i) assure that the Property will be preserved forever in its predominantly open, scenic, undeveloped and natural condition; (ii) prevent any uses of the Property that will significantly impair or interfere with the areas of biological, ecological, or geologic importance (the "Conservation Values") of the Property; (iii) conserve habitat for wildlife; (iv) protect rare and unique native plants and animals currently known or later identified; and (v) promote the conservation purposes stated in A.R. S. § 33-271(2).

2. RIGHTS OF COUNTY. Grantor hereby grants the following rights to County:

2.1 To identify, preserve, protect and monitor, in perpetuity, the Conservation Values of the Property;

2.2 To prevent Grantor or third persons from conducting any activity on or use of the Property that is prohibited or inconsistent with this Easement;

2.3 To enter upon the Property for administrative purposes, provided that such entry shall be upon seven (7) days written notice to Grantor, and County shall not in any case unreasonably interfere with Grantor's use and quiet enjoyment of the Property;

2.4 Upon thirty (30) days written notice to Grantor, and subject to Grantor's approval, which shall be in Grantor's sole discretion, County or other educational or research agencies and institutions may enter upon the Property to engage in ecological, geological and/or archeological studies, research and special projects, provided that County shall not unreasonably interfere with Grantor's use and quiet enjoyment of the Property;

2.5 To enter upon the Property at any time during the term of this Conservation Easement under emergency circumstances to prevent an imminent breach of the terms of this Easement or, in County's sole discretion, to prevent damage to or destruction of the Conservation Values.

3. PERMITTED ACTIVITIES. The following activities shall be permitted on the Property as on all lands that County designates as Level II or Level III for purposes of complying with the MSCP:

3.1 Livestock grazing under a current ranch management or grazing plan that is referenced in the Easement and reviewed by Grantee annually. Such grazing may be confined to specific areas of the Property and may be prohibited in certain critical areas, such as springs or riparian areas.

3.2 Farming in existing areas of use, as described herein.

3.3 Vegetation removal as reasonable and necessary for habitat improvements to promote recovery or reestablishment of native species, fencing, maintaining utility easements, livestock developments and residential needs, except where priority vulnerable species may be negatively impacted.

3.4 The use of existing corrals, barns, outbuildings or ranch dumpsites, as identified herein, that is reasonable and necessary to sustain ranching and farming operations, provided they do not compromise the Conservation Values for which the Property was acquired.

3.5 The construction of replacement corrals, barns, outbuildings, residences or other structures on the existing disturbed sites. New structures may be permitted consistent with the purposes of this Easement.

3.6 Use of surface or subsurface water from water developments or natural sources for on-site domestic use, habitat improvements, livestock watering, wildlife waters, farming, fire-fighting, or dust control that is not inconsistent with the purposes of the Easement.

3.7 Prescribed fire for areas of 10 acres or less. Prescribed fire on areas exceeding 10 acres requires written approval from Grantee.

3.8 Installation of new or replacement of existing wire-strand fencing, built to wildlife-friendly standards as established by the Arizona Game and Fish Department.

3.9 The use of herbicides or pesticides on cultivated lands, as part of habitat improvement projects, in residential areas, barns, corrals, or other livestock confinements.

3.10 Replacement of existing wells, pumps, pipelines, windmills, septic systems and storage tanks as necessary for permitted operations on the Property along with maintenance and repair of existing water developments.

3.11 Construction of new roads, permanent or temporary, where necessary to enhance or protect Conservation Values on the Property or to facilitate farming or livestock-related activities.

3.12 Construction of trails for non-motorized recreation including hiking, wildlife-watching, mountain biking, hunting access to adjoining public lands, and horseback riding, provided the trails don't compromise the Conservation Values for which the Property was acquired.

3.13 Hunting by licensed and/or permitted hunters consistent with the rules, regulations and seasons established by the Arizona Game and Fish Department.

3.14 Wildlife management activities carried out in cooperation with the Arizona Game and Fish Department.

4. PROHIBITED ACTIVITIES. Any activity or use of the Property inconsistent with the purpose of this Easement or the Conservation Values of the Property is prohibited. Without limiting the generality of the foregoing, the following activities and uses are expressly prohibited:

4.1 Development of the Property, including subdivision or lot splitting of the Property.

4.2 Constructing or placing of any additional buildings or structures, except construction of additional residences, associated outbuildings and agricultural outbuildings or recreational development, as might be provided elsewhere in this Easement.

4.3 Surface alteration or natural vegetation alteration other than that necessary to retain, restore or enhance the Property's Conservation Values as defined herein.

4.4 Severing of surface or subsurface water rights associated with the Property, including the transfer, encumbrance, lease and sale of water rights, except where severance of such water rights benefits the Conservation Values as defined herein.

4.5 Manipulating, impounding or altering any natural watercourse, except as may be necessary to retain, restore or enhance the Conservation Values as defined herein.

4.6 Development of, or the granting of rights-of -way, access or easements for new roads, except as might be provided elsewhere in this Easement.

4.7 Development of, or the granting of rights-of-way, access or easements for new utilities, including telecommunications facilities, except where environmental analysis adequately demonstrates that allowing such activities is not harmful to the Conservation Values of the Property. Review of such environmental analyses and final determination as to the harmful nature of such impacts is granted solely to Grantee.

4.8 Filling, excavating, dredging, mining, drilling, exploration, or extraction of minerals, hydrocarbons, soils, sand, gravel, rock or other materials on or below the surface of the Property, except as minimally necessary in connection with such activities as may be required in performing any activities permitted herein or as allowed under Federal law.

4.9 The storage, dumping, accumulation or disposal of toxic and/or hazardous materials, trash, garbage, solid waste or other unsightly material on the Property.

4.10 The introduction of non-native fish or amphibians or other non-native organisms to or from catchments, tanks, springs or creeks.

4.11 The introduction of non-native species of noxious or aggressive character that might adversely affect the Conservation Values of the Property.

4.12 Storage and use of biocides and chemical fertilizers except for residential and agricultural purposes that may be provided for herein. Aerial application of biocide or other chemicals is prohibited except where Grantor and Grantee concur that it is an appropriate and necessary management technique to promote the recovery or reestablishment of native species or to reduce threats to ecosystem structure and function.

4.13 Pumping of surface or subsurface water from existing diversions for other than on-site residential, wildlife, recreational, habitat enhancement and agricultural uses associated with livestock grazing on the Property as provided for herein. Increases in the amount of surface or subsurface water per pump shall not be permitted without joint approval from Grantor and Grantee.

4.14 Construction of new water diversions that divert surface or subsurface water from any spring or watercourse, except for activities otherwise permitted herein.

4.15 Planting non-native or invasive plant species. Planting of such vegetative species is permissible only for the purposes of supporting existing ranching operations, if any, and will be limited to those areas identified herein that have historically been devoted to the growing of such species.

4.16 Installation of underground storage tanks for petroleum or other polluting substances, except those already existing or permitted septic tanks.

4.17 Confinement of livestock where animals are permanently located in enclosures and the majority of their feed supplied from outside sources. This includes but is not limited to feeder cattle, dairy, pig, poultry and exotic animal farm operations.

4.18 Commercial enterprises inconsistent with protection of the Property's Conservation Values, excluding farming and ranching as provided herein. Commercial enterprises, other than farming or ranching, that provide for ecotourism or wildlife-related recreation may be approved subject to the joint consent of Grantor and Grantee.

4.19 Use of the Property to provide temporary residential space for mobile homes, travel trailers, tent trailers, self-propelled recreational vehicles and like structures or vehicles, except that such vehicular campers owned by the Grantor, guests or other individuals engaging in activities otherwise permitted by this Easement who may be parked on the Property to accommodate reasonable visitation.

4.20 Any paving of roads using asphalt or concrete except where required by County ordinance.

4.21 Any modification of the topography of the Property through the placement thereon of soil, dredging spoils, or other material, except for those uses permitted under this Easement.

4.22 Off-road vehicular travel except as reasonably necessary to facilitate permitted activities on the Property.

5. DEFAULT AND REMEDIES.

5.1 If County determines that Grantor is in breach of the terms of this Easement, County shall give written notice to Grantor of such breach and demand corrective action sufficient to cure the breach and, where the breach involves injury to the Property resulting from any activity inconsistent with the purpose of this Easement, to restore the portion of the Property so injured. If Grantor fails to cure the breach within thirty (30) days after receipt of such notice, or under circumstances where the breach cannot reasonably be cured within a thirty (30) day period, fails to begin curing such breach within the thirty (30) day period, or fails to continue diligently to cure such breach until finally cured, then the County may bring an action at law or in equity in a court of competent jurisdiction to enforce the terms of this Easement, to enjoin the breach by temporary or permanent injunction, to recover any damages to which it may be entitled for breach of the terms of this Easement or injury to any protected uses or Conservation Values, including damages for any loss thereof, and to require the restoration of the Property to the condition that existed prior to any such injury. If upon receipt of notice from the County the Grantor fails to cease the activity which caused the breach, the County may bring immediate action at law or equity to enjoin the breach by temporary or permanent injunction.

5.2 Nothing contained in this Easement shall be construed to entitle County to bring any action against Grantor for any injury to or change in the Property resulting from causes beyond Grantor's control, including unforeseeable acts of trespassers, fire, flood, storm, drought, pests, earth movement, and major vegetative disease, or from any prudent action taken by Grantor under emergency conditions to prevent, abate or mitigate significant injury to the Property resulting from such causes.

6. COSTS, TAXES. Grantor retains all responsibilities and shall bear all costs and liabilities of any kind related to the ownership, operation, upkeep, and maintenance of the Property. Grantor remains solely responsible for obtaining any applicable governmental permits and approvals for any activity or use which shall be undertaken in accordance with all applicable Federal, state, and local laws, regulations, and requirements. Grantor shall pay before delinquent all taxes, assessments, fees, and charges of whatever description levied on or assessed against the Property by competent authority (collectively "taxes"), and shall furnish Grantee with satisfactory evidence of payment upon request.

7. THIRD PARTY BENEFICIARY. Grantor grants to _____ the right as third party beneficiary to enforce the terms and conditions of this Easement ensuring perpetual preservation of the Conservation Values of the Property.

8. GENERAL PROVISIONS.

8.1 **Severability**. If any provision of this Easement is found to be invalid, the remainder of the provisions of this Easement shall not be affected thereby.

8.2 **Entire Agreement**. This instrument sets forth the entire Agreement of the Parties with respect to this Easement.

8.3 **Public Access.** Nothing contained herein shall be construed as affording the public at large access to any portion of the Property, except that the public shall have ingress and egress over the Property along any and all designated trails constructed pursuant to paragraph 3.12 above, for the purpose of engaging in any properly permitted activity on the Property.

8.4 **Successors**. The covenants, terms, conditions, and restrictions of this Easement shall be binding upon, and inure to the benefit of the Parties hereto and their respective personal representatives, heirs, successors, and assigns, and shall continue as a servitude running in perpetuity with the Property.

8.5. **Cancellation**. This Easement is subject to cancellation per A.R.S. §38-511.

8.6 **No Subordination**. Upon recordation in the Pima County, Arizona, Recorder's Office, this Easement shall be deemed superior to all after acquired property interests in the Property. County shall have no obligation to subordinate its rights and interests in this Easement to any party.

Appendix L. Habitat Protection Priorities in eastern Pima County.

The Habitat Protection Priorities (Fig. A-35) were developed for the 2004 Bond election by the Arizona Land and Water Trust and The Nature Conservancy, using data developed by Pima County, STAT, and others. The data were integrated into a computer data set that enabled basic modeling of goals and criteria to identify priorities.

Conservation goals included: 1) to maximize the benefit of existing protected areas by increasing their size; 2) to emphasize protection of the rarest habitat types or "special elements" as per STAT; 3) to maintain a network of connected protected lands where native habitat and natural corridors remain; and 4) to systematically evaluate lands throughout all of eastern Pima County so that priorities are identified in all of the County's biologically important areas.

Selection criteria included: 1) lands from the most biologically important CLS categories including the Biological Core, Important Riparian and Recovery Management Areas; 2) private lands equal to or greater than 10 acres in size in vacant or agricultural status; and 3) State Trust lands within the priority CLS categories, emphasizing lands eligible for conservation under the Arizona Preserve Initiative. Thousands of parcels met the selection criteria, and were evaluated as to how each parcel met the conservation goals. The evaluation resulted in the Figure A-35.

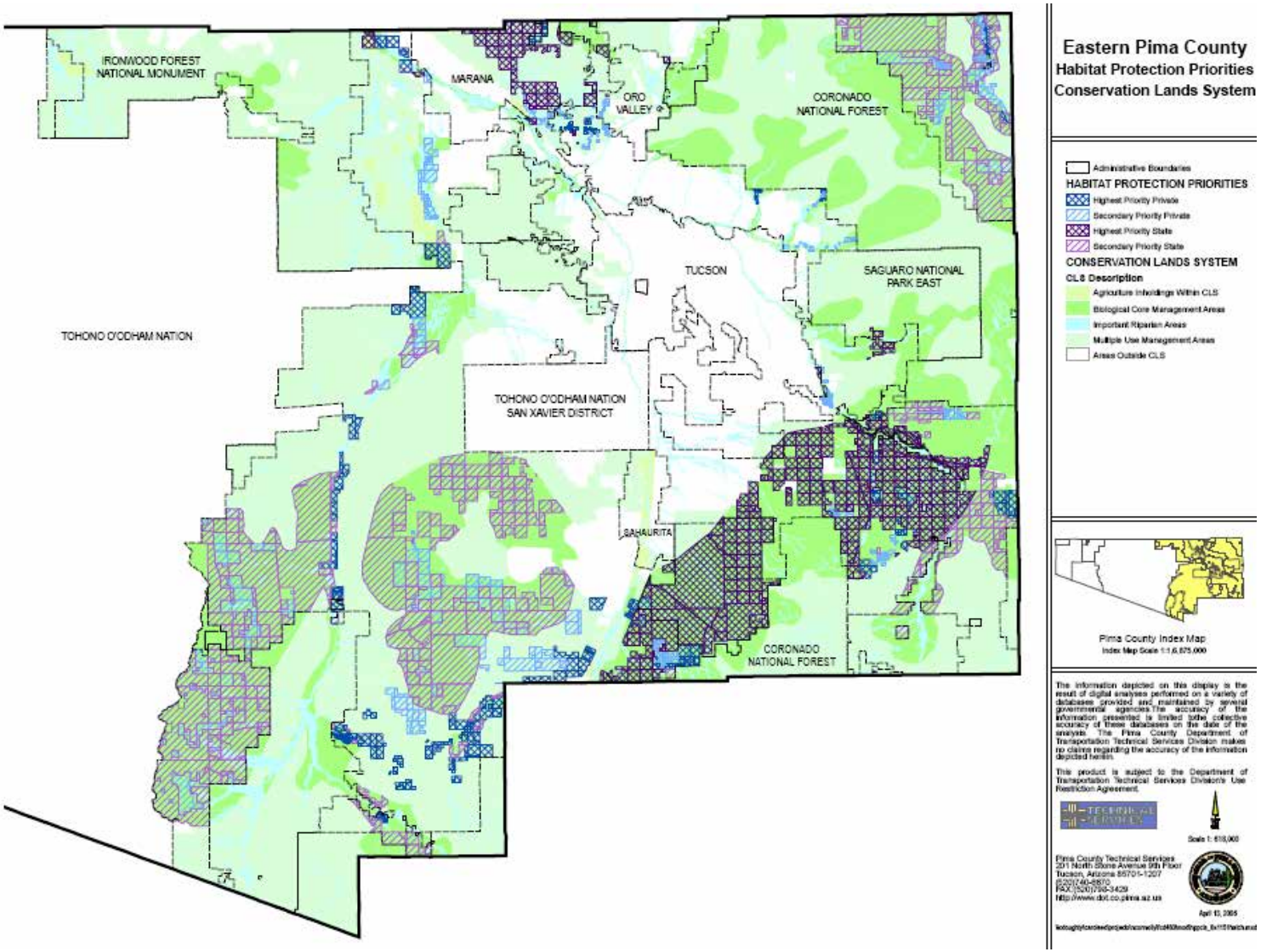

Figure A-35. Map of Habitat Protection Priorities in eastern Pima County.

Appendix M. Conservation easement template for In-Lieu Fee projects.

RECORDING REQUESTED BY:
AND WHEN RECORDED MAIL TO:

Address

Space Above Line for Recorder's Use Only

CONSERVATION EASEMENT

THIS CONSERVATION EASEMENT is made this _____ day of _____, 201_ by [insert name], a _____ company, ("**Grantor**"), in favor of the _____ ("**Grantee(s)**") with reference to the following facts:

RECITALS

A. Grantor is the sole owner in fee simple of certain real property containing approximately ____ acres, located in the City of _____, County of _____, State of Arizona, designated Assessor Parcel Number(s) _____ (the "Property"). The Property is legally described on **Exhibit "A"** attached hereto and incorporated by this reference. Grantor intends to grant a conservation easement over a ____–acre portion of the Property (the "**Easement Area**"). The Easement Area is legally described and depicted in **Exhibit "B"** attached hereto and incorporated herein by this reference.

B. The Easement Area possesses wildlife and habitat values of great importance to Grantee, the people of the State of Arizona and the people of the United States. The Easement Area will provide high quality natural, restored and/or enhanced habitat for [***specify listed and sensitive plant and/or animal species***] and contain [***list habitats; native and/or non-native***], [***include the following phrase only if there are jurisdictional wetlands:*** and restored, created, enhanced and/or preserved jurisdictional Waters of the United States]. Individually and collectively, these wildlife and habitat values comprise the "**Conservation Values**" of the Easement Area.

C. Grantee is authorized to hold conservation easements pursuant to Arizona Revised Statute Section 33-271, *et seq*. Specifically, Grantee is an entity identified in Arizona Revised Statute Section 33-271 and otherwise authorized to acquire and hold title to real property.

D. The United States Army Corps of Engineers ("**USACE**") is the Federal agency charged with regulatory authority over discharges of dredged and fill material in Waters of the United States pursuant to Section 404 of the Clean Water Act, and is a third party beneficiary of this Conservation Easement.

E. This Conservation Easement is granted pursuant to the In-Lieu Fee Enabling Instrument (the "**ILFEI**") by and between Grantee, the Los Angeles District of USACE, Region

IX of the United States Environmental Protection Agency ("USEPA"), the U.S. Fish and Wildlife Service (USFWS), the Arizona Game and Fish Department (AGFD), the Arizona Department of Environmental Quality (ADEQ), Pima County, and the City of Phoenix dated _____, and the Development Plan (the "**Development Plan**"), and the Interim Management Plan and Long-Term Management Plan (as applicable, the "**Management Plan**") created under the ILFEI. USACE, USEPA, USFWS, AGFD, ADEQ, Pima County, and the City of Phoenix are together referred to in this Conservation Easement as the "**Signatory Agencies**." The ILFEI, the Development Plan and the Management Plan are incorporated by this reference into this Conservation Easement as if fully set forth herein.

F. All section numbers referred to in this Conservation Easement are references to sections within this Conservation Easement, unless otherwise indicated.

COVENANTS, TERMS, CONDITIONS AND RESTRICTIONS

In consideration of the above recitals and the mutual covenants, terms, conditions, and restrictions contained herein, and pursuant to the laws of the United States and State of Arizona, including Arizona Revised Statute Section 33-271, *et seq.*, Grantor hereby voluntarily grants and conveys to Grantee a conservation easement in perpetuity over the Easement Area of the nature and character and to the extent hereinafter set forth ("**Conservation Easement**"). This Conservation Easement shall run with the land and be binding on Grantor's heirs, successors, administrators, assigns, lessees, and other occupiers or users of the Easement Area or any portion of it.

1. Purposes.

(a) The purposes of this Conservation Easement are to ensure that the Easement Area will be retained in perpetuity in its natural, restored, or enhanced condition as contemplated by the ILFEI, the Development Plan, and the Management Plan, and to prevent any use of the Easement Area that will impair or interfere with the Conservation Values of the Easement Area. Grantor intends that this Conservation Easement will confine the use of the Easement Area to activities that are consistent with such purposes, including, without limitation, those involving the preservation, restoration and enhancement of native species and their habitats implemented in accordance with the ILFEI, the Development Plan and the Management Plan.

(b) The term "**Natural Condition**," as referenced in the preceding paragraph and other portions of this Conservation Easement, shall mean the condition of the Easement Area, as it exists at the time this Conservation Easement is executed, as well as future enhancements or changes to the Easement Area that occur directly as a result of the following activities:

(1) Compensatory mitigation activities, including implementation, maintenance and monitoring as described in the Development Plan and Management Plan; or

(2) Activities described in Section 4 and Section 6 herein.

(c) Grantor represents and warrants that there are no structures or improvements existing on the Easement Area at the time this grant is executed that interfere or conflict with the Purposes of this Conservation Easement. Grantor further represents and warrants that there are no other previously granted easements existing on the Easement Area that interfere or conflict with the Purposes of this Conservation Easement as evidenced by the Title Report attached at **Exhibit "C."** The present Natural Condition is evidenced in part by the depiction of the Easement Area attached on **Exhibit "D,"** showing all relevant and plottable property lines, easements, dedications, improvements, boundaries and major, distinct natural features such as Waters of the United States. Grantor has delivered further evidence of the present Natural Condition to Grantee and USACE consisting of (1) a color aerial photograph of the Easement Area at an appropriate scale taken as close in time as possible to the date this Conservation Easement is executed; (2) an overlay of the Easement Area boundaries on such aerial photograph; and (3) on-site color photographs showing all man-made improvements or structures (if any) and the major, distinct natural features of the Easement Area.

(d) If a controversy arises with respect to the current Natural Condition of the Property, Grantor, Grantee or USACE or any designees or agents of Grantor, Grantee, and USACE shall not be foreclosed from utilizing any and all other relevant documents, surveys, photographs or other evidence or information to assist in the resolution of the controversy.

2. Grantee's Rights. To accomplish the Purposes of this Conservation Easement, Grantor, its successors and assigns hereby grants and conveys the following rights to Grantee. These rights are also granted to the USACE or its designees as third party beneficiaries of this Conservation Easement:

(a) To preserve and protect the Conservation Values of the Easement Area; and

(b) To enter upon the Property and Easement Area at reasonable times in order to monitor compliance with and to otherwise enforce the terms of this Conservation Easement, the ILFEI, the Development Plan and the Management Plan, to implement at Grantee's sole discretion Development Plan and Management Plan activities that have not been implemented, and for scientific research and interpretive purposes by Grantee or its designees, provided that Grantee shall not unreasonably interfere with Grantor's authorized use and quiet enjoyment of the Easement Area; and

(c) To prevent any activity on or use of the Easement Area that is inconsistent with the Purposes of this Conservation Easement and to require the restoration of such areas or features of the Easement Area that may be damaged by any act, failure to act, or any use that is inconsistent with the Purposes of this Conservation Easement; and

(d) To require that all mineral, air and water rights as Grantee deems necessary to preserve and protect the biological resources and Conservation Values of the

Easement Area shall remain a part of and be put to beneficial use upon the Easement Area, consistent with the Purposes of this Conservation Easement.

(e) All present and future development rights allocated, implied, reserved or inherent in the Easement Area; such rights are hereby terminated and extinguished, and may not be used on or transferred to any portion of the Easement Area; and

(f) The right to enforce by any means, including, without limitation, injunctive relief, the terms and conditions of this Conservation Easement; and

(g) The right to enhance native plant communities, including the removal non-native species, the right to plant trees and shrubs of the same type as currently existing on the Easement Area, or other appropriate native species. Habitat enhancement activities shall not conflict with the preservation of the Natural Condition of the Easement Area or the Purposes of this Conservation Easement and shall be performed in compliance with all applicable laws, regulations, and permitting requirements.

3. Prohibited Uses. Any activity on or use of the Easement Area that is inconsistent with the Purposes of this Conservation Easement is prohibited. Without limiting the generality of the foregoing, the following uses and activities by Grantor, Grantee, and their respective agents, and third parties are expressly prohibited:

(a) Introduction of nuisance water, such as any drainage or overflow, including but not limited to water from pools, aquariums, waterbeds and fountains, and unseasonable and supplemental watering, except nuisance water associated with irrigation outside the Easement Area by adjacent homeowners or others and the natural drainage of rainfall and water related to Grantee's habitat enhancement activities as set forth in the Development Plan;

(b) Use of herbicides, pesticides, biocides, fertilizers, or other agricultural chemicals or weed abatement activities, except weed abatement activities necessary to control or remove invasive, exotic plant species as set forth in the Development Plan or Management Plan;

(c) Use of off-road vehicles and use of any other motorized vehicles except in the execution of management duties;

(d) Grazing or other agricultural activity of any kind except highly managed, short duration, spatially controlled grazing utilized for invasive species control in areas effectively devoid of native perennial vegetation

for the execution of management duties (e.g. a few goats corralled within a mobile and flexible shaped paddock made of electric fencing used to graze Bermuda grass back to the roots which encourages new sprouts which make the plant more susceptible to herbicides);

(e) Recreational activities including, but not limited to, camping, picnicking, horseback riding, biking, hunting or fishing;

(f) Residential, commercial, retail, institutional, or industrial uses;

(g) Any legal or de facto division, subdivision or partitioning of the Easement Area;

(h) Construction, reconstruction or placement of any building, road, wireless communication cell towers, billboard, sign, or any other structure or improvement of any kind except those signs specifically allowed under Section 5(e) or as specifically provided for in the Development Plan or Management Plan;

(i) Dumping soil, trash, ashes, refuse, waste, bio-solids, garbage or any other material;

(j) Planting, gardening, or introduction or dispersal of non-native plant or animal species except in the execution of management duties where biologically or ecologically advantageous to the restoration of the site including, but not limited to:

1-introducing temporary hives of honeybees to ensure pollination during critical periods for areas depauperate of native pollinators

2-introducing certain plants, with future removal once purpose is accomplished, used in specific instances to:

- a- increase soil nutrient level for heavily depleted former agricultural fields
- b- decrease soil nutrient level for areas that have become hyper-nutrient due to anthropogenic effects
- c- remediate levels of toxins in soil making them more suitable to native plants which may not be tolerant of anthropogenic chemical loads

3-introducing soil mycorrhizae that are commercially available if unable to generate sufficient quantities of inoculum from mycorrhizae that are native to the specific restoration site

4-introducing soil Rhizobial bacteria that are commercially available if unable to generate sufficient quantities of inoculum from Rhizobia that are native to the specific restoration site

5-introducing established biological control agents for control of invasive species

6-introducing commercially available species of plants, with planned removal once purpose is accomplished, used to provide equivalent critical habitat

components for local sensitive species of animals while native species, which are not commercially available, can be produced and established in a bespoke fashion, that will fill the habitat needs long-term.

7-non-native annual plants with no capacity to self-seed that are of high palatability to herbivorous animals on site may be planted as 'sacrificial plants' to help protect the establishment of native plants until mature enough to survive herbivory.

(k) Filling, dumping, excavating, draining, dredging, mining, drilling, removing or exploring for or extraction of minerals, loam, gravel, soil, rock, sand or other material on or below the surface of the Easement Area;

(l) Altering the surface or general topography of the Easement Area, including but not limited to any alterations to habitat, building roads or trails, paving or otherwise covering the Easement Area with concrete, asphalt or any other impervious material except for those habitat management activities specified in the Development Plan or Management Plan;

(m) Removing, destroying, or cutting of trees, shrubs or other vegetation, except for (1) emergency fire breaks as required by fire safety officials, (2) prevention or treatment of disease, (3) control of invasive species which threaten the integrity of the habitat, (4) completing the Development Plan and Management Plan, or (5) activities described in Section 2;

(n) Manipulating, impounding or altering any natural watercourse, body of water or water circulation on the Easement Area, and activities or uses detrimental to water quality, including but not limited to degradation or pollution of any surface or sub-surface waters except for as specifically provided for in the Development Plan or Management Plan;

(o) Creating, enhancing, and maintaining fuel modification zones (defined as a strip of mowed land or the planting of vegetation possessing low combustibility for purposes of fire suppression) or other activities that could constitute fuel modification zones;

(p) Without the prior written consent of Grantee, which Grantee may withhold, transferring, encumbering, selling, leasing, or otherwise separating the mineral, air or water rights for the Easement Area; changing the place or purpose of use of the water rights; abandoning or allowing the abandonment of, by action or inaction, any water or water rights, ditch or ditch rights, spring rights, reservoir or storage rights, wells, ground water rights, or other rights in and to the use of water historically used on or otherwise appurtenant to the Easement Area, including but not limited to: (1) riparian

water rights; (2) appropriative water rights; (3) rights to waters which are secured under contract with any irrigation or water district, to the extent such waters are customarily applied to the Easement Area; and (4) any water from wells that are in existence or may be constructed in the future on the Easement Area;

(q) Engaging in any use or activity that may violate, or may fail to comply with, relevant federal, state, or local laws, regulations, or policies applicable to Grantor, the Easement Area, or the use or activity in question; and

(r) No use shall be made of the Easement Area, and no activity thereon shall be permitted, that is or is likely to become inconsistent with the Purposes of this Conservation Easement. Grantor and Grantee acknowledge that, in view of the perpetual nature of this Conservation Easement, they are unable to foresee all potential future land uses, future technologies, and future evolution of the land and other natural resources, and other future occurrences affecting the Purposes of this Conservation Easement. Grantee, therefore, in its sole discretion, may determine whether (1) proposed uses or proposed improvements not contemplated by or addressed in this Conservation Easement or (2) alterations in existing uses or structures, are consistent with the Purposes of this Conservation Easement.

4. Grantor's Duties. To accomplish the Purposes of this Conservation Easement as described in Section 1, Grantor, its successors and assigns shall:

(a) Undertake all reasonable actions to prevent the unlawful entry and trespass by persons whose activities may degrade or harm the Conservation Values of the Easement Area. In addition, Grantor shall undertake all necessary actions to perfect Grantee's rights under Section 2 of this Conservation Easement;

(b) Cooperate with Grantee in the protection of the Conservation Values;

(c) Repair and restore damage to the Easement Area directly or indirectly caused by Grantor, Grantor's guests, representatives, employees or agents, and third parties within Grantor's control; provided, however, Grantor, its successors or assigns shall not engage in any repair or restoration work on the Easement Area without first consulting with the Grantee and USACE; and

(d) Obtain any applicable governmental permits and approvals for any Activity or use permitted by this Conservation Easement, and any activity or use shall be undertaken in accordance with all applicable federal, state, local and administrative agency statutes, ordinances, rules, regulations, orders or requirements.

5. Grantee's Duties. To accomplish the Purposes of this Conservation Easement as described in Section 1, Grantee, its successors and assigns shall:

(a) Perform, at a minimum on an annual basis, compliance monitoring inspections of the Easement Area; and

(b) Prepare reports on the results of the compliance monitoring inspections,

and provide these reports to the Signatory Agencies on an annual basis; and

(c) Undertake construction, maintenance and monitoring of mitigated areas pursuant to the Development Plan and Interim Management Plan until issuance of final approval from the USACE confirming that Grantee has successfully completed construction, maintenance and monitoring of mitigated areas pursuant to said Plans ("**Final Approval**"). This duty is non-transferable;

(d) Upon receipt of Final Approval, perform long-term management of the Easement Area pursuant to the Long-term Management Plan;

(e) Within 120 days of recordation of this Conservation Easement, install signs and other notification features saying "Natural Area Open Space," "Protected Natural Area," or similar descriptions. Prior to erection of such signage, the Grantee shall submit plans showing the location and language of such signs to the USACE for review and approval;

(f) Repair and restore damage to the Easement Area directly or indirectly caused by Grantee, Grantee's guests, representatives, employees or agents, and third parties within Grantee's control provided, however, Grantee, its successors or assigns shall not engage in any repair or restoration work on the Easement Area without first consulting with USACE.

6. Reserved Rights. Grantor reserves to itself, and to its personal representatives, heirs, successors, and assigns, all rights accruing from its ownership of the Easement Area, including the right to engage in or to permit or invite others to engage in all uses of the Easement Area that are not prohibited or limited by, and are consistent with, the Purposes of this Conservation Easement.

7. Enforcement.

(a) Right to Enforce. Grantor, its successors and assigns, grant to the USACE, the U.S. Department of Justice, and the State Attorney General a discretionary right to enforce this Conservation Easement in a judicial or administrative action against any person(s) or other entity(ies) violating or attempting to violate this Conservation Easement; provided, however, that no violation of this Conservation Easement shall result in a forfeiture or reversion of title. The USACE, U.S. Department of Justice, and the State Attorney General shall have the same rights, remedies and limitations as Grantee under this Section 7. The rights under this Section are in addition to, and do not limit rights conferred in Section 2 above. The term "Party" means Grantor or Grantee, as the case may be. Grantor, Grantee, and any third party beneficiaries, when implementing any remedies under this easement, shall provide timely written notice to each other of any actions taken under this section, including, but not limited to copies of all notices of violation and related correspondence.

(b) Notice of Violation. In the event that either Party or its employees, agents, contractors or invitees is in violation of the terms of this Conservation Easement or that a violation is threatened, the non-violating Party and/or third party beneficiaries may demand the cure of such violation. In such a case, the non-violating Party and/or third party beneficiaries shall issue a written notice to the violating Party (hereinafter "**Notice of Violation**") informing the violating Party of the actual or threatened violations and demanding cure of such violations. The Notice of Violation shall be sent to the other Party and third party beneficiaries listed under Section 15 of this Conservation Easement.

(c) Time to Cure. The violating Party shall cure the noticed violation within thirty (30) days of receipt of said written Notice of Violation. If said cure reasonably requires more than thirty (30) days, the violating Party shall, within the thirty (30) day period, submit to the non-violating Party and/or third party beneficiaries, as the case may be, for review and approval a plan and time schedule to diligently complete a cure. The violating Party shall complete such cure in accordance with the approved plan. If the violating Party disputes the notice of violation, it shall issue a written notice of such dispute (hereinafter "**Notice of Dispute**") to the appropriate Party and/or third party beneficiary within thirty (30) days of receipt of written Notice of Violation.

(d) Failure to Cure. If the violating Party fails to cure the violation within the time period(s) described in Section 7(c), above, or Section 7(e)(2), below, the non-violating Party and/or third party beneficiaries may bring an action at law or in equity in a court of competent jurisdiction to enforce compliance by the violating Party with the terms of this Conservation Easement. In such action, the non-violating Party and/or third party beneficiaries may:

(1) Recover any damages to which they may be entitled for violation by the violating Party of the terms of this Conservation Easement or for any injury to the Conservation Values of the Easement Area. The non-violating Party shall first apply any damages recovered to the cost of undertaking any corrective action on the Easement Area. Prior to implementation of any remedial or restorative actions pursuant to this paragraph, USACE shall be consulted.

(2) Enjoin the violation by temporary or permanent injunction without the necessity of proving either actual damages or the inadequacy of otherwise available legal remedies.

(3) Obtain other equitable relief, including, but not limited to, the restoration of the Easement Area to the condition in which it existed prior to any such violation or injury.

(e) Notice of Dispute.

(1) If the violating Party provides the non-violating Party and/or third party beneficiaries with a Notice of Dispute, as provided herein, the non-violating Party and/or third party beneficiaries shall meet and confer with the violating Party at a mutually agreeable place and time, not to exceed thirty (30) days from the date that the non-violating Party and/or third party beneficiaries receive the Notice of Dispute. The non-violating Party and/or third party beneficiaries shall consider all relevant

information concerning the disputed violation provided by the violating Party and shall determine whether a violation has in fact occurred and, if so, whether the Notice of Violation and demand for cure issued by the non-violating Party and/or third party beneficiaries is appropriate in light of the violation.

(2) If, after reviewing the violating Party's Notice of Dispute, conferring with the violating Party, and considering all relevant information related to the violation, the non-violating Party and/or third party beneficiaries determine that a violation has occurred, the non-violating Party and/or third party beneficiaries shall give the violating party notice of such determination in writing. Upon receipt of such determination, the violating Party shall have fifteen (15) days to cure the violation. If said cure reasonably requires more than fifteen (15) days, the violating Party shall, within the fifteen (15) day period, submit to the non-violating Party and/or third party beneficiaries for review and approval a plan and time schedule to diligently complete a cure. The violating Party shall complete such cure in accordance with the approved plan.

(f) Conflicting Notices of Violation.

(1) If any Party receives a Notice of Violation that is in material conflict with one or more prior written Notices of Violation that have not yet been cured by the Party (hereinafter "Active Notice(s) of Violation") such that the conflict makes it impossible for the Party to carry out the cure consistent with all prior Active Notices of Violation, the Party shall give written notice (hereinafter "Notice of Conflict") to the non-violating Party and/or third party beneficiaries issuing the later, conflicting Notice(s) of Violation. The Party shall issue said Notice of Conflict to the appropriate non-violating Party and/or third party beneficiaries within fifteen (15) days of the receipt of each such conflicting Notice of Violation. A valid Notice of Conflict shall describe the conflict with specificity, including a description of how the conflict makes compliance with all Active Notices of Violation impossible.

(2) Upon issuing a valid Notice of Conflict to the appropriate non-violating Party and/or third party beneficiaries, as described above, the violating Party shall not be required to carry out the cure described in the conflicting Notice or Notices of Violation until such time as the non-violating Party responsible for said conflicting Notice(s) of Violation issue(s) a revised Notice of Violation that is consistent with prior Active Notices of Violation. Upon receipt of a revised, consistent Notice of Violation, the violating Party shall carry out the cure recommended in such notice within the time period(s) described in Section 7(c) above. Notwithstanding Section 7(g), failure to cure within said time period(s) shall entitle the non-violating Party to the remedies described in Section 7(d) and Section 7(h).

(3) The failure of the violating Party to issue a valid Notice of Conflict within fifteen (15) days of receipt of a conflicting Notice of Violation shall result in a waiver of the violating Party's ability to claim a conflict.

(g) Immediate Action. In the event that circumstances require immediate action to prevent or mitigate significant damage to the Conservation Values of the Property, the Party and/or third party beneficiary seeking enforcement pursuant to Section 7(b) above may immediately pursue all available remedies, including injunctive relief, available pursuant to both

this Conservation Easement and state and federal law after giving the violating Party at least twenty four (24) hours' written notice before pursuing such remedies. So long as such twenty-four (24) hours' notice is given, the non-violating Party may immediately pursue all available remedies without waiting for the expiration of the time periods provided for cure or Notice of Dispute as described in Section 7(c). The written notice pursuant to this paragraph may be transmitted to the violating Party by facsimile and shall be copied to the other Party and/or third party beneficiaries listed in Section 15 of this Conservation Easement. The rights of the non-violating Party and/or third party beneficiaries under this paragraph apply equally to actual or threatened violations of the terms of this Conservation Easement. The violating Party agrees that the remedies at law for any violation of the terms of this Conservation Easement are inadequate and that the non-violating Party and third party beneficiaries shall be entitled to the injunctive relief described in this section, both prohibitive and mandatory, in addition to such other relief to which they may be entitled, including specific performance of the terms of this Conservation Easement, without the necessity of proving either actual damages or the inadequacy of otherwise available legal remedies. The remedies described in this Section 7(g) shall be cumulative and shall be in addition to all remedies now or hereafter existing at law or in equity, including but not limited to, the remedies set forth in Arizona Revised Statute Section 33-271, *et seq.*, inclusive.

(h) Costs of Enforcement. All costs incurred by a Party, where that Party is the prevailing party, in enforcing the terms of this Conservation Easement against the other Party, including, but not limited to, costs of suit and attorneys' and experts' fees, and any costs of restoration necessitated by negligence or breach of this Conservation Easement, shall be borne by the non-prevailing Party.

(i) Enforcement Discretion. Enforcement of the terms of this Conservation Easement by a Party and/or third party beneficiary shall be at the discretion of the Party and/or third party beneficiary, and any forbearance by such Party and/or third party beneficiary to exercise its rights under this Conservation Easement in the event of any breach of any term of the Conservation Easement by a Party or any subsequent transferee shall not be deemed or construed to be a waiver by the non-violating Party and third party beneficiary of such terms or of any subsequent breach of the same or any other term of this Conservation Easement or of any of the rights of the non-violating Party and third party beneficiary under this Conservation Easement. No delay or omission by the non-violating Party and/or third party beneficiaries in the exercise of any right or remedy upon any breach by the violating Party shall impair such right or remedy or be construed as a waiver. Further, nothing in this Conservation Easement creates a non-discretionary duty upon the non-violating Party and/or third party beneficiaries to enforce its provisions, nor shall deviation from these terms and procedures, or failure to enforce its provisions give rise to a private right of action against the non-violating Party and/or third party beneficiaries by any third parties.

(j) Acts Beyond Grantor's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantee to bring any action against Grantor for any injury to or change in the Easement Area resulting from:

(1) Any natural cause beyond Grantor's control, including without limitation, fire not caused by Grantor, flood, storm, and earth movement;

(2) Any prudent action taken by Grantor under emergency conditions to prevent, abate, or mitigate significant injury to the Easement Area resulting from such causes;

(3) Acts by Grantee, USACE, or their employees, directors, officers, agents, contractors, or representatives; or

(4) Acts of third parties (including any governmental agencies) that are beyond Grantor's control.

Notwithstanding the foregoing, Grantor must obtain any applicable governmental permits and approvals for any emergency activity or use permitted by this Conservation Easement, and undertake any activity or use in accordance with all applicable federal, state, local and administrative agency statutes, ordinances, rules, regulations, orders or requirements.

(k) Acts Beyond Grantee's Control. Nothing contained in this Conservation Easement shall be construed to entitle Grantor to bring any action against Grantee for any injury to or change in the Easement Area resulting from:

(1) Any natural cause beyond Grantee's control, including without limitation, fire not caused by Grantee, flood, storm, and earth movement;

(2) Any prudent action taken by Grantee under emergency conditions to prevent, abate, or mitigate significant injury to the Easement Area resulting from such causes;

(3) Acts by Grantor, USACE or their employees, directors, officers, agents, contractors, or representatives; or

(4) Acts of third parties (including any governmental agencies) that are beyond Grantee's control.

Notwithstanding the foregoing, Grantee must obtain any applicable governmental permits and approvals for any emergency activity or use permitted by this Conservation Easement, and undertake any activity or use in accordance with all applicable federal, state, local and administrative agency statutes, ordinances, rules, regulations, orders or requirements.

8. Access. This Conservation Easement does not convey a general right of access to the public.

9. Costs and Liabilities.

(a) Grantor, its successors and assigns retain all responsibilities and shall bear all costs and liabilities of any kind related to the ownership, operation, upkeep, and maintenance (except Long-Term Maintenance by Grantee) of the Easement Area. Grantor agrees Grantee and USACE shall not have any duty or responsibility for the operation, upkeep, or maintenance (except Long-Term Maintenance by Grantee) of the Easement Area, the monitoring of hazardous conditions thereon, or the protection of Grantor, the public or any third parties from risks relating

to conditions on the Property. Grantor, its successor or assign remains solely responsible for obtaining any applicable governmental permits and approvals for any activity or use permitted by this Conservation Easement, and any activity or use shall be undertaken in accordance with all applicable federal, state, local and administrative agency statutes, ordinances, rules, regulations, orders and requirements.

(b) Hold Harmless.

(1) Grantor shall hold harmless, protect and indemnify Grantee and its directors, officers, employees, agents, contractors, and representatives and the heirs, personal representatives, successors and assigns of each of them (each a "Grantee Indemnified Party" and collectively, "Grantee's Indemnified Parties") from and against any and all liabilities, penalties, costs, losses, damages, expenses (including, without limitation reasonable attorneys' fees and experts' fees), causes of action, claims, demands, orders, liens or judgments (each a "Claim" and, collectively, "Claims"), arising from or in any way connected with: (i) injury to or the death of any person, or physical damage to any property, resulting from any act, omission, condition, or other matter related to or occurring on or about the Easement Area, regardless of cause, except that this indemnification shall be inapplicable to any Claim due solely to the negligence of Grantee or any of its employees; (ii) the obligations or rights specified in Sections 4, 6, 9(a), 10, and 19(l); and (iii) the existence or administration of this Conservation Easement. If any action or proceeding is brought against any of the Grantee's Indemnified Parties by reason of any such Claim, Grantor shall, at the election of and upon written notice from Grantee, defend such action or proceeding by counsel reasonably acceptable to the Grantee's Indemnified Party or reimburse Grantee for all charges incurred in defending the action or proceeding.

(2) Grantor shall hold harmless, protect and indemnify USACE and their respective directors, officers, employees, agents, contractors, and representatives and the heirs, personal representatives, successors and assigns of each of them (each a "**Third-Party Beneficiary Indemnified Party**" and collectively, "**Third-Party Beneficiary Indemnified Parties**") from and against any and all Claims arising from or in any way connected with: (i) injury to or the death of any person, or physical damage to any property, resulting from any act, omission, condition, or other matter related to or occurring on or about the Easement Area, regardless of cause and (ii) the obligations or rights specified in Sections 4, 5, 6, 9(a), 10, and 19(l), except that any indemnification under this Section 9(b) shall be inapplicable to Third-Party Beneficiary Indemnified Parties with respect to any Claim due to the negligence or intentional acts only of USACE or any of its employees.

10. Taxes, No Liens. Grantor, its successors and assigns shall pay before delinquency all taxes, assessments, fees, and charges of whatever description levied on or assessed against the Easement Area by competent authority, including any taxes imposed upon, or incurred as a result of, this Conservation Easement, and shall furnish Grantee and USACE with satisfactory evidence of payment upon request. Grantor, its successors and assigns shall keep Grantee's interest in the Easement Area free from any liens.

11. Condemnation. The Purposes of the Conservation Easement is presumed to be the best and most necessary public use as defined in Arizona Revised Statute Section 12-1122 notwithstanding. Nevertheless, if the Easement Area is taken, in whole or in part, by exercise of the power of eminent domain, Grantor and Grantee shall be entitled to compensation in accordance with applicable law.

12. Transfers of Conservation Easement or Easement Area.

(a) Conservation Easement. This Conservation Easement may be assigned or transferred by Grantee upon written approval of the Signatory Agencies, which approval shall not be unreasonably withheld or delayed, but Grantee shall give Grantor and the Signatory Agencies at least sixty (60) days prior written notice of the proposed assignment or transfer. Grantee may assign or transfer its rights under this Conservation Easement only to an entity or organization: (i) authorized to acquire and hold conservation easements pursuant to Arizona Revised Statute Section 33-271 (and any successor or other provision(s) then applicable), or the laws of the United States; and (ii) otherwise reasonably acceptable to the Signatory Agencies. Grantee shall require the assignee to record the assignment in the county where the Easement Area is located. The failure of Grantee to perform any act provided in this section shall not impair the validity of this Conservation Easement or limit its enforcement in any way. Any transfer under this section is subject to the requirements of Section 13.

(b) Easement Area. Grantor agrees to incorporate the terms of this Conservation Easement by reference in any deed or other legal instrument by which Grantor divests itself of any interest in all or any portion of the Easement Area, including, without limitation, a leasehold interest. Grantor agrees that the deed or other legal instrument shall also incorporate by reference the ILFEI, the Development Plan, the Management Plan, and any amendment(s) to those documents. Grantor further agrees to give written notice to Grantee and the Signatory Agencies of the intent to transfer any interest at least sixty (60) days prior to the date of such transfer. Grantee or the Signatory Agencies shall have the right to prevent any transfers in which prospective subsequent claimants or transferees are not given notice of the terms, covenants, conditions and restrictions of this Conservation Easement (including the exhibits and documents incorporated by reference in it). The failure of Grantor to perform any act provided in this section shall not impair the validity of this Conservation Easement or limit its enforceability in any way. Any transfer under this section is subject to the requirements of Section 13.

13. Merger. The doctrine of merger shall not operate to extinguish this Conservation Easement if the Conservation Easement and the Easement Area become vested in the same party. If, despite this intent, the doctrine of merger applies to extinguish the Conservation Easement then, unless Grantor, Grantee, and the Signatory Agencies otherwise agree in writing, a replacement conservation easement or restrictive covenant containing the same protections embodied in this Conservation Easement shall be recorded against the Easement Area.

14. Additional Interests. Grantor shall not grant any additional easements, rights of way or other interests in the Easement Area (other than a security interest that is expressly subordinated to this Conservation Easement), nor shall Grantor grant, transfer, abandon or relinquish (each a

"**Transfer**") any mineral, air, or water right or any water associated with the Easement Area, without first obtaining the written consent of Grantee and the Signatory Agencies. Such consent may be withheld if Grantee or the Signatory Agencies determine(s) that the proposed interest or Transfer is inconsistent with the Purposes of this Conservation Easement or will impair or interfere with the Conservation Values of the Easement Area. This Section 14 shall not limit the provisions of Section 2(d) or 3(p), nor prohibit transfer of a fee or leasehold interest in the Easement Area that is subject to this Conservation Easement and complies with Section 12. Grantor shall provide a copy of any recorded or unrecorded grant or Transfer document to the Grantee and Signatory Agencies.

15. Notices. Any notice, demand, request, consent, approval, or other communication that Grantor or Grantee desires or is required to give to the other shall be in writing, with a copy to each of the Signatory Agencies, and served personally or sent by recognized overnight courier that guarantees next-day delivery or by first class United States mail, postage fully prepaid, addressed as follows:

To Grantor:

To Grantee: To be included with each specific property for which this CE is executed.

With a copy to: District Counsel
U.S. Army Corps of Engineers
Los Angeles District
915 Wilshire Boulevard, Room 1535
Los Angeles, California 90017-3401
FAX: 213-452-4217

and IRT Members:

U.S. Army Corps of Engineers
Los Angeles District, Tucson Resident Office
5205 E. Comanche St
Tucson, AZ 85707
Attn: Marjorie Blaine
520-584-1684

United States Environmental Protection Agency
Region IX, WTR-8
75 Hawthorne Street
San Francisco, CA 94105
Attn: Elizabeth Goldmann
415-972-3398

Wildlife Management Division
Arizona Game and Fish Department
5000 W. Carefree Hwy
Phoenix, AZ 85086-5000
Attn: Bob Broscheid
623-236-7276

Arizona Department of Environmental Quality
Mailstop 5415A-1
1110 W. Washington
Phoenix, AZ 85007
Attn: Linda Taunt
602-771-4502

Pima County
Office of Conservation Science and Sustainability
201 N. Stone Ave, 6th Floor
Tucson, AZ 85701
Attn: Julia Fonseca
520-724-6460

City of Phoenix
Office of Environmental Programs
200 W. Washington Street
14th Floor
Phoenix, AZ 85003
Attn: Wendy Wonderley
602-534-1775

U.S. Fish and Wildlife Service
Arizona Ecological Services Field Office
2321 W. Royal Palm Road, Suite 103
Phoenix, AZ 85021
Attn: Mike Martinez
602-242-0524, ext 224

or to such other address a party or a Signatory Agency shall designate by written notice to Grantor, Grantee and the Signatory Agencies. Notice shall be deemed effective upon delivery in the case of personal delivery or delivery by overnight courier or, in the case of delivery by first class mail, three (3) days after deposit into the United States mail.

The parties agree to accept facsimile signed documents and agree to rely upon such documents as if they bore original signatures. Each party agrees to provide to the other parties, within seventy-two (72) hours after transmission of such a facsimile, the original documents that bear the original signatures.

16. Amendment. This Conservation Easement may be amended only by mutual written agreement of Grantor and Grantee and written approval of the USACE, which approval shall not be unreasonably withheld or delayed. Any such amendment shall be consistent with the Purposes of this Conservation Easement and Arizona law governing conservation easements, and shall not affect its perpetual duration. Any such amendment shall be recorded in the official records of the county in which the Easement Area is located, and Grantee shall promptly provide a conformed copy of the recorded amendment to the Grantor and the Signatory Agencies.

17. Recordation. Grantor shall promptly record this instrument in the official records of Pima County, Arizona and immediately notify the Grantee and USACE through the mailing of a conformed copy of the recorded easement. Grantee may re-record this Conservation Easement at any time as Grantee deems necessary to preserve its rights in this Conservation Easement.

18. Estoppel Certificate. Upon request, Grantee shall within fifteen (15) days execute and deliver to Grantor, its successors and assigns any document, including an estoppel certificate, which certifies compliance with any obligation of Grantor, its successors and assigns contained in this Conservation Easement and otherwise evidences the status of this Conservation Easement as may be requested by Grantor, its successors and assigns.

19. General Provisions.

(a) Controlling Law. The laws of the United States and the State of Arizona, disregarding the conflicts of law principles of such state, shall govern the interpretation and performance of this Conservation Easement.

(b) Liberal Construction. Any general rule of construction to the contrary notwithstanding, this Conservation Easement shall be liberally construed in favor of and to effect the Purposes of this Conservation Easement and the policy and purpose set forth in Arizona Revised Statute 33-271, et seq. If any provision in this instrument is found to be ambiguous, an interpretation consistent with the Purposes of this Conservation Easement that would render the provision valid shall be favored over any interpretation that would render it invalid.

(c) Change of Conditions. If one or more of the Purposes of this Conservation Easement may no longer be accomplished, such failure of purpose shall not be deemed sufficient cause to terminate the entire Conservation Easement as long as any other purpose of the Conservation Easement may be accomplished. In addition, the inability to carry on any or all of the permitted uses, or the unprofitability of doing so, shall not impair the validity of this Conservation Easement or be considered grounds for its termination or extinguishment. Grantor and Grantee agree that global warming and climate change-caused effects shall not be a basis for termination of this Conservation Easement.

(d) Severability. If a court of competent jurisdiction voids or invalidates on its face any provision of this Conservation Easement, such action shall not affect the remainder of this Conservation Easement. If a court of competent jurisdiction voids or invalidates the application of any provision of this Conservation Easement to a person or circumstance, such action shall not affect the application of the provision to other persons or circumstances.

(e) Entire Agreement. This document (including its exhibits and ILFEI, the Development Plan, and the Management Plan incorporated by reference in this document) sets forth the entire agreement of the parties and the Signatory Agencies with respect to the Conservation Easement and supersedes all prior discussions, negotiations, understandings, or agreements of the parties relating to the Conservation Easement. No alteration or variation of this Conservation Easement shall be valid or binding unless contained in an amendment in accordance with Section 15.

(f) No Forfeiture. Nothing contained herein will result in a forfeiture or reversion of Grantor's title in any respect.

(g) Successors and Assigns. The covenants, terms, conditions, and restrictions of this Conservation Easement shall be binding upon, and inure to the benefit of, the parties hereto and their respective personal representatives, heirs, successors, and assigns and shall constitute a servitude running in perpetuity with the Easement Area. The covenants hereunder benefiting Grantee shall also benefit the USACE as a third party beneficiary.

(h) Termination of Rights and Obligations. Except as otherwise expressly set forth in this Conservation Easement and provided the transfer was consistent with the terms of this Conservation Easement, a party's rights and obligations under this Conservation Easement shall terminate upon transfer of the party's interest in the Conservation Easement or Property (respectively), except that liability for acts or omissions occurring prior to transfer shall survive transfer.

(i) Captions. The captions in this instrument have been inserted solely for convenience of reference and are not a part of this instrument and shall have no effect upon its construction or interpretation.

(j) Counterparts. The parties may execute this instrument in two or more counterparts, which shall, in the aggregate, be signed by all parties; each counterpart shall be deemed an original instrument as against any party who has signed it. In the event of any disparity between the counterparts produced, the recorded counterpart shall be controlling.

(k) Exhibits. All Exhibits referred to in this Conservation Easement are attached and incorporated herein by reference.

(l) No Hazardous Materials Liability.

(1) Grantor represents and warrants that there has been no release or threatened release of Hazardous Materials (defined below) or underground storage tanks existing, generated, treated, stored, used, released, disposed of, deposited or abandoned in, on, under, or from the Easement Area, or transported to or from or affecting the Easement Area.

(2) Without limiting the obligations of Grantor under Section 9(b), Grantor hereby releases and agrees to indemnify, protect and hold harmless the Grantee Indemnified Parties (defined in Section 9(b)(1)) from and against any and all Claims (defined in Section 9(b)(1)) arising from or connected with any Hazardous Materials or underground storage tanks present, alleged to be present, released in, from or about, or otherwise associated with the Easement Area at any time, except any Hazardous Materials placed, disposed or released by Grantee or any of its employees. This release and indemnification includes, without limitation, Claims for (i) injury to or death of any person or physical damage to any property; and (ii) the violation or alleged violation of, or other failure to comply with, any Environmental Laws (defined below). If any action or proceeding is brought against any of the Grantee's Indemnified Parties by reason of any such Claim, Grantor shall, at the election of and upon written notice from the applicable Grantee Indemnified Party, defend such action or proceeding by counsel reasonably acceptable to the Grantee Indemnified Party or reimburse Grantee for all charges incurred in defending the action or proceeding.

(3) Without limiting the obligations of Grantor under Section 9(b)(2) herein, Grantor hereby releases and agrees to indemnify, protect and hold harmless the Third Party Beneficiary Indemnified Parties (defined in Section 9(b)(2)) against any and all Claims (defined in Section 9(b)(1)) arising from or connected with any Hazardous Materials present, alleged to be present, or otherwise associated with the Easement Area at any time, except that this release and indemnification shall be inapplicable to the Third Party Beneficiary Indemnified Parties with respect to any Hazardous Materials placed, disposed or released by third party beneficiaries, their employees or agents. This release and indemnification includes, without limitation, Claims for (i) injury to or death of any person or physical damage to any property; and (ii) the violation or alleged violation of, or other failure to comply with, any Environmental Laws (defined below).

(4) Despite any contrary provision of this Conservation Easement, the parties do not intend this Conservation Easement to be, and this Conservation Easement shall not be, construed such that it creates in or gives Grantee and USACE any of the following:

(i) The obligations or liabilities of an "owner" or "operator," as those terms are defined and used in Environmental Laws (defined below), including, without limitation, the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (42 U.S.C. Section 9601 et seq.; hereinafter, "**CERCLA**"); or

(ii) The obligations or liabilities of a person described in 42 U.S.C. Section 9607(a)(3) or (4); or

(iii) The obligations of a responsible person under any applicable Environmental Laws; or

(iv) The right to investigate and remediate any Hazardous Materials associated with the Property; or

(v) Any control over Grantor's ability to investigate, remove, remediate or otherwise clean up any Hazardous Materials associated with the Easement Area.

The term "**Hazardous Materials**" includes, without limitation, (a) material that is flammable, explosive or radioactive; (b) petroleum products, including by-products and fractions thereof; and (c) hazardous materials, hazardous wastes, hazardous or toxic substances, or related materials defined in CERCLA; Resource Conservation and Recovery Act (42 U.S.C. 6901 et seq.); the Hazardous Materials Transportation Act (49 U.S.C. Section 5101 et seq.); the Arizona equivalents (18 AAC Chapter 16 and Chapter 8; 17 AAC Chapter 5) and in the regulations adopted and publications promulgated pursuant to them, or any other applicable federal, state or local laws, ordinances, rules, regulations or orders now in effect or enacted after the date of this Conservation Easement.

The term "**Environmental Laws**" includes, without limitation, any federal, state, local or administrative agency statute, ordinance, rule, regulation, order or requirement relating to pollution, protection of human health or safety, the environment or Hazardous Materials. Grantor represents, warrants and covenants to Grantee and USACE that Grantor's activities upon and use of the Easement Area will comply with all Environmental Laws.

(m) Extinguishment. If circumstances arise in the future that render the preservation of Conservation Values, or other Purposes of this Conservation Easement impossible to accomplish, this Conservation Easement can only be terminated or extinguished, in whole or in part, by judicial proceedings in a court of competent jurisdiction.

(n) Warranty. Grantor represents and warrants that Grantor is the sole owner of the Easement Area. Grantor also represents and warrants that, except as specifically disclosed to and approved by the Grantee and USACE pursuant to the Property Assessment signed by Grantor and attached as an exhibit to the ILFEI, [***choose applicable statement***: there are no outstanding mortgages, liens, encumbrances or other interests in the Bank Property (including, without limitation, mineral interests) which may conflict or are inconsistent with this Conservation Easement or the holder of any outstanding mortgage, lien, encumbrance or other interest in the Easement Area (including, without limitation, mineral interest) which conflicts or is inconsistent with this Conservation Easement has expressly subordinated such interest to this Conservation Easement by a recorded Subordination Agreement approved by Grantee and the USACE].

(p) Third-Party Beneficiary. Grantor and Grantee acknowledge that the USACE (the "**Third-Party Beneficiary**") is a third party beneficiary of this Conservation Easement with the right of access to the Easement Area and the right to enforce all of the obligations of Grantor and Grantee under this Conservation Easement.

(q) Funding. Funding for the perpetual management, maintenance and monitoring of the Easement Area is specified in and governed by the ILFEI and the Management Plan.

IN WITNESS WHEREOF Grantor and Grantee have executed this Conservation Easement the day and year first above written and have agreed to be bound by the terms and provisions hereof.

GRANTOR:
[insert name]

By:_____
Name:_____
Title:_____

IN WITNESS WHEREOF Grantor and Grantee have executed this Conservation Easement the day and year first above written and have agreed to be bound by the terms and provisions hereof.

GRANTOR:
[insert name]

By:_____
Name:_____
Title:_____

State of Arizona }
County of _____ }

On _____ before me, _____,
Date Here Insert Name and Title of the Officer

personally appeared _____
Name(s) of Signer(s)

_____

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of Arizona that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature_____
Signature of Notary Public

Place Notary Seal Above

Appendix N. List of prohibited and permitted activities on County-controlled Mitigation Lands.

Section 1: High value Biological resources: Prohibited activities

Purpose. County-controlled mitigation lands shall promote the biological goal and objectives of the Sonoran Desert Conservation Plan and associated MSCP and seek to appropriately manage natural land cover and water resources, promote recovery or reintroduction of native species, and to reduce threats to ecosystem structure and functions, including threats to habitat for identified species.

Prohibited Activities:

Any activity or use of the Property inconsistent with the purpose of this easement is prohibited. Without limiting the generality of the foregoing, the following activities and uses are expressly prohibited:

1) Development of the Property, including subdivision or lot splitting of the Property.
2) Constructing or placing of any additional buildings, permanent camping developments, mobile homes or billboards except construction of additional residences, associated outbuildings and agricultural outbuildings as might be provided elsewhere in this easement.
3) Surface alteration or natural vegetation alteration other than that necessary to accommodate the uses of the Property authorized herein.
4) Severing of surface or subsurface water rights associated with the Property, including the transfer, encumbrance, lease and sale of water rights.
5) Development of, or the granting of rights-of-way, access or easements for, new roads or utilities including telecommunications facilities.
6) Filling, excavating, dredging, mining, drilling, exploration or extraction of minerals, hydrocarbons, soils, sand, gravel, rock, or other materials on or below the surface of the Property, except as minimally necessary in connection with such activities as may be required in performing any activities permitted herein.
7) The dumping, extended storage, accumulation or disposal of toxic and/or hazardous materials, trash, ashes, garbage, waste or other unsightly or offensive material on the Property.
8) The introduction of non-native fish or amphibians or other non-native organisms to or from catchments, tanks, springs or creeks.
9) The introduction of non-native species of noxious or aggressive character that might adversely affect the natural values of the Property.
10) Storage and use of biocides and chemical fertilizers, except for residential and agricultural purposes that may be provided for herein. Aerial application of biocide

or other chemicals is prohibited, except where utilized for rehabilitation of native habitats and approved by Grantee.

11) Pumping of groundwater for other than on-site residential, habitat restoration, ecotourism and agricultural uses associated with livestock grazing on the Property as provided for herein, except that any increases in groundwater pumping shall not be permitted that might adversely affect the natural values of the property.

12) Any actual or planned diversion or pumping of water from any perennial spring or watercourse, unless otherwise permitted herein.

13) Any actual or planned planting of non-native vegetation or plant species, except for such uses that have historically been part of the ranching operation, if any, on the Property, and such plantings remain confined to the areas where they exist at the time of the grant of this easement.

14) Any actual or planned underground storage tanks for petroleum or other polluting substances, except already existing or permitted septic tanks.

15) Confinement livestock feeding in which animals are permanently located in enclosures and the majority of their feed supplied from outside sources. This includes but is not limited to cattle feeder, dairy, pig, poultry, ostrich and emu farm operations.

16) Commercial enterprises inconsistent with protection of the Property's conservation values, excluding farming, ranching, and ecotourism operations provided for herein.

17) Any actual or planned use or location on the Property of mobile homes, travel trailers, tent trailers, self-propelled recreational vehicles and like structures or vehicles, except for vehicular campers authorized by Grantor, may only be parked on the Property to accommodate reasonable visitation and management operations.

18) Any actual or planned paving of roads using asphalt or concrete.

19) Any actual or planned commercial logging.

20) Any actual or planned modification of the topography of the Property through the placement thereon of soil, landfill, dredging spoils, or other material, except for those uses permitted under this easement.

21) Any actual or planned surface collection or excavation of archaeological artifacts, fossils, and/or materials other than those approved by Grantor and Arizona State Museum.

22) Off road vehicular travel except as reasonably necessary to facilitate permitted activities on the Property, such as ranching operations, habitat restoration projects, and site monitoring.

<u>Permitted Activities</u>

These may be modified as appropriate for an individual property.

1) Livestock grazing under a ranch management or grazing plan identified and referenced in the easement. Such grazing may be confined to specific areas of the

Property and may prohibit grazing in certain critical areas, such as springs or riparian zones.

2) Farming in existing areas of use.
3) Shrub removal as reasonable and necessary for fencing or maintaining utility easements, livestock developments, and residential needs, except individuals of sensitive or T&E species.
4) The use of existing corrals, barns, outbuildings, or ranch dumpsites reasonable and necessary for ranching and farming operations, provided they do not compromise the biological values for which the Property is acquired.
5) The construction of replacement corrals, barns, outbuildings, residences or other structures on the existing disturbed sites. The easement may provide for building envelopes or identify locations where new structures may be permitted.
6) Use of water from designated water developments or natural sources for on-site domestic, livestock watering, farming, fire-fighting, or dust control that is not excessive or inconsistent with the purposes of the easement.
7) Prescribed fire, with written approval of Grantee, for areas exceeding 10 or more acres.
8) New or replacement fencing, provided the fencing allows safe passage of wildlife.
9) Use of herbicides or pesticides on cultivated lands, in the residential area, or in barns, corrals, or other livestock confinements.
10) Replacement of existing wells, pumps, pipelines, windmills and storage tanks as necessary for permitted operations on the Property along with maintenance and repair of existing water developments.
11) Construction of new roads where necessary to enhance or protect biological values on the Property or to facilitate farming or livestock-related activities.
12) Construction of trails for non-motorized, passive recreation including hiking, horseback riding, picnicking, and bird watching.
13) Grantee shall have the right to enter the Property, upon reasonable notice to Grantor, for monitoring and enforcement of the terms of this easement.

Section 2: High-value community resources

Purpose: This designation shall protect lands that contribute to the preservation of resources valued by urban and suburban residents including, but not limited to, open space, signature viewsheds, archaeological and cultural resources, significant natural vegetative features, wildlife habitat, riparian areas, and groundwater recharge areas. (Based on purpose statement for Bond Question #1 and 11/16/03 memo from Bond Advisory Committee to BOS re: Recommendations on Other Jurisdiction's Open Space Bond Proposals.)

Prohibited Activities

Any activity or use of the Property inconsistent with the purpose of this easement is prohibited. Without limiting the generality of the foregoing, the following activities and uses are expressly prohibited:

14) Development of the Property, including subdivision or lot splitting of the Property.

15) Constructing or placing of any additional buildings, permanent camping accommodations, mobile homes or billboards except construction of additional residences, associated outbuildings, and agricultural outbuildings, as might be provided elsewhere in this easement.

16) Surface alteration or natural vegetation alteration other than that necessary to accommodate the uses of the Property authorized herein.

17) Severing of surface or subsurface water rights associated with the Property, including the encumbrance, lease, and sale of water rights.

18) Development of, or the granting of rights-of-way, access or easements for, roads or utilities, including telecommunications facilities.

19) Filling, excavating, dredging, mining, drilling, exploration or extraction of minerals, hydrocarbons, soils, sand, gravel, rock, or other materials on or below the surface of the Property, except as minimally necessary in connection with such activities as may be required in performing any activities permitted herein.

20) The storage, dumping, accumulation or disposal of toxic and/or hazardous materials, trash, ashes, garbage, waste, or other unsightly or offensive material on the Property.

21) Any actual or planned surface collection or excavation of archaeological artifacts, fossils, and/or materials, unless authorized by Grantor and Arizona State Museum.

22) The introduction of invasive, non-native plant species or exotic animals other than domestic animals.

23) Pumping of groundwater for other than currently existing uses on the Property as provided for herein, except that any increases in groundwater pumping shall not be permitted that might adversely affect the natural values of the property.

Permitted Activities

Activities consistent with the purpose of the open space acquisition shall be permitted. This may include, but is not limited to, the following:

24) Livestock grazing, preferably under a ranch management or grazing plan, identified and referenced in the easement.

25) Farming in existing areas of use.

26) Shrub removal as reasonable and necessary for fencing or maintaining utility easements, livestock developments, and residential needs, except for individuals of sensitive or T&E species.

27) The use of existing corrals, barns, outbuildings, or ranch dumpsites reasonable and necessary for ranching and farming operations, provided they do not compromise the biological values for which the Property is acquired.

28) The construction of replacement corrals, barns, outbuildings, residences or other structures on the existing disturbed sites. The easement may provide for building envelopes or identify locations where new structures may be permitted.

29) Use of water from designated water developments or natural sources for on-site domestic, livestock watering, farming, fire-fighting, or dust control that is not excessive or inconsistent with historic and traditional uses on the Property.

30) Fire protection and prescribed fire activities, with written approval of Grantee, for areas exceeding 10 or more acres.

31) New or replacement fencing, provided the fencing allows safe passage of wildlife.

32) Use of herbicides or pesticides on cultivated lands, in the residential area, or in barns, corrals, or other livestock confinements.

33) Replacement of existing wells, pumps, pipelines, windmills, and storage tanks as necessary for permitted operations on the Property, along with repair of existing water developments.

34) Construction of new roads where necessary to enhance or protect biological values on the Property or to facilitate farming, livestock-related activities, or habitat monitoring efforts.

35) Construction of trails for non-motorized, passive recreation including hiking, horseback riding, swimming, picnicking, and birdwatching.

36) Grantees shall have the right to enter the Property, upon reasonable notice to Grantor, for monitoring and enforcement of the terms of this easement.

Appendix O. Current Pima County Parks Rules, P.C.P.R. § 4-040.

The Pima County Parks Rules are adopted by the Pima County Board of Supervisors as the code of rules and regulations for Pima County parks and recreation areas pursuant to A.R.S. 11-935(B)(2) and 11-936.The Pima County Park Rules are organized by subject matter under an expandable two-factor decimal numbering system which is designed to facilitate supplementation without disturbing the numbering of existing provisions. Each section number designates, in sequence, the numbers of the chapter and section. Thus, Section 2.020 is Section 020 located in Chapter 2.

In parentheses following each section, is a legislative history identifying the specific sources for the provisions of that section by stating the adopting or amending resolution number, resolution section, and year the resolution was adopted.

The Pima County Parks Rules are subject to change. The most recent and accurate resolutions of the Pima County Parks and Recreation Commission amending the Pima County Parks Rules may be found in the Pima County Parks and Recreation Department office.

1.010 Fees

It shall be unlawful to enter upon or use for any purpose the land, water or facilities within the boundaries of County parks and recreation areas when a fee, rental, admission or other consideration has been established for such use, unless the person entering or using such land, water or facility has paid said fee, rental, admission or other consideration. (Res. 2000-3, § 2, 2000)

1.020 Commercial activity

It shall be unlawful to use County park or recreation areas for commercial purposes, public meetings or assemblies, erection of signs, fences, barriers or structures, to distribute advertising materials, or to sell any goods or services without first obtaining a written permit from the Pima County Parks and Recreation Department. (Res. 2000-3, § 2, 2000).

1.030 Motor vehicles

It shall be unlawful:

A. To operate a motorbike, motorcycle or other motor vehicle on trails, or cross country, or on primitive unsurfaced roadways that have been posted, signed, or barriered to prohibit vehicle use.

B. To operate a motor vehicle except on roads and parking areas designated for such purposes.

C. To operate a motor vehicle at a speed greater than that posted or to fail to obey traffic signs.

D. In all cases, a motor vehicle shall be operated in compliance with the Arizona Motor Vehicle Code as provided under Title 28, Arizona Revised Statutes, while within the boundaries of any Pima County Park or Recreation area. (Res. 2000-3, § 2, 2000).

1.040 Bicycles

Within Tucson Mountain Park, Tortolita Mountain Park, Roy P. Drachman Agua Caliente Regional Park, Cienega Creek Natural Preserve and Colossal Cave Mountain Park, it shall be unlawful to ride a bicycle except on a road or established trail, or in an arroyo, wash or riverbed. It shall further be unlawful to ride a bicycle on a road or established trail posted to prohibit bicycle use. (Res. 2000-3, § 2, 2000).

1.050 Destruction, damage or removal of County property

A. It shall be unlawful to destroy, damage, deface or remove any County regulatory sign, property or facility owned or administered by the Pima County Parks and Recreation Department.

B. It shall be unlawful to collect, remove, destroy, mutilate, damage or deface any natural resource, including, but not limited to, all live and dead vegetation and all parts thereof, wildlife, soil, rocks, and water, except as otherwise provided for by law or without obtaining prior written approval from the Pima County Parks and Recreation Department.

C. Except as otherwise planned for and provided for by the Pima County Parks and Recreation Department, all environmental settings shall be kept in their natural state. (Res. 2000-3, § 2, 2000)

1.060 Litter

It shall be unlawful to litter, deposit, or abandon in or on any County park, parkway or recreational facility any garbage, sewage, refuse, trash, waste, or other obnoxious materials except in receptacles or containers provided for such purposes. These receptacles are not to be used for residential trash disposal. (Res. 2000-3, § 2, 2000).

1.070 Areas posted against entrance, use or occupancy

It shall be unlawful to enter, use or occupy public parks or recreation under the supervision and control or Pima County Parks and Recreation Department for any purpose when said parks or areas are posted against such entrance, use or occupancy. (Res. 2000-3, § 2, 2000).

1.080 Hunting

Hunting is not permitted within the fenced boundaries of Rifle Ranges or Archery Ranges. (Res. 2000-3, § 2, 2000)

1.090 Firearms

It shall be unlawful to discharge firearms or other weapons in Pima County public parks except in designated Rifle Ranges or Pistol Ranges. (Res. 2000-3, § 2, 2000)

1.100 Archery

A. It shall be unlawful to shoot with bow-and-arrow except in designated "Archery Ranges" and subject to the following specific regulations:

1. Tucson Mountain Park. Bow hunting areas are all areas in the Tucson Mountain Park, except that no discharge of archery weapons is permitted within the corridor described by 660 feet on either side of the centerline of Gates Pass Road between Gates Pass Overlook and the intersection of Gates Pass Road and Kinney Road.

2. David Yetman Trail. Discharge of archery weapons is not permitted within 660 feet on either side of the David Yetman Trail from G-3 entry to the 22nd Street entry.

3. Tucson Estates. Discharge of archery weapons is not permitted within 2,640 feet of the park boundary around Tucson Estates including all the Little Cat Mountain range between Starr Pass Trail and the David Yetman Link Trail.

4. Old Tucson; Arizona-Sonora Desert Museum; Sonoran Arthropod Studies area; Gilbert Ray Campground. Discharge of archery weapons is not permitted within 2,640 feet of the boundaries of the Old Tucson premises, the Arizona-Sonora Desert Museum premises, the Sonoran Arthropod Studies premises and the Gilbert Ray Campground.

B. In addition to the foregoing limitations, all bow hunting must comply with all rules, regulations and other requirements of the Arizona Game and Fish Department. (Res. 2000-3, § 2, 2000)

1.110 Fires

It shall be unlawful to build fires, except in designated places, or in fireplaces, stoves or grills either provided or approved by the Pima County Parks and Recreation Department. (Res. 2000-3, § 2, 2000)

1.120 Aircraft, parachutes and hang gliders

It shall be unlawful to operate any aircraft of any nature or parachute or hang glide on County Park property except in areas designated for such use by the Commission, or in an emergency. (Res. 2000-3, § 2, 2000)

2.010 Registration and User fees

A. Registration is required.

B. Registration shall include the license number of the vehicle and the state where registered.

C. The registration fee shall be paid in advance. (Res. 2000-3, § 2, 2000)

2.020 Camping regulations

A. All registrants must park in the space assigned by the registrar.

B. One camping unit per site only.

C. Checkout time is Noon.

D. A seven day camping limit will be enforced, without exception. After seven days, the campers must leave the park for a minimum of seven days to gain eligibility to re-register.

E. Open camp fires are not permitted. Fireplaces have been provided for this purpose. Registrar may permit approved portable grills upon inspection.

F. Under no circumstances may clotheslines, lanterns, wiring, flags, or any other articles whatsoever, be strung across or secured to any vegetation or other County properties.

G. The County assumes no responsibility for personal belongings or property of any kind. (Res. 2000-3, § 2, 2000)

2.030 Water

A. The washing of vehicles and any other unnecessary use of water is prohibited.

B. Hose connections to or from any camper or trailer for any purpose other than filling holding tanks is strictly prohibited by order of the State Health Department.

C. The State Health Department requires that all water-soluble waste be disposed of at the Dumping Station, although dishwater waste and contents of commode bags may be emptied in the restroom toilets. Registrar will direct all non-specified disposals to avoid illegal dumping. (Res. 2000-3, § 2, 2000)

4.010 Domestic animals and other pets at large

No domestic animals or other pets are permitted to be at large in Pima County Parks and Recreation areas. (Res. 2000-3, § 2, 2000)

4.020 Restraint

A. Domestic animals and pets shall be restrained by a cage, or a leash of not more than six (6) feet in length and of sufficient strength to control the animal.

B. Exemptions from restraint requirements:

1) Animals participating in pet shows or classes approved by the Parks and Recreation Department, provided that the animal is accompanied by and under the control of its owner or handler.

2) Dogs confined within a county maintained temporary or permanent dog run located within a county park. (Res. 2000-3, § 2, 2000)

4.030 Saddle, pack and draft animals

It shall be unlawful to bring saddle, pack or draft animals into a County Park and Recreation site unless it has been developed to accommodate them and is posted accordingly. (Res. 2000-3, § 2, 2000)

4.040 Grazing and foraging

It shall be unlawful to allow grazing or allow any forage-consuming domestic livestock to graze or to roam at-large within the fenced or posted boundaries of Pima County Parks. (Res. 2000-3, § 2, 2000)

4.050 Tucson Mountain Park

A. Dogs are not permitted within Tucson Mountain Park, except in the Gilbert Ray Campground. Seeing eye dogs shall be exempt.
(Res. 2000-3, § 2, 2000)

4.060 License

Dogs over four (4) months of age shall wear a valid license on a collar. (Res. 2000-3, § 2, 2000)

4.070 Litter

A. Dog owners or handlers shall clean up all litter created by the animal and place it in trash cans.

B. Exemption. Owners of seeing eye dogs shall be exempt.
(Res. 2000-3, § 2, 2000)

5.010 Intoxicants in Park and Recreation Areas

A. No person shall posses or consume spirituous liquor in Pima County Parks and Recreation areas.

B. Exemption. On premises under lease from Pima County and upon compliance with the terms of the lease and with applicable State liquor licensing laws.

C. "Spirituous liquor" includes alcohol, brandy, whiskey, rum, tequila, mescal, gin, wine, porter, ale, beer, any malt liquor or malt beverage, absinthe, a compound or mixture of any of them or of any of them with any vegetable or other substance, alcohol bitters, bitters containing alcohol, any liquid mixture or preparation, whether patented or otherwise, which produces intoxication, fruits preserved in ardent spirits, and beverages containing more than one-half of one percent of alcohol by volume. (Res. 2000-3, § 2, 2000)

5.020 Disturbing the Peace in Park and Recreation Areas

No person shall maliciously and willfully disturb the peace or quiet of a neighborhood, family or person by: loud or unusual noise; tumultuous or offensive conduct; threatening, traducing, quarreling, challenging to fight or fighting; or applying any violent, abusive or obscene epithets to another. (Res. 2000-3, § 2, 2000)

7.010 Violations and penalties

A person who violates any of the Parks Rules, adopted pursuant to A.R.S. § 11-931, et seq., is guilty of a class 2 misdemeanor pursuant to A.R.S. § 11-940. (Res. 2000-3, § 2, 2000)

7.020 Expulsion of violators

Pima County park police officers and other law enforcement officers shall have authority to order violators of the Park Rules to leave parks and recreation areas. (Res. 2000-3, § 2, 2000).

Appendix P. Pima County Multi-species Conservation Plan annual report and compliance analysis: template and outline.

Pima County Multi-species Conservation Plan annual report and compliance analysis: template and outline.

Version 4

October 31, 2013

Submitted by:

Pima County Office of Sustainability and Conservation

Tucson, AZ

Submitted To:

U.S. Fish and Wildlife Service, Ecological Services Office

Tucson, Arizona

Albuquerque, New Mexico

Introduction

Identifies the time period covered by the report, which will usually be either a calendar or fiscal year. Description about Pima County, the MSCP, and the need for the report. This section will include maps, such as:

- Location of Pima County
- Land ownership in Pima County
- County-controlled mitigation lands

Permit Changes

Describes change(s) to the permit (if any) approved by U. S. Fish and Wildlife Service during the past year. Such changes might include major amendments such as changes to Covered Species or Covered Activities, or minor amendments to the MSCP or IA such as correction of errors. Documentation of changes will be placed as an appendix.

Administrative Changes

Describes approved changes that did not require an amendment, including impacts of take, avoidance, minimization, and/or mitigation. This section will give a description of the effect of the administrative change(s) to the relevant portions of the MSCP. Proposed changes to ordinances and guidelines will be noted in Section 12. If needed, additional information will be included as an attachment to the report. Also noted will be requests by the FWS for other information for the purpose of assessing whether the terms and conditions of the permit are met, and how FWS requests were addressed. This section will also describe and document changes to habitat models or Priority Conservation Areas.

Take

Summarizes the number of County and private projects covered by the permit this year, and to date. Includes a table listing Certificates of Coverage issued. This section will include tables and figures showing location of habitat loss for that year, and for the permit to date.

Conservation Measures

Mentioned here will be updates to procedures or processes for avoiding and minimizing take.

The following information will be summarized for mitigation activities:

1. Habitat loss with associated mitigation ratios (table and map);
2. Total mitigation obligated since permit issuance (table and map);
3. Replacement of lost mitigation credit;
4. Summary of mitigation lands available for future commitment; and
5. Anticipated future mitigation requirements, if new assessments are available.

Funding

Summary of expenses and income during the past fiscal year on enforcement, management, monitoring, and administration. Include grant monies and fees. Included will be a forecast of the year's work and budget relative to permit obligations.

Assess whether the County's funding resources have materially changed from the information provided in Chapter 8 of the MSCP, and if so how that affects ability to meet the terms of the permit.

Management

Highlights significant management activities throughout the year. Actions include re-introduction and habitat restoration efforts, road improvements, installation of fencing/cattleguards, and trash pickup events. Also note any adaptive management activities taken, whether initiated by County or requested by the USFWS. More detailed reports, if any, will be placed in an appendix.

Monitoring

Summarizes monitoring activities, including those of RFCD and NRPR. Include summaries of each of the five program elements, and maps of where monitoring took place for the year. Any new or updated protocols will be included as appendices as would any data summaries, especially analyses of trends. Report number of site visits, new species, number of hours of volunteer efforts, and any grants to support the monitoring program.

Non-mitigation Lands Transactions and Processes

Donations and voluntary dedications that may qualify as mitigation lands, Pima County land exchanges, or other commitments of potential mitigation lands.

Changed or Unforeseen Circumstances

Update on Changed Circumstances that Pima County believes have occurred during the year, including location, extent, duration, and timing of such events and response taken.

Partnerships

Significant progress on IAs and MOUs, and any dealings with new entities.

Prospective Issues

This is really an assortment of issues that we would see as having a future impact on the permit, permit funding, covered species, etc. Details on acquisitions and land exchanges not reported elsewhere can go here, if they would influence the pool of properties that will, over time, contribute to the suite of mitigation lands.

Appendices

Attach New CIP projects added to covered activities, administrative changes, management plans, monitoring plans, protocols, etc.

Certification of Supervising Official

I certify that, to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of this report, the information submitted is true, accurate, and complete.

_____ (Signature)

_____ (Date)

Appendix Q. Ecological Monitoring Plan for the Pima County MSCP

Introduction and Monitoring Setting

This appendix provides additional details about the ecological effectiveness monitoring activities and commitments that Pima County will undertake as part of the County's Section 10 permit obligations. As noted in Chapter 6 of the MSCP, the Pima County Ecological Monitoring Program (PCEMP) will be the primary monitoring program for the MSCP and will endeavor to monitor a mix of parameters, from species-level monitoring to monitoring habitat, threats, landscape pattern, and climate. This approach, which provides species-level monitoring commitments for many of the Covered Species, but which also includes other monitoring activities, has its genesis in the SDCP, which had the biological goal of ensuring "*the long-term survival of the full spectrum of plants and animals that are indigenous to Pima County through maintaining or improving the habitat conditions and ecosystem functions necessary for their survival*" (Pima County 2000a). That goal is broad in scope and required thinking that incorporated—but ultimately transcended—species-level needs to create a landscape conservation plan that has received widespread acclaim and success.

Further justification for expanding the monitoring program from a traditional HCP focus on individual species to a broader, more integrated approach can be found in the nature of the larger HCPs, such as Pima County's. Monitoring programs with many species have found that monitoring for each Covered Species have often not been fully implemented, and if developed, are very expensive to maintain. Further, many monitoring efforts for HCPs have been criticized for not provided sufficient information to detect meaningful changes in populations of target species and for not adequately informing management (see critiques in Harding et al. 2001; Wilhere 2002; Rahn et al. 2006). Populations of many vertebrates, for example, change markedly through time and in response to environmental changes that occur over lengthy periods of time, so assessing trends can take years, even if the trend is biologically meaningful (Elzinga et al. 2001; Fleishman and Mac Nally 2003). For these reasons, Pima County has chosen a monitoring approach that integrates a range of parameters over an approach that focuses solely on species-level monitoring.

After developing the scientific foundation of the biological element of the SDCP, the Science and Technical Advisory Team (STAT), which guided the formulation of the biological element of the SDCP, developed the foundation of the multi-element monitoring approach that is outlined here. In 2006, the STAT developed the program's guidance document (Shaw 2006) and subsequent financial support from the USFWS—by way of a Section 6 (ESA) planning grant—lent support to this effort (Powell 2007b). This appendix summarizes and builds on earlier reports by RECON Environmental Inc. (2007), Powell (2010c), and Steidl et al. (2010), all of which summarize a design process for choosing specific program elements and parameters, where they will be monitored, and by what methods.

Location of Monitoring Activities

Most on-the-ground monitoring activities will take place on mitigation lands, as well as at other properties owned and/or managed by Pima County for open-space conservation such as Tucson Mountain Park. Collectively, these are known as County preserve lands and they encompass approximately 230,000 acres (see Figure A-36). Pima County owns and/or manages >120 properties, many of which are small in area. To establish efficiencies for the PCEMP, Pima County will establish most on-the-ground monitoring activities on properties ≥100 acres in size. Together, these properties represent over 99% of the County's preserve lands. On-the-ground monitoring will take place on a property <100 acres in size if a specific resource of interest exists on that property such as springs, mines, and caves.

Ground-based monitoring will not take place on privately-owned natural open-space set asides (those undeveloped lands within subdivisions for which Pima County is seeking mitigation for the MSCP) unless Pima County acquires fee title to those lands for conservation (see Section 6.4 of the MSCP for greater detail). On natural open-space set asides for which partial credit is being sought by Pima County, the County will use remote-sensing methods to ensure that the set asides remain in their natural (i.e., undeveloped) state.

The specific location of monitoring activities on County preserves will vary by the parameter being monitored and this appendix provides a description of monitoring site locations. In some cases, specific sites that have already been determined to be suitable for monitoring are presented (such as for many of the Covered Species and water resources), but for other parameters, specific locations need to be determined after the onset of protocol development. For these parameters, the sampling frame (i.e., spatial extent that covers all of the possible monitoring sites) is specified.

Protocol Development

Throughout this appendix are found references to protocols. Protocols will vary somewhat in scope and detail, but for the purposes of Pima County's monitoring effort, protocols will be of sufficient detail so that it is clear what is being monitored, where (exactly) it is monitored, by what methods, and what will be done with the resulting data. Each step of the project will include standard operating procedures for data collection, storage, and analysis so that future field and office workers will be able to collect data in exactly the same manner over time (Oakley et al. 2003). Long-term monitoring efforts that have been established in the last decade or so (e.g., National Park Service Inventory and Monitoring Program) have recognized the importance of developing clear and detailed protocols and Pima County will adhere to this standard. In some cases (and especially for some single-species efforts), Pima County will

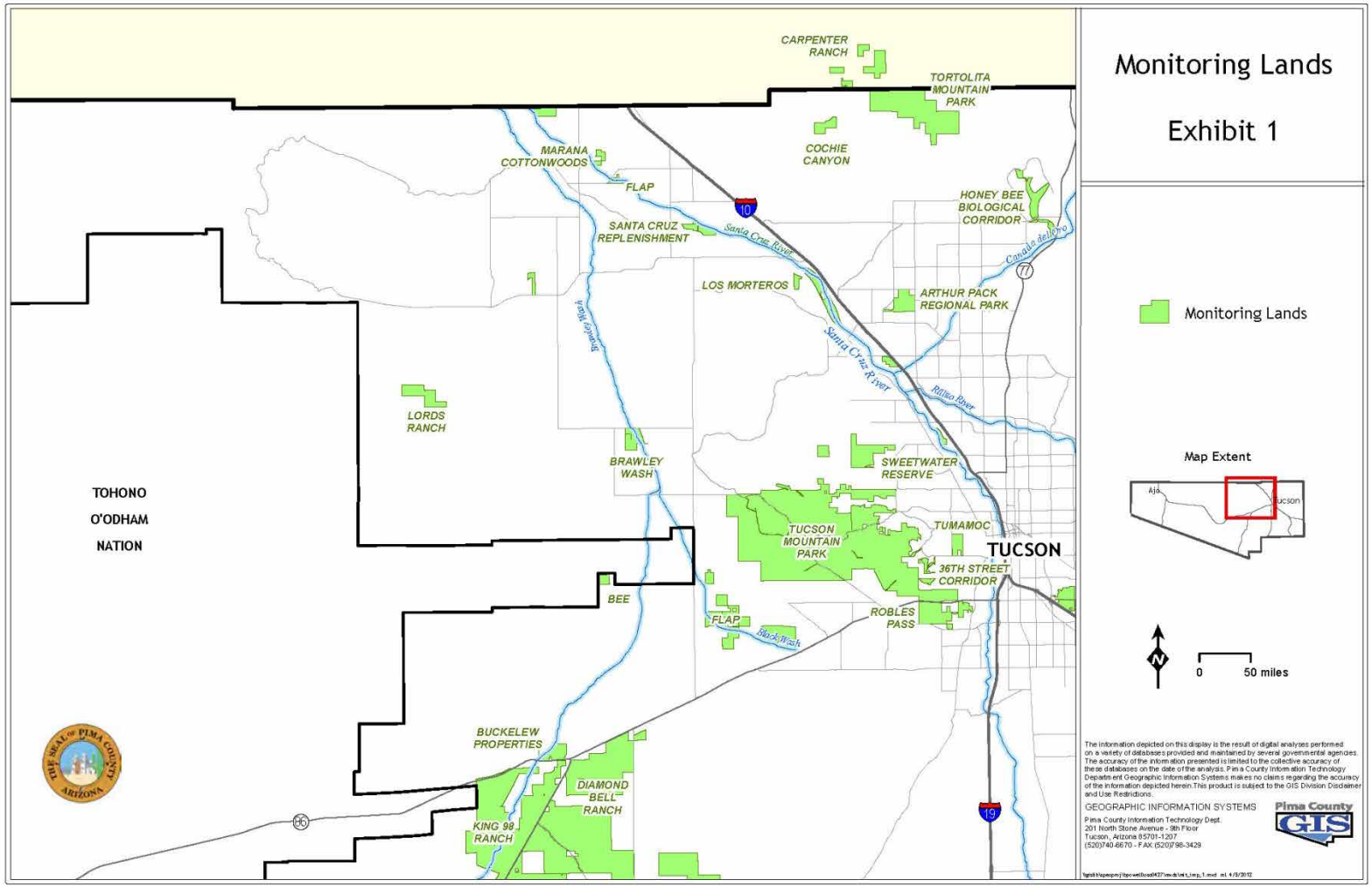

Figure A-36. County preserves >100 acres that will be included in the sampling frame for the establishment of long-term monitoring plots and on which other parameters may be monitored. The sampling frame will likely change over time; updated maps will be provided to the USFWS, as appropriate.

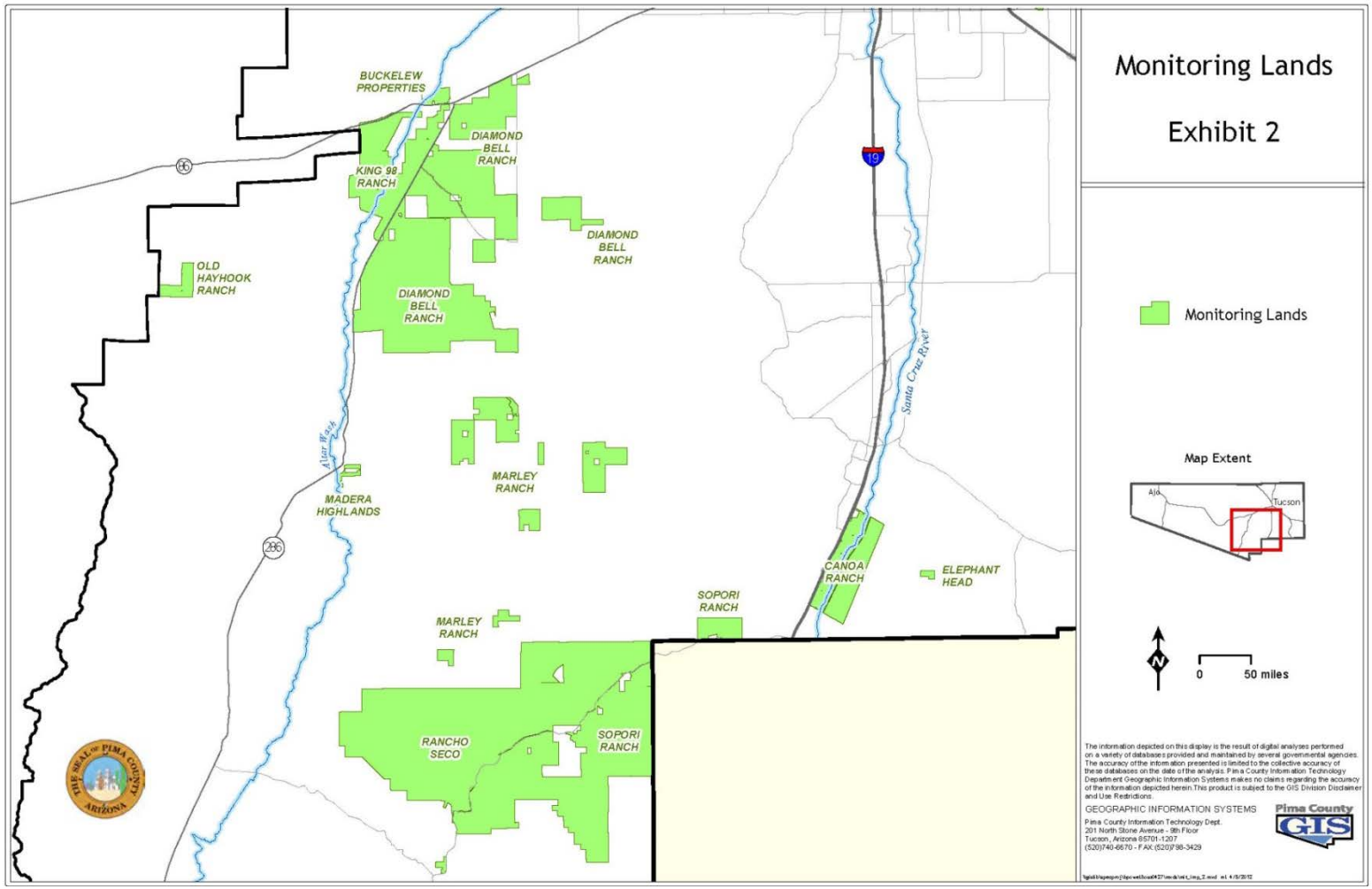

Figure A-36 cont.

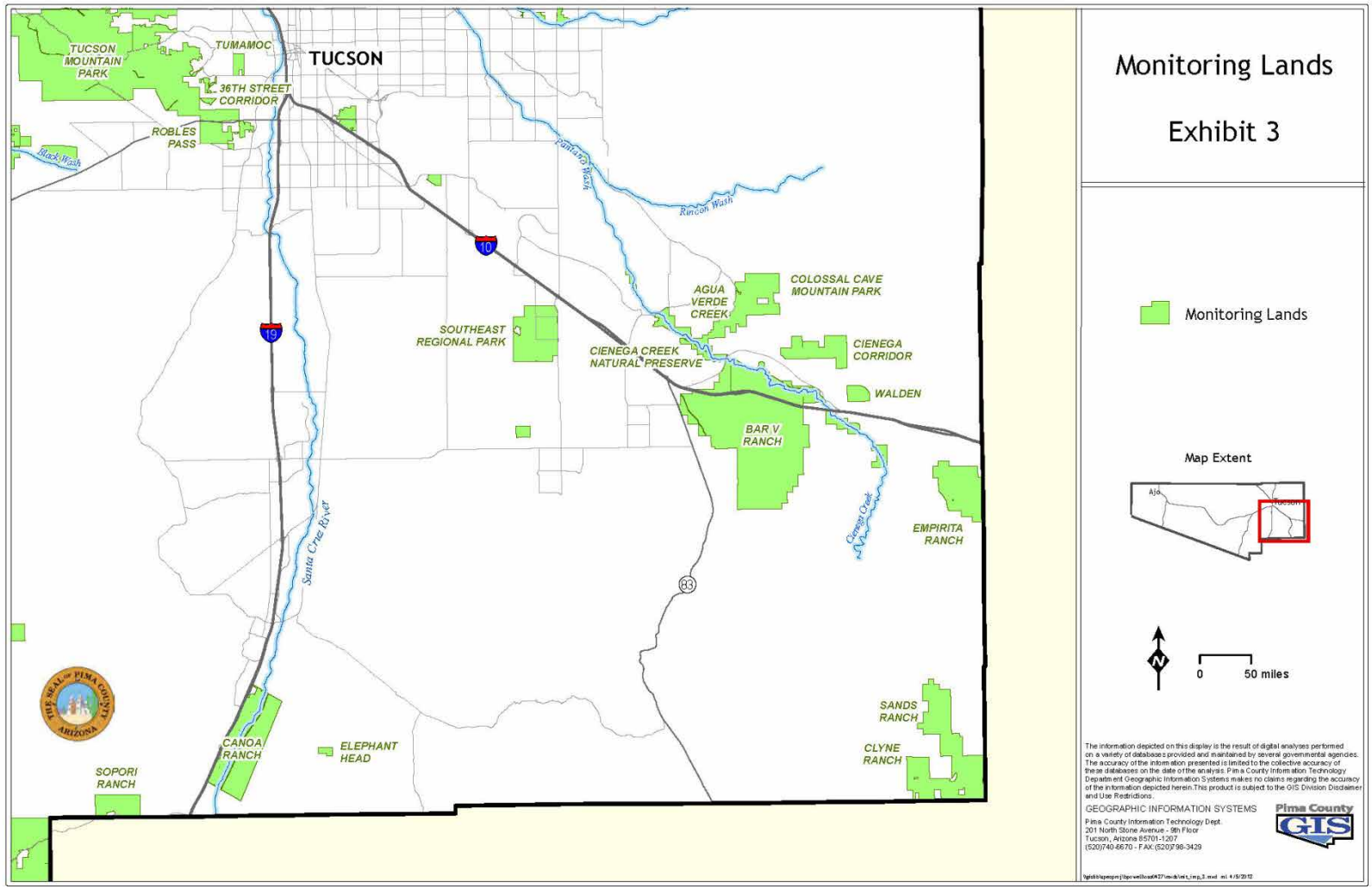

Figure A-36 cont.

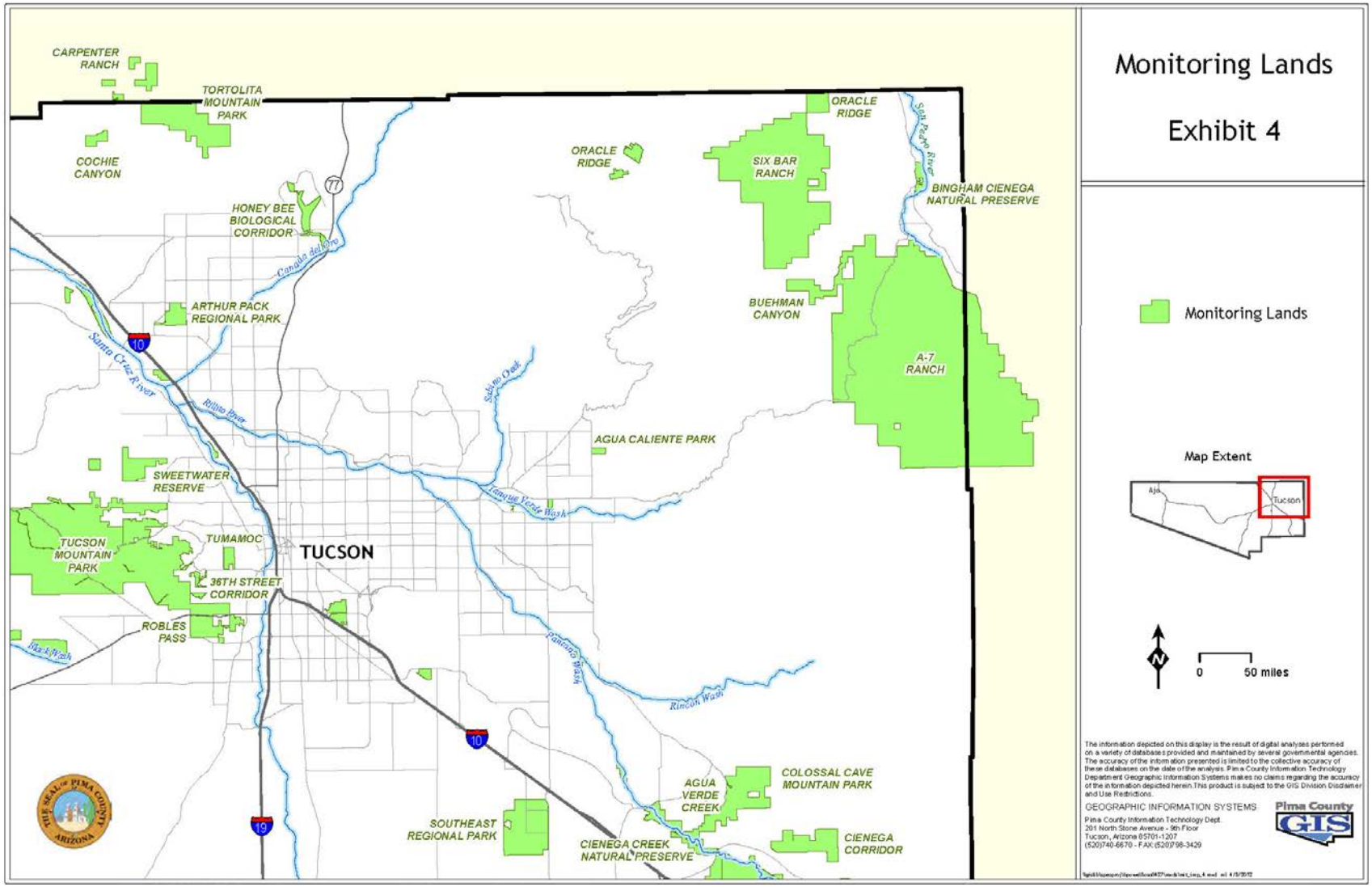

Figure A-36 cont.

utilize an already established field-data collection protocol as a starting point for developing a protocol that is both specific to Pima County and that takes into account other aspects of the data cycle—not just how to collect data in the field. Additionally, where possible the monitoring efforts of Pima County will be complementary to broader efforts involving similar goals (e.g., specific habitat or species monitoring) being carried out on a scale larger than simply Pima County, such as at the state level, in order to maximize the benefits to species or habitat conservation efforts. Development of protocols often involves initial field testing and subsequent revisions before a final protocol is accepted.

The time frames proposed here for the development and implementation of monitoring protocols will allow us to adequately consider and evaluate existing protocols, gather additional information, and field test protocol options. Pima County will be conducting these types of activities throughout the time periods indicated; this will allow us to develop protocols specific to the MSCP approach that will most effectively and efficiently provide us the necessary information and data to evaluate the objectives of the MSCP and to meet permit requirements.

Species Monitoring

Species-level monitoring is a key feature of the PCEMP and Pima County will commit to monitor population parameters for 15 species, which represent a mix of spatially-restricted and widespread species; and includes species that occur in a variety of locations (Table A.3; first column). This section provides information about the parameters to be monitored, the monitoring protocol to be used, and where and how often monitoring will take place. If a Covered Species is not listed here, it will be monitored through habitat, threats, and/or landscape monitoring. (A summary of how Pima County is addressing monitoring for each Covered Species is covered in Table A.3 of this appendix). If a species-specific monitoring effort is not being proposed for that species, it does not mean that Pima County will not be tracking information about it. Instead, the County will track incidental sightings (i.e., observations of a species made by staff and others while performing other work duties). In addition, the County will promote the use of County preserves for non-invasive research and monitoring studies by other entities, as well as soliciting and recording observations made by the general public. If an established field survey protocol will be used by Pima County, a web-based link to that protocol is provided in the literature cited section of this appendix.

Species-specific monitoring may take place at additional sites than those noted below or more frequently if Pima County and the USFWS agree that such an undertaking is warranted. For example, though Pima County has completed biological inventories of some preserve lands, more work is needed and therefore additional populations of a Covered Species may be discovered (e.g., additional talussnail population locations). The species-specific accounts, below, provide details on situations where new information can lead to additional monitoring commitments. The data-collection protocol to be used is noted, but Pima County may change protocols based on information collected during the initial years of monitoring and any changes to a protocol will be

discussed and agreed upon with the USFWS prior to implementation. Species monitoring does not preclude habitat monitoring, threats monitoring, landscape-pattern monitoring, and climate monitoring; and for most Covered Species, the combination of these monitoring approaches will help ensure that biologically important changes are detected and addressed.

For species surveys that involve the use of protocols that are regulated by the State or Federal government, Pima County staff and contractors will possess all necessary permits, training, and licenses.

Pima Pineapple cactus

Pima County currently monitors populations of the Pima pineapple cactus on two mitigation banks (Elephant Head and Madera Highlands) using a protocol that tracks the fate of individuals that were identified in a previous survey. This approach does not provide a measure of true population size (i.e., it does not account for new individuals to be included in the sample) and therefore it will not be used in the PCEMP. Instead, Pima County will commit to monitoring at least 10 sites on County preserves (including mitigation banks) where the species is known to occur. The goal will be to monitor abundance at select sites. Monitoring will take place every three years. Surveys will involve line or plot-based surveys based on the work by Roller (1996a; see Literature Cited for website link to protocol), but it may be appropriate to refine the sampling design and protocol to increase efficiency of surveys and survey a larger area. Refinement of the protocol may include population estimation (rather than enumeration) using occupancy models that account for imperfect detectability (Royle et al. 2005; MacKenzie et al. 2006). A recovery plan for the species is being drafted by Marc Baker, who has indicated that he is developing a long-term monitoring plan for the species (Marc Baker, *personal communication* to Brian Powell). Pima County will work with the USFWS to determine if that protocol is appropriate for our needs. A preliminary protocol for the County effort (including a detailed sampling design, survey method, and mapped locations of monitoring sites) will be developed in consultation with the USFWS and submitted within 18 months of permit issuance. Until or unless Pima County adopts a new protocol, the County's Pima pineapple cactus surveys will follow Roller (1996).

Huachuca Water Umbel

The Huachuca water umbel is not currently found on County preserves, but Pima County will commit to monitoring two sites (Bingham Cienega and the Cienega Creek Natural Preserve) every three years, and/or where Pima County does introduction efforts to establish the plant in suitable habitat. Bingham Cienega will be monitored for surface water (currently absent), which is vital to supporting the umbel. If surface water conditions are appropriate, then monitoring will commence at that site. The Cienega Creek Natural Preserve was periodically checked for umbel in 2013 and 2014; future monitoring will take place in suitable habitat within the Preserve.

Lesser long-nosed bat

The lesser long-nosed bat can forage >40 km from their day roost each night (Ober et al. 2005), thereby making it more effective to focus monitoring efforts at roost and maternity sites (caves, mines, and adits) where population estimation may be possible. Pima County will commit to monitoring lesser long-long nosed bat abundance (or an index of abundance) at all known lesser long-nosed bat roosts and/or maternity sites within County preserves, though to date there are no known roosts on County preserves. (Pima County is currently undertaking an inventory of caves, mines, and adits). If one or more sites are found, Pima County will commit to monitor the site(s) annually in coordination with the multi-agency lesser long-nosed bat monitoring effort headed by the Arizona Game and Fish Department. Until or unless a site is found on County preserves, Pima County will offer to participate in an annual count at one of the known roost and/or maternity sites outside of the County's preserve system and within eastern Pima County or adjacent Cochise County. Regardless of the location of the site to be monitored, Pima County will employ whatever counting method the Arizona Game and Fish Department and USFWS deem appropriate. Monitoring will begin within 12 months of permit issuance, as applicable. Finally, the Arizona Game and Fish Department has indicated that they will develop a multi-species bat monitoring plan and if that is ever developed, Pima County will work with the USFWS to determine if the plan's goals and methods are appropriate for application to Pima County's Section 10 monitoring and management needs and responsibilities. The continued spread of white-nosed syndrome should not directly impact this species, but may impact guidelines and protocols for accessing caves, mines, and adits to conduct bat assessments and monitoring. See note in the section below on contingency plans.

Mexican long-tongued bat, California leaf-nosed bat, and Pale Townsend's big-eared bat

As with the lesser long-nosed bat, monitoring for these species is best performed at roost and maternity sites. Therefore, Pima County will monitor species' occupancy and the availability and management of roost sites at a subset of known cave and adit roost sites within County preserves, as well as monitoring habitat improvement projects, which includes stabilization and gating. Pima County will also endeavor to map all known roost or maternity sites for these species. Following the conclusion of an ongoing cave, mine, and adit inventory, Pima County will have a more complete understanding of the distribution and use of these resources by bats and will supply this information to the USFWS when the inventory process is complete. Regardless of the outcome of that effort, Pima County will commit to monitoring a total of at least 10 sites (for all species) every three years for occupancy and site condition for all bats species, with the possibility of adding additional sites if a roost is deemed by Pima County and the USFWS to be of significant size to warrant such an effort. Restoration sites will be monitored each year for 3 years following the restoration effort, with monitoring changing to every three years thereafter. Pima County will enter sites to conduct visual counts using low or infrared lights, unless it is determined that monitoring with acoustic sampling devices is more effective (i.e., when bats are in crevasses that hide them). Because visits to the sites will be infrequent, it is not anticipated to result in long-term

stress to the animals, but where possible monitoring efforts will seek to minimize disturbance during key life history periods, such as when maternity sites are occupied by nursing young. Pima County will develop a cave, mine, and adit visitation protocol (including stipulating what kinds of equipment to be used) to minimize disturbance to bats at all caves, mines, and adits. This is particularly important because many of these species are sensitive to disturbance and this will need to be considered in developing and implementing the monitoring protocol. For example, in some situations it may be deemed inappropriate to disturb roosting bats. Pima County will work with the USFWS to determine what level of disturbance is appropriate and determine the tradeoffs between protecting the species and monitoring their populations. Also, the monitoring program may be altered because of the potential spread of white-nosed syndrome into the area if this fungal disease is documented in the region, or if new, and pertinent information becomes available. If this occurs, Pima County will coordinate with state and Federal wildlife officials to potentially restrict visitation of caves, mines, and adits to protect species that are susceptible to white-nosed syndrome (most likely the Pale Townsend's big eared bat because it hibernates) and other species, such as *Myotis velifer*, that may not be covered under this MSCP, but which might co-locate with Covered Species. If closure of the caves, mines, and adits occurs, it will likely impact monitoring activities and Pima County will work with the USFWS to develop an alternative protocol. A preliminary monitoring protocol will be provided to the USFWS within 24 months of permit issuance and monitoring will begin within 24 months of permit issuance.

Cactus Ferruginous Pygmy-Owl

The cactus ferruginous pygmy-owl has been a cornerstone of the County's conservation planning since the late 1990s, but since that time, the owl population has declined so significantly in the Permit Area that it may no longer occur there. Because of the low probability of encountering the species, Pima County will monitor sites with the highest likelihood of occurrence. A map of the species' most suitable habitat was obtained from the Arizona Game and Fish Department and USFWS (unpublished data); this map will be used to develop the sampling frame from which 10 sites will be chosen by Pima County to survey for occupancy at a minimum of 10 transects (with multiple sampling points in each transect) within the preserve system. Each transect will be surveyed using the large-area survey protocol (Arizona Game and Fish Department and U.S. Fish and Wildlife Service 2000). Pima County may modify this protocol based on data from Flesch and Steidl (2007), which indicates that the number of within-season surveys can be reduced if surveys take place at specific periods in the species' nesting cycle when detectability is greatest. Regardless of the number and/or timing of intra-annual surveys, Pima County will survey all transects every three years. Mapping habitat and identifying the sampling frame for monitoring within County preserves will take place within 18 months of permit issuance and revisions to the sampling protocol and full implementation of the monitoring protocol will begin within 24 months of permit issuance. Any revisions to the protocol will be approved by the USFWS prior to implementation. If, after three sampling seasons (i.e., nine years), no individuals have been observed, Pima County will meet with the USFWS and species experts to

determine if additional monitoring is appropriate for this species or if monitoring resources would best be directed elsewhere. Finally, Pima County will also offer AZGFD the opportunity to use County lands for future release and monitoring of captive-bred individuals if necessary, and as agreed upon.

Southwestern Willow Flycatcher

Pima County will monitor for the presence of the southwestern willow flycatcher at 3 sites (totaling 4 transects; each transect includes multiple survey points) within the following County preserves: Cienega Creek Preserve (2 transects), Bingham Cienega Preserve (1 transect), and at the A7 Ranch along the San Pedro River (1 transect). These sites encompass the entirety of the known or potential habitat for this species within the County's preserve system. Pima County will use the call-playback survey protocol of Sogge et al. (2010; see Literature Cited for website link to protocol), which prescribes 3 surveys per year per site during the breeding season. Surveys will take place every 3 years at all sites. Survey results will be reported to the USFWS and AZGFD within 3 months of completing surveys. The first monitoring season will take place within 12 months of permit issuance and the protocol and survey site maps will be provided to the USFWS within 24 months of permit issuance. Pima County will investigate credible sightings of this species on other preserve lands and if presence is confirmed, Pima County may decide to pursue monitoring at that site.

Yellow-billed Cuckoo

Pima County will monitor for abundance and/or occupancy at 2 sites (a total of 3 transects; each transect includes multiple survey points): Cienega Creek Preserve (2 transects) and Bingham Cienega Preserve (1 transect). Agua Verde Creek in Colossal Cave Mountain Park may also be monitored, as well as County-owned sites along the effluent-dominated section of Santa Cruz River north of Roger Road if sufficient evidence exists of yellow-billed cuckoo occupying those locations during the breeding season. Periodic surveys of the Santa Cruz River by entities such as the Tucson Audubon Society will inform us if cuckoos have occupied areas at those sites . All monitoring will employ a USFWS-approved protocol (e.g., by Laymon (1998) and Wiggins (2005; see Literature Cited section for link to on-line protocol). Pima County will conduct at least 3 surveys per year during the breeding season and surveys will be conducted every 3 years at all sites beginning in the second spring after permit issuance. Monitoring will begin within 18 months of permit issuance and the protocol and maps will be provided to the USFWS within 30 months of permit issuance.

Fishes: Gila chub, Gila topminnow, longfin dace, desert sucker, and Sonora sucker

Fish species that are covered under the County's Section 10 permit only occur at 2 sites within the preserve system: Cienega Creek Preserve and Buehman Canyon. Buehman Canyon currently contains only the longfin dace, but the Cienega Creek Preserve contains all 3 fish species that are covered under the Section 10 permit and that are confirmed to occur within the Permit Area: Gila chub, Gila topminnow, and longfin dace. Pima County will monitor for the presence of the longfin dace at Buehman Canyon at

least every 2 years using a passive survey method (using binoculars). The primary focus of fish monitoring will be at the Cienega Creek Preserve, and there the County will rely on the annual monitoring effort that is part of the Bureau of Reclamation's biological opinion related to the Central Arizona Project (Bureau of Reclamation 1998). The revised biological opinion and long-term monitoring program includes a 100-year, annual monitoring effort in areas throughout Arizona, including 2 sites within the Cienega Creek Preserve (Clarkson et al. 2011), where monitoring began in 2008 (Marsh et al. 2009). The long-term monitoring protocol used can be found in Clarkson et al. (2011; see Literature Cited section for a link to the document). Though the primary purpose of the CAP monitoring effort is to detect the presence of non-native fish, surveyors also record the number of native fish caught per species, catch-per-unit-effort, and presence of crayfish. They employ electrofishing and seining. Because this is a long-term effort and ties into a monitoring program that includes sites throughout central and southern Arizona, Pima County will rely on this effort for monitoring fish species at the Cienega Creek Preserve. If, for any reason, the program ceases monitoring activity at the Cienega Creek Preserve, Pima County will assume responsibility for the effort by monitoring annually through the end of the 30-year permit.

Following significant upgrades to the County's two wastewater facilities, the Santa Cruz River downstream of the facilities may show more favorable conditions for the reestablishment of Gila topminnow, longfin dace, desert sucker, and Sonora sucker. Pima County will work with the USFWS following upgrades in 2016 and subsequent water-quality testing to determine if fish monitoring is a reasonable and prudent activity at that location. If so, Pima County will commit to monitoring every 5 years using electrofishing and seining using the same methods as employed by Clarkson *et al.* (2011).

Lowland leopard frog

Recent surveys for lowland leopard frogs on County preserves found that the species occurs in 6 sites: Cienega Creek Natural Preserve, Youtcy Canyon Spring (A7 Ranch), Espiritu Canyon (tinajas; A7 Ranch), Buehman Canyon, and Edgar Canyon (Six Bar Ranch) (Brian Powell, *unpublished data*). Pima County will monitor occupancy of lowland leopard frogs at these sites every 3 years. Surveys will take place in the late spring and early summer (pre-monsoon). Occupancy will be for any stage of the species' life cycle (eggs, tadpoles, adults) and employ a visual encounter survey method (Heyer 1994), which is the same as for the Chiricahua leopard frog (see below). Surveys will include a rapid assessment of habitat conditions (mostly water availability) during each visit. Survey protocols will include a detailed procedure for cleaning equipment to prevent the spread of Chytrid fungus among frog populations. While conducting surveys for the lowland leopard frog, Pima County will also note the presence of other aquatic species such as the Sonoran mud turtle, canyon treefrog, as well as nonnative invasive species such as American bullfrogs and crayfish. Pima County will investigate any sightings of the lowland leopard frogs on other preserve lands and, if presence is confirmed, Pima County may decide to pursue monitoring at that site. Pima County may also periodically test frogs for the presence of Chytrid

fungus. Monitoring will begin within 24 months of permit issuance and protocols and maps will be provided to the USFWS within 30 months of permit issuance.

Chiricahua leopard frog

No known populations of this species currently exist on County preserves. However, Pima County will inventory any new County preserve for this species. In addition, Pima County has been planning to create habitat for this species on the Sands Ranch (Goat Well) and recently completed work at Hospital Tank on the Clyne Ranch specifically for the benefit of this species. According to David Hall (*personal communication* to Brian Powell), Chiricahua leopard frogs are known to have historically occurred in Hospital Tank. Whether these reintroductions take place under the State of Arizona's safe harbor agreement (Arizona Game and Fish Department and U.S. Fish and Wildlife Service 2006) or under this Section 10 permit is unknown at this time and will depend on the timing of implementation of the Section 10 permit. Regardless, Pima County will commit to monitoring all reintroduced populations for each of the first 3 years following the reintroduction effort, then every 3 years thereafter. Surveys will take place in the late spring and early summer (pre-monsoon). Occupancy will be established if there is an observation for any stage of the species' life cycle (eggs, tadpoles, adults). Surveys will employ a visual encounter survey method (Heyer 1994) (U.S. Fish and Wildlife Service 2006; see Literature Cited section for link to the document and included monitoring protocol), but would also likely involve capturing individuals to ensure proper species identification. Surveys will also include a rapid assessment of habitat conditions (mostly water availability) during each visit. Survey crews will strictly follow a detailed procedure for cleaning equipment to prevent the spread of Chytrid fungus among populations of frogs. While conducting surveys for the lowland or Chiricahua leopard frog, Pima County will also note the presence of other aquatic species such as the Sonoran mud turtle, canyon treefrog, as well as nonnative species such as American bullfrogs and crayfish. Pima County may periodically test frogs for the presence of Chytrid fungus. Monitoring will begin within 24 months of permit issuance and protocols and maps will be provided to the USFWS within 30 months of permit issuance.

Sonoran desert tortoise

The desert tortoise is the most widespread of all the Covered Species for which Pima County is proposing single-species monitoring. Pima County will monitor tortoise occupancy or population density, on plots within the preserve system that contain the species' modeled habitat. Pima County will commit to monitoring at approximately 10 sites, which will be surveyed every 2 or 3 years according to the field protocol suggested by Zylstra (2008), although modifications may be made based on field suitability and the status of the best available knowledge. This protocol suggests at least 4 visits to each site each survey year. Ideally, Pima County's monitoring for this species would contribute to a larger monitoring effort throughout the species' range. A long-term monitoring protocol may be developed by the Arizona Game and Fish Department (Cristina Jones, *personal communication* to Brian Powell). Once the AGZGD protocol is complete, Pima County will decide if it is appropriate for Pima

County to be involved. The County's commitment to monitoring the desert tortoise is not contingent on the state's development of a long-term monitoring plan for the tortoise. Monitoring by Pima County will begin within 24 months of permit issuance and protocols and maps will be provided to the USFWS within 30 months of permit issuance.

Habitat Monitoring

Introduction

Habitat is the sum of resources that a particular species needs to perform life-history functions such as foraging, nesting, mating, and seeking refuge (Morrison et al. 1998). Because of its important to all species, habitat monitoring will be a critical component of the PCEMP. As noted in the introductory section of this appendix, monitoring certain parameters in addition to—or instead of—the species themselves is often warranted for landscape-scale conservation programs. In the case of the County's considerable conservation commitment for the MSCP (including over 200,000 acres under ownership or management), habitat monitoring at landscape or ecosystem level is particularly warranted. A second—and related—justification for this approach is that changes to a species' habitat are most likely to affect populations of the species themselves and, in some cases may predict these changes in advance, thereby providing timely opportunities to address impacts to species or habitats, or enact management actions to improve habitat quality (e.g., Krueper et al. 2003). This is the reason why many successful species conservation projects focus on improving a species' habitat as well as reducing threats. The USFWS has acknowledged that the habitat-based approach to monitoring for HCPs is appropriate in their five-point policy, provided that there is a tie to the Covered Species (U.S. Fish and Wildlife Service 2000a). These ties are delinieated in Table A.3 of this appendix.

The design process for the habitat element of the PCEMP is given in detail by Steidl et al. (2010) and we refer to the reader to that document for details (a link to the document is provided in the Literature Cited section of this appendix). The following sections provide an overview of what, how, and where Pima County will be undertaking habitat monitoring.

An Overview of Long-term Monitoring Plots

Pima County will establish a network of long-term monitoring plots within County preserves. Within each plot, multiple parameters (i.e., measures or indicators) will be monitored over time, with most of the focus being on vegetation, groundcover, and soils. During the early planning stages of the PCEMP, it was determined that monitoring a host of parameters at the same location has inherent advantages over designs that monitor only one or a few resources at a site. Co-location of monitoring plots is common (e.g., National Biological Service 1995; Manley et al. 2006), particularly when the resources of interest have an important effect on—or are influenced by—each other. Sampling for multiple parameters at the same location has two primary advantages over strategies that establish sampling locations for parameters independently. First, co-

locating measurements will allow for assessments of interactions among parameters and provide data that can be used as covariates (i.e., explanatory variables) in analyses of trends. For example, changes in vegetation structure and composition can be explored to assess whether these changes are associated with changes in precipitation, altered land use patterns, or the presence of nonnative invasive species. Second, costs are reduced when sampling plots are co-located because several parameters can be measured at a site during a single visit.

Pima County will employ the vegetation and soils monitoring protocol developed by the National Park Service's Sonoran Desert Inventory and Monitoring Program (Hubbard et al. 2012; see Literature Cited for link to the document and standard operating procedures). The protocol is currently being used in national parks and USFWS refuges located within Pima County (Organ Pipe Cactus National Monument, Saguaro National Park, Buenos Aires National Wildlife Refuge, and Cabeza Prieta National Wildlife Refuge) as well as elsewhere in Arizona, New Mexico, and Texas.

This protocol supersedes the vegetation monitoring protocol that was outlined in the draft MSCP and reviewed by the USFWS and the public. Changing the protocol allows Pima County to retain many of the key elements in the previous protocol (e.g., vegetation structure and floristics) but also has a number of advantages over the previous protocol. Principal advantages of adopting the protocol by Hubbard et al. (2012) include: (1) the protocol and standard operating procedures are already established, which will save Pima County time and money; (2) collection of data at Pima County sites as well as at Federal reserves will allow for important comparisons to be made; and (3) the protocol provides the potential for Pima County to use the same field crews that survey Federal lands, which increases precision and lowers costs. A recent review by the USFWS (Ecological Services) endorsed this approach (email by Scott Richardson to Brian Powell, March 2015).

Establishing Long-term Monitoring Plot Locations

The primary goal of the PCEMP is to determine the status and trends in resources over time. However, in the case of parameters measured at long-term monitoring plots, it is not possible to survey all of these resources across the preserve lands due to financial and logistical limitations. To increase the efficiency of monitoring, Pima County will employ *sampling,* which is the process of selecting units from a larger population so as to draw inferences to the larger population. In particular, Pima County will establish monitoring plots using a *probability-based sampling* approach, which employs a component of randomization in selecting sampling units to ensure that inferences can be made to the entire preserve system (Thompson 2002). The method of selecting where and how often to sample is referred to as *sampling design*; these choices ultimately determine the power and precision of the monitoring program, its spatial and temporal inference, and overall cost (see Thompson and Seber 1996; Lohr 1999; Morrison et al. 2001; Thompson 2002).

Monitoring at long-term monitoring plots will take up a significant amount of the on-the-ground monitoring effort for the PCEMP. As such, it is crucial to develop a program that

maximizes the amount of information gained with the minimum amount of field work necessary. To accomplish this objective, Pima County will stratify all potential monitoring plots and then employ a random (e.g., GRTS) design to determine the location of plots within each stratum (Theobald et al. 2007). Stratification will be necessary because of the wide range of ecological communities within the preserve system and because stratification adds greater efficiencies in situations where there are considerable differences among sites (e.g., differences within strata are minimized; Scott 1998). Stratification will likely follow the method of Hubbard et al. (2012), which uses elevation and soil fragment size. Site visits, on-the-ground protocol testing, and input from experts will be required to further refine the approach used.

Parameters Monitored at Long-term Monitoring Plots

On-the-ground monitoring activities will be focused primarily on vegetation, groundcover, and soils. Vegetation is a key habitat feature for many Covered Species (see habitat narratives in Table A.3) and vegetation is an indicator of site characteristics, past disturbance events, and climatic patterns. Two aspects of vegetation are important: (1) *structure* is the physical formation, arrangement, and physiognomy of vegetation and will be measured as density or volume of vegetation; and (2) *composition* is the array of plant species present on a site and will be measured as stem density, abundance, or frequency. Pima County will only monitor perennial plants at long-term monitoring plots because growth of annual plants is often extremely variable from year-to-year and season-to-season, making establishing trends in annual plants very difficult. However, Pima County will note the presence of select annual plants, particularly invasive species, while surveying at long-term monitoring plots.

Soils play a central role in the cycling of nutrients, water, and energy in terrestrial ecosystems and are primary determinants of ecosystem productivity. Therefore, soils monitoring will also take place at long-term monitoring plots, with key parameters monitored being soil cover and stability.

Number and Revisit Pattern for Long-term Monitoring Plots

After permit issuance, Pima County will establish at least 100 long-term monitoring plots across the County preserve system. This is the minimum effort that Pima County will commit to, but the final number of plots will be determined after permit issuance and after pilot data is collected. To assist in this planning effort, Pima County will use statistical power analyses to assist in determining the number of plots needed to detect a biologically meaningful change by strata (Peterman 1990; Steidl et al. 1997) and power analysis will be performed using data from the pilot test of the protocol. Once the number of plots has been established, Pima County will determine the best revisit interval for plot monitoring. The most common temporal strategies involve surveying sites at fixed intervals such as at five year intervals. Other options for temporal sampling involve the use of panel designs (McDonald 2003). At this stage of planning, Pima County commits to monitoring each site on the same revisit schedule (i.e., every five years), but the County will periodically assess if there is a more efficient approach. These decisions will be made in consultation with experts and the USFWS.

Using Remote Sensing Tools to Monitor Habitat Change

Habitat monitoring, particularly for vegetation, does not need to be restricted to on-the-ground measurements at long-term monitoring plots. The PCEMP will determine if remote sensing technologies can be used to monitor changes in habitat parameters, most notably vegetation structure and composition. In particular, the use of light detection and ranging technology (LiDAR), combined with multispectral (or hyperspectral) imagery, is a powerful new tool set for monitoring vegetation structure change, as well as changes in stream channel morphology. (Stream channel morphology was not chosen for inclusion into the program, in part because of the expense of collecting on-the-ground monitoring data for this type of parameter, but it can be monitored easily and inexpensively using LiDAR). Swetnam and Powell (2010) conducted a pilot study of the effectiveness of LiDAR for characterizing vegetation along the Cienega Creek Natural Preserve and for its application to the MSCP. The pilot study found that vegetation monitoring using LiDAR is feasible, particularly in areas with significant amounts of vegetation, such as in riparian systems.

LiDAR is an optical remote sensing technology that uses a rapid pulse laser beam to measure the distances between the sensor and an object. The resulting data is a 3-D image of vegetation and 2-D image of the bare ground layer. LiDAR data are spatially extensive and intensive, mapping nearly every plant that has direct overhead exposure to the sensor. LiDAR data have many applications for ecological monitoring, but the most important application for the PCEMP is the ability to obtain detailed vegetation maps of individual plants to estimate their vertical and horizontal measurements (Andersen et al. 2006). LiDAR data can also be combined with 2-D orthophotographic imagery to generate accurate vegetation maps at landscape scales (Hudak et al. 2008). The result is a map that has characteristics of vegetation structure from the LiDAR data and vegetation greenness from the aerial imagery. In addition to vegetation maps, some human induced impacts that might be tracked in a bare earth surface layer include roads, ATV trails, hiking trails, grazing and agricultural impacts, and structures.

LiDAR is not without its problems, not the least of which is the high cost of data acquisition and specialized expertise to analyze it. Data requirements for vegetation applications, such as for Pima County, are far greater than for more standard applications of LiDAR (e.g., bare earth layer), meaning that for vegetation, it can be more than twice as expensive to acquire data for vegetation as compared to bare earth. Other challenges include questions about its utility for monitoring change in plant communities with less vertical plant structure such as desert uplands and semi-desert grassland communities (e.g., Streutker and Glenn 2006). Despite these challenges, Pima County will continue to explore options for employing this promising new tool, especially the deployment of LiDAR using drones.

Though LiDAR presents an exciting and potentially powerful tool for monitoring vegetation and stream-channel morphology change, Pima County will not commit to including LiDAR as part of the MSCP at this time, because of the County's commitment to monitoring soils and vegetation at long-term monitoring plots. Over time, Pima County may use LiDAR data to replace long-term monitoring plots if (and only if) Pima

County and the USFWS agree to such a change as part of the County's adaptive monitoring strategy.

Water Resources

Water is a driver of ecological patterns and processes, especially in arid environments. In riparian areas, in particular, water availability has a profound effect on biodiversity (Stromberg et al. 1996; Eby et al. 2003). In the southwestern U.S., more than 70 percent of vertebrate species use riparian areas during some stage of their life cycles (Knopf et al. 1988), and in Pima County many Covered Species occur in riparian areas, especially hydo-riparian and meso-riparian communities (Rosen 2000). In addition to supporting high biodiversity, naturally functioning riparian areas improve water quality and provide important floodplain functions (Leopold et al. 1964; Stromberg et al. 1996; Naiman and Decamps 1997). Water monitoring is therefore an essential component of the PCEMP, especially given the increasing demand for water by humans and the likelihood of reduced natural water resources as a result of climate change (Powell 2010a). Three primary water resources will be monitored as part of the PCEMP: (1) seeps and springs, (2) shallow groundwater in select systems, and (3) perennial streams. The following sections provide details of the County's justification for—and commitment to— monitoring these resources. A narrative on the connection between Covered Species and the water resources can be found in Table A.3.

Springs

Springs are places where water, traveling through soil or rock, naturally rises to the surface. The discharge (flow) at springs is controlled by the rate of replenishment of the aquifer or water table and as a result, spring flow can decline as a result of drought, groundwater pumping, or natural disruption. Though small in area, springs are well-known hotspots of biodiversity (Sada et al. 2005) and are important for a number of the Covered Species including fish, the lowland leopard frog, and bats (Fonseca et al. 2000).

Pima County is compiling an inventory of springs on County preserves and has begun annual monitoring of select springs. In January 2012, the Sky Island Alliance began developing an interagency springs monitoring and stewardship program based on the highly successful program by the Springs Stewardship Institute (http://www.springstewardship.org/). Pima County will continue to be a partner in the Sky Island Alliance effort and will likely adopt the protocol and use of the database that is established. Participating in a large landscape monitoring effort has many advantages, perhaps most importantly by being able to compare trends on County preserves to those of the larger landscape. At a minimum, Pima County will commit to monitor at least eight springs that are identified in the County's ongoing springs inventory, which likely represents >60% of the known springs on County preserves (Brian Powell, *unpublished data*). Monitoring of those springs will take place at least once every 2 years. Pima County will present a springs monitoring protocol (including site maps and the types of data collected at each visit), to the USFWS within 3 years of permit issuance.

Perennial Stream Flow and Extent

Like springs, perennial streams are restricted to relatively few areas within Pima County but contribute disproportionately to the species richness of an area (Naiman and Decamps 1997). Stream flow length has been identified in a number of local assessments as a top-ranking monitoring parameter (Mau-Crimmins et al. 2005; RECON Environmental Inc. 2007) because flow length can be impacted by a host of threats such as drought (Christensen et al. 2004) and adjacent land-use. Stream flow and associated vegetation can also respond positively to threats reduction, such as removal of nonnative vegetation or proper livestock grazing management (Krueper et al. 2003; Katz et al. 2009).

Pima County will commit to monitoring perennial stream flow and/or extent at all of the sites that Pima County has determined that this valuable resource exists on preserve lands: Cienega Creek Preserve, Buehman Canyon, Davidson Canyon, Youtcy Canyon, and Espiritu Canyon. Monitoring streamflow extent will involve mapping the "wetted" areas along the entire stretch of these riparian systems. This "wet/dry" mapping has been taking place since 2001 at the Cienega Creek Natural Preserve (e.g., Pima Association of Governments 2009). Flow volume monitoring involves the use of a pygmy meter at the same sites over time. Flow monitoring has been conducted for years along Cienega Creek Preserve by the Pima Association of Governments and along Buehman Canyon by The Nature Conservancy (until 2014). Pima County will commit to monitoring these parameters at least once per year and most likely during the hottest and driest part of the year (i.e., June) at these same sites. Pima County will present a monitoring protocol to the USFWS within three years of permit issuance and data will be collected at the above-mentioned sites within four years of permit issuance.

Depth to Water in Select Groundwater-dependent Systems

Areas with shallow groundwater that support stream flow and/or riparian ecosystems are critical landscape features. Here, water is available for riparian and aquatic resources, including for many of the Covered Species and their habitat. Depth to groundwater is a key monitoring parameter because relatively small differences in shallow groundwater elevations can be of great significance ecologically, particularly in the first several feet below the land surface (Lite and Stromberg 2005; Stromberg et al. 2006). Depth to groundwater is a very sensitive and important indicator of ecosystem health and habitat for Covered Species because of its important connection to vegetation and surface water availability and because it is less variable than surface-water measurements. Fonseca (2008a) provides an in-depth analysis and discussion of this topic and we refer the reader there for more information, including recommendations for the PCEMP.

Because of its importance to habitat of Covered Species (see Table A.3), Pima County will commit to monitoring depth to shallow groundwater at sites along Cienega Creek and Bingham Cienega. Other sites may be included in the PCEMP and evaluation of these sites will be made within two years of permit issuance. Many other groundwater monitoring wells are monitored throughout eastern Pima County by other entities and

the PCEMP will both contribute data to those efforts and receive periodic updates from these other entities. Putting Pima County sites within a regional context will have the same advantages as noted for the springs monitoring protocol.

Caves, Mines, and Adits

Some caves, mines, and adits (herein caves) are key habitat components for a number of Covered Species, most importantly bats, and therefore will be a top priority for monitoring. As noted in the species-specific monitoring effort for cave-dwelling bats, caves on County preserves that provide bat habitat will be visited at least once every 3 years, and all possible efforts will be taken to minimize disturbance to bat populations in the course of monitoring activities Initial site visits to lesser-known caves (i.e., all caves except at Colossal Cave Mountain Park) will entail a detailed survey of conditions including size and dimensions of the feature, evidence of vandalism, and any structural issues that may cause deterioration of the cave or preclude subsequent visits, as well as a determination regarding the potential for installing bat-friendly gating. Pima County is conducting an inventory of caves and mines within the County Preserve System and recording key information about each site. Site monitoring will document changed conditions since the last visit, such as evidence of collapse and vandalism.

As mentioned in the section on Mexican long-tongued, California leaf-nosed, and Pale Townsend's big-eared bats, Pima County will develop a cave, mine and adit visitation protocol that will be sensitive to the potential for Pima County staff to spread white-nosed syndrome. Pima County will also work with State and Federal partners to develop a region-wide response if the disease is discovered in southern Arizona and/or. Pima County will abide by the directives from the State and Federal wildlife agencies regarding cave closure or visitation protocols, if such a directive is developed.

Talus Deposits

Talus deposits are habitat for the talussnail species and subspecies that Pima County is proposing to cover under the MSCP. Therefore, protection of these sites on County preserves is a top priority for Pima County and the management objective is to avoid direct or indirect impacts to the deposits or the natural processes affecting these deposits. There has been no systematic inventory of talus deposits on County preserves. Within five years of permit issuance, Pima County will complete an inventory of talus deposits on County preserves. Inventories will include incidental observations of shell casings that would indicate recent talussnail occupancy, as well as habitat quality. Monitoring will be directed towards documenting evidence of vandalism and encroachment by non-native species, especially buffelgrass, which could impact habitat quality for the snails. Monitoring will take place at minimum every 5 years on at least 20 of the largest talus deposits in the preserve system.

Landscape-pattern Monitoring

Landscape pattern is a broad category describing the spatial configuration and extent of land-cover and land-use parameters. *Land cover* is the observed biophysical state of

the earth's surface and immediate subsurface and is typically delineated into major categories such as types of natural vegetation (e.g., forest and grassland) and human uses such as urban development, agricultural fields, mine sites, and roads (McConnell and Moran 2000). *Land use* involves both the manner that land is manipulated and the intent of that manipulation (Turner et al. 1995). The difference between land cover and land use can best be explained by example. Classification of an area by land cover may assign it as semi-desert grassland, but the land use there may vary from protected area to active ranchland with very different and important conservation implications such as the potential for future subdivision of the ranchland. This example illustrates why land use is considered an excellent leading indicator of environmental condition and a major determinant of land cover (Meyer and Turner 1994). Further, the type, distribution, and extent of major land uses can foreshadow changes to the distribution and abundance of plant and animal species (Blair 1999) or other parameters such as water quality (e.g., Soranno et al. 1996) that have important implications for maintenance of biodiversity and ecological health in Pima County.

Throughout the development of the SDCP and PCEMP, the STAT has recommended monitoring landscape-level parameters. Fortunately, there are a host of tools that Pima County can use for this element, as suggested by Fonseca (2008b). To monitor landscape pattern, Pima County will use tools that are produced as part of the County's day-to-day operations to measure and forecast development-related activities, as well as remote-sensing tools including, but not limited to, products such as the National Land Cover Dataset and Regional GAP (Table A.1).

Retrospective Monitoring of Landscape Patterns

The objective of retrospective monitoring is to document changes in the type and location of conversion activities such as new roads and sewers, and land cover that took place in a previous time period (often every year, but sometimes longer depending on the interval over which the data source is collected). Retrospective monitoring will be completed using two primary methods: using the County's internal data and using freely available information from other sources. Information gained from this analysis will be useful in understanding regional trends affecting species and inform other regional conservation and monitoring efforts.

During the 30 years of the monitoring program, new tools will be available to obtain a more accurate footprint of roads and development activities and Pima County will work with the USFWS to determine the suitability of applying these new products to the PCEMP. Using freely available datasets, Pima County will monitor changes in land cover over longer time periods as the tools become available (usually every 3-5 years). For this, Pima County will likely use the National Land Cover Dataset (NLCD) and the Southwestern ReGAP. The NLCD was used to map Arizona in 1992, 2001, and 2006, with changes in land cover summarized over that time period. Pima County and its partners can use the NLCD to understand conversion of natural cover to urban, agricultural and mining land uses, and to understand regional changes in the distribution and extent of bare soil, rock, and riparian forests (primarily mesquite bosques, broadleaf deciduous forests, and wetlands combined). Data is acquired at a resolution of 30

meters and at a time interval of at least every 10 years. Change can be resolved at a minimum of 1 acre. For more information on this approach, see Fonseca (2008).

Prospective Monitoring

Prospective monitoring will *forecast* the location of development by showing the spatial footprint of processes such as rezonings, plat and subdivision approvals by the Pima County Board of Supervisors, and planned capital improvement projects. Pima County will summarize these data as they become available, most likely on 3-5 year intervals. See Table A.1 for more information.

Threats Monitoring

Threats are any past, present, or future anthropogenic activity that may impact a Covered Species or which degrades or destroys its habitat. Many threats result from past human actions, which are not repeatedly carried out, but have had serious and ongoing negative impacts, such as the introduction of an invasive species. Threats are widely recognized as being an important component of broad-scale monitoring programs (Salafsky and Margoluis 1999).

There are many threats that can be monitored (for a complete list of those considered, see Steidl et al. [2010)]) but Pima County has narrowed the list to a select set that are likely to have the greatest impact on the Covered Species and their habitat. The suite of chosen parameters is listed in Table A.2, which provides a summary of threats and how they will be monitored as part of the PCEMP. Threats were chosen for a variety of reasons, including their importance in the SDCP planning process, direction from technical advisors (the STAT, and during the Phase I scoping sessions; RECON Environmental Inc. 2007), and because of ongoing efforts to collect the information. For some threats that are not included as part of the PCEMP (e.g., water quality, hunting pressure), there may be other entities collecting this information. Similarly, some threats are not currently being considered for inclusion into the program, but may be monitored in the future by employing collaborations that are not currently in place. It is possible that threats that have not been considered to be an issue may become important during the life of the MSCP, and in this case they will be responded to appropriately and included in monitoring efforts.

Table A.1. Retrospective and prospective approaches that will be employed to monitor changes in landscape pattern as part of the PCEMP. Changes in these monitoring parameters will be reported each year or as new information is received.

Approach	Parameter	Data sources used in analysis
Retrospective	Miles of new roads in Pima County	Annual additions to highways, roads, streets will be based on Pima County GIS information.
	Extent and location of the built environment	A number of measures will be used to monitor this parameter. 1) Grading and/or building permits issued would be considered to be developed, 2) for improvements to a parcel outside of the sewer service area, changes in the tax assessor's records from "unoccupied" to "occupied" would be noted as developed, and 3) approved applications to Development Services for "Notice of Intent to Discharge" and "Discharge Authorization through Pima County's Department of Environmental Quality. Reporting will be annually.
	Changes in land cover type and location	Pima County will use data from a variety of free sources as they become available. The National Land Cover Dataset and Southwestern ReGAP are two products that are likely to be used. Summaries will occur as data become available.
Prospective	Extent and location of potential future development	Pima County collects the following information and stores it in a GIS that can be summarized as data become available, most likely every 5 years. (1) Rezoning. Some development activity in eastern Pima County happens after the approval of rezoning applications. Pima County will track the location and type of rezoning within unincorporated Pima County and report separately changes in land use codes, such as from ranchlands to agriculture or mining. (2) Subdivision Plat Approvals. After rezoning approval by the Pima County Board of Supervisors, subdivision or plat plans are submitted to Development Services for approval. Approvals in the planning period will be mapped. (3) Planned CIP Projects. Any proposed and approved (but not started) county or incorporated jurisdiction CIP project such as roads, sewers, and bank stabilization.

Table A.2. Threats that will be monitored as part of the PCEMP.

Threat	Justification, Parameters and Approach
Development and fragmentation	Justification: Development-related activities are the leading cause of habitat destruction and fragmentation in Pima County and are the reason for the County's acquisition of a Section 10 permit. Parameters: Location and area of development (buildings, roads, sewer, bank stabilization, etc.) resulting from the private and public sectors.
Motorized off-road vehicle impacts	Justification: Off-road vehicles (from road recreation, drug smuggling, and law enforcement) are an increasing threat to a variety of resources including Covered Species, soils, and vegetation. Parameters: Location, extent, and condition of new, illegal roads. Monitoring Approach: Yet to be determined, but is likely to be anecdotal and qualitative within County preserves.
Invasive aquatic vertebrates and crayfish	Justification: Bullfrogs, invasive fish, and crayfish can significantly impact aquatic Covered Species. In areas where they are not currently present, early detection will be critical. Parameters: Presence and relative abundance. Monitoring Approach: Monitored concurrently with fish, leopard frogs, and presence of water along key perennial riparian areas within County preserves. Surveys will be conducted using visual encounter surveys and will be conducted during surveys for Covered Species.
Invasive plants	Justification: Invasive plants can out-compete native plants and alter ecosystem structure and function and therefore threaten habitat of Covered Species. Of particular concern are buffelgrass, fountaingrass, Lehmann's lovegrass, and giant reed, and African sumac. Parameters: Variable depending on the species, but the number of new individuals in an area (i.e., early detection) is critical. Monitoring Approach: Pima County will develop a database for recording observations for 15-20 of the most important invasive species that all appropriate County staff and cooperators should be able to identify. These invasive species will be surveyed for in and around all long-term monitoring plots at the same time as vegetation monitoring. Buffelgrass mapping and monitoring efforts are ongoing and are being coordinated by the Southern Arizona Buffelgrass Coordination Center; Pima County will assist with this effort. Lehmann's lovegrass will be monitored at most long-term monitoring plots that occur in semi-desert grassland communities.

Climate Monitoring

Climate is the average weather over a long time period and is fundamental to ecosystem patterns and processes and, as such, is the broadest-scale category for inclusion into the PCEMP. Especially in arid regions, the amount and timing of precipitation and temperature, in particular, has an overwhelming influence on distribution and abundance of plants and animals in both space and time, and is an important determinant of regional biodiversity (e.g., Brown et al. 1997; Preston et al. 2008).

Many parameters are used in monitoring climate, most importantly temperature, humidity, wind speed, and precipitation. The PCEMP will focus only on monitoring precipitation because this parameter is more spatially variable and has such an important control over the distribution of Covered Species. Fortunately, many of the other important climate parameters are being collected by other entities within the County (Flood Control District) and Pima County will periodically obtain data on temperature, humidity, and wind speed from these entities, including: Arizona Automated Local Evaluation in Real Time Network, Arizona Meteorological Network, National Weather Service Cooperative Observer Program, Colorado River Basin Forecast Center, Rainlog.org volunteer network, and Remote Automated Weather Station Network. In addition, Pima County will benefit from broader-scale syntheses of climate that are being conducted by researchers and Pima County will continue to keep abreast of the most current findings.

Pima County will investigate collecting precipitation data at a subset of long-term vegetation monitoring plots and/or at other sites to be established in select areas throughout the County preserves using manual rain gauges or multi-function weather stations with data loggers, where appropriate. Personnel will check manual rain gauges and/or download data from automatic data loggers as often as twice per year (September and May). The protocol for this monitoring element will be finished within 2 years of permit issuance. If it is deemed appropriate, an alternative protocol will be presented to the USFWS for review before adoption.

How Pima County is Addressing Monitoring Needs for Each Covered Species

This appendix has provided a summary of the variety of monitoring methods that Pima County will employ to satisfy the effectiveness monitoring requirements of the MSCP. A key requirement of the MSCP effectiveness monitoring element is to demonstrate that the monitoring being proposed addresses key needs of each Covered Species. Table A.3 summarizes the monitoring commitments that Pima County will undertake and how each relates to individual Covered Species.

Table A.3. Summary of monitoring justification and approach for Covered Species. See the respective sections in this appendix for additional information. Note that the number of acres of a species' modeled habitat or Priority Conservation Area that is lost due to Covered Activities will be reported elsewhere as part of the County's compliance monitoring effort.

Common Name	Single-Species Monitoring	Habitat Monitoring Summary	Threats Monitoring Summary	Other Notes
Pima pineapple cactus	Monitoring for occupancy and/or abundance at a minimum of 10 sites in the County preserve system	The Pima pineapple cactus is found on relatively flat areas in desert scrub and semi-desert grasslands. Pima County will monitor vegetation on County preserves within the species' PCA for trends in shrub encroachment and shifts in species composition for perennial plant species	Number and location of building permits issued within the species' PCA in unincorporated Pima County will be reported annually. Land-use change within the PCA will be reported as data become available.	
Needle-spined pineapple cactus		The needle-spined pineapple cactus is found on alluvial fans on southern and western exposures and requires undisturbed lands for reproduction and growth. Pima County will monitor vegetation within the PCA at long-term monitoring plots for trends in shrub encroachment and shifts in perennial species composition and structure in the County preserve system, especially at Bar V Ranch and the Cienega Creek Preserve.	Number and location of building permits issued within the species' PCA in unincorporated Pima County will be reported annually. Land-use change within the PCA will be reported as data become available.	
Huachuca water umbel	Monitor occupancy in 2 sites every 3 years.	This species requires permanent water, which will be monitored along Cienega Creek and Bingham Cienega, the 2 sites where this species has been found in the past. In addition, shallow groundwater levels will also be monitored.	Land-use change within the Cienega watershed will be reported as data become available.	
Tumamoc globeberry		Dominant nurse plants for this species (e.g., *Larrea* and *Ambrosia*) will be monitored at long-term monitoring plots with the County preserves, especially at Tucson Mountain Park, the northern Altar Valley, and San Pedro River valley.	Number and location of building permits issued within the species' modeled habitat in unincorporated Pima County will be reported annually. Land-use change within the PCA will be reported as data become available. Buffelgrass is likely a threat to this species and Pima County will continue to provide information on the spatial distribution and relative abundance of this species within the County preserves.	
Lesser long-nosed bat	Pima County will commit to monitoring at least one roost site on or off of Pima County preserves. (Currently, there are	This species relies on Palmer's agave and saguaro cacti resources and they will be monitored at long-term monitoring plots throughout the County's preserve system, including in the bat's known habitat, which is widespread throughout the species' known range in Pima County. Though those particular plant	Cave, mine, and roost characteristics on County preserves will be monitored for evidence of vandalism and collapse. Number and location of building permits issued within the species' PCA in unincorporated Pima County will be reported annually. Land-use change within the	

Common Name	Single-Species Monitoring	Habitat Monitoring Summary	Threats Monitoring Summary	Other Notes
	no known roosts of the species on Pima County preserves, but if additional sites are discovered, Pima County will endeavor to monitor those as well).	species are not targeted as separate monitoring components, Pima County anticipates that enough plots will be established to determine trends in these important plant species. Pima County will also monitor the condition of potential roost sites throughout the County's preserve system. Condition parameters will begin with initial characterization of cave conditions (e.g., size and dimensions, geological features, and evidence of recent human use), to be followed by assessments of condition, especially evidence of collapse and vandalism.	PCA will be reported as data become available.	
Mexican long-tongued bat	Pima County will commit to monitoring occupancy of this (and select additional bat species, below) at 10 caves, mines, and adits that will be determined after an inventory of these resources is complete.	This pollen-loving bat cues into floristic, rather than structural features of vegetation, and is therefore closely tied to agave and cacti (particularly saguaro), resources. These resources will be monitored at a host of long-term monitoring plots throughout the County's preserve system, including within the bat's known habitat in the Altar valley, the Cienega watershed, and the San Pedro watershed. Though those particular plant species are not be targeted in separate monitoring components, we anticipate that enough plots will be established to determine trends in these important plant species. In addition to its key food resources, Pima County will monitor the condition of potential roost sites throughout the County's preserve system. Condition parameters will begin with initial characterization of cave conditions (e.g., size and dimensions, geological features, and evidence of recent human use), to be followed by assessments of condition, especially evidence of collapse and vandalism.	Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Pima County will also periodically monitor vandalism or disturbance activities at roost sites.	
Western red bat		Habitat features that are important for this species are 1) many types of water resources for foraging, and 2) structure and composition of vegetation (especially overstory and midstory) for daytime roosts in vegetation, particularly along stream courses. These components will be monitoring using remote sensing tools such as orthophotography and/or LiDAR.	Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Pima County will also monitor groundwater levels in select sites in eastern Pima County (e.g., Cienega Creek	

Common Name	Single-Species Monitoring	Habitat Monitoring Summary	Threats Monitoring Summary	Other Notes
			Preserve and Bingham Cienega) according to the protocol recommendations of Fonseca (2008a); groundwater levels that are too low will threaten the broadleaf riparian vegetation that is so important to this species.	
Western yellow bat		Habitat features that are important for this species are 1) many types of water resources for foraging, and 2) structure and composition of vegetation (especially overstory) for daytime roosts in vegetation, particularly palm trees and cottonwood trees along stream courses. These components will be monitoring using remote sensing tools such as orthophotography and/or LiDAR.	Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Pima County will also monitor groundwater levels in select sites in eastern Pima County (e.g., Cienega Creek Preserve and Bingham Cienega) according to the protocol recommendations of Fonseca (2008a); groundwater levels that are too low will threaten the broadleaf riparian vegetation that is so important to this species.	
California leaf-nosed bat	Pima County will commit to monitoring occupancy of this (and select additional bat species) at 10 caves, mines, and adits that will be determined after an inventory of these resources is complete.	This wide-ranging bat is not known to be tied to any specific terrestrial resource that might reasonably be monitored except caves, mines, and adits used for roosting, which will be monitored every 3 years for changes in condition.	Condition parameters will begin with initial characterization of cave conditions (e.g., size and dimensions, geological features, and evidence of recent human use), to be followed by periodic assessments of condition, especially evidence of collapse and vandalism. Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available.	
Pale Townsend's big-eared bat	Pima County will commit to monitoring occupancy of this (and select additional bat species) at 10 caves, mines, and adits that will be determined after an inventory of these	Known habitat features that are important for this species are 1) caves, mines, and adits for roosting, 2) water resources for foraging, 3) trees and buildings for temporary night roosts. Habitat monitoring for this species will take place at caves, mines and adits within the preserve system, with visits taking place every 3 years. Water resources, such as presence of water in select locations (e.g., Cienega Creek Preserve), will be monitored at least once per year. Though there is no link to specific vegetation features,	Caves, mines, and adits will be visited every 3 years to document changes to conditions, especially vandalism or modification. Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. If white-nosed syndrome is found in Arizona, the Pale Townsend's big-eared bat may be particularly susceptible	

Common Name	Single-Species Monitoring	Habitat Monitoring Summary	Threats Monitoring Summary	Other Notes
	resources is complete.	vegetation monitoring will take place at long-term monitoring plots throughout the species' PCA, such as in the Altar and Cienega valleys. As more information is known about the habitat requirements of this species, Pima County will link this information back to the data that will be collected at these plots.	because the species hibernates. Pima County will work with state and Federal officials to initiate a more rigorous, state-wide monitoring program and adhere to cave-visiting protocols so as not to allow for transmittal of the disease.	
Merriam's mouse		Habitat features that are important for this species are: 1) course woody debris, 2) vegetation structure and composition. This species is associated with bottomland mesquite forests, which will be monitored by way of remote sensing tools such as orthophotography and/or LiDAR.	Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available.	
Western burrowing owl		Habitat features that are important for this species are: 1) alluvial soils with existing burrows, usually located along river banks or in abandoned agricultural fields or other areas cleared of vegetation and 2) general lack of vegetation so that predators can be easily seen. Pima County will monitor these resources at long-term monitoring plots within the species' PCA that are located within the County's preserve system.	Buffelgrass is likely a threat to this species and Pima County will continue to collect information on the spatial distribution and relative abundance of this species within the County's preserve system and provide this information to the Buffelgrass Coordination Center, which is standardizing the protocol for buffelgrass mapping and abundance estimates. Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available.	
Cactus ferruginous pygmy-owl	Monitoring for occupancy at a minimum of 10 sites within the County preserve system. If after 9 years (3 monitoring cycles) no owls have been detected, then efforts will be re-evaluated in conjunction with USFWS input.	Habitat features that are important for this species are: 1) cavities for nesting, 2) vegetation in all height categories including ash, mesquite, and ironwood. Pima County will monitor these vegetation resources at long-term monitoring plots within the species' PCA that are located within the County's preserve system, especially in the Altar Valley. Pima County is also investigating the use of LiDAR to monitor vegetation structure, which is very important for this species.	Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available.	
Rufous-winged		Habitat features that are important for this	Pima County will annually report the number	

Common Name	Single-Species Monitoring	Habitat Monitoring Summary	Threats Monitoring Summary	Other Notes
sparrow		species are primarily vegetation in the overstory, midstory, and understory. Plant species associated with nesting and foraging habitat include mesquite and palo verde trees, hackberry, greythorn, and the species seems to be associated with the presence of some understory grasses. Pima County will monitor these vegetation resources at long-term monitoring plots within the species' PCA located within the County's preserve system, especially in the Altar Valley. Changes in understory composition, especially an increase in buffelgrass, may impact this species.	and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Pima County will continue to collect information on the spatial distribution of buffelgrass within the County's preserve system.	
Swainson's hawk		Habitat features that are important for this species are primarily vegetation in understory (perennial grasses and general lack of shrubs) and lack of vegetation in the overstory and midstory, except for the importance of nesting trees along washes bordering semi-desert grasslands. Pima County will monitor these key vegetation resources at long-term monitoring plots, many of which will be the species' PCA and within the County's preserve system, such as in the Altar and Cienega valleys. Particular attention will be paid to the increase in shrubs in semi-desert grassland areas within the preserve system. Data from long-term monitoring plots will help inform management efforts to restore grasslands.	Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available.	
Yellow-billed cuckoo	Pima County will monitor abundance and occupancy at 3 transects (2 sites) within the County preserve system. Monitoring will take place every 3 years.	Habitat features that are important for this species are primarily mesic and hydro-riparian trees (willows and cottonwoods) and large mesquite trees adjacent to these areas. Because of the importance of these resources for this and many other species, Pima County will place particular emphasis on monitoring these key vegetation resources by way of remote sensing tools such as orthophotography and/or LiDAR., particularly along Cienega Creek, Bingham Cienega, and the A7 ranch.	Pima County will monitor groundwater levels at the Cienega Creek Preserve and Bingham Cienega; groundwater levels that are too low will threaten the broadleaf riparian vegetation that is so important to this species. Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available.	
Southwestern willow flycatcher	Pima County will monitor abundance	Habitat features that are important for this species are primarily mesic and hydro-riparian	Pima County will annually report the number and location of building permits issued within	

Common Name	Single-Species Monitoring	Habitat Monitoring Summary	Threats Monitoring Summary	Other Notes
	and occupancy at 4 transects (3 sites) within the County preserve system. Monitoring will take place every 3 years.	shrubs and trees. Because of the importance of these resources for this and many other species, Pima County will be monitored by way of remote sensing tools such as orthophotography and/or LiDAR. within the County's preserve system such as along the San Pedro River.	the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Pima County will also monitor groundwater levels in select sites in eastern Pima County (e.g., Cienega Creek Preserve and Bingham Cienega) using the protocol recommendations of Fonseca (2008a); groundwater levels that are too low will threaten the riparian vegetation that is so important to this species.	
Abert's towhee		Habitat features that are important for this species are primarily mesic-riparian and xeric-riparian small trees and shrubs and vegetation structure in the understory and midstory. These features will be monitored by way of remote sensing tools such as orthophotography and/or LiDAR within the species' PCA in the County's preserve system such as at Canoa Ranch, Cienega Creek Preserve, and the A7 ranch. Reductions in dense vegetation volume in the understory and midstory will be of concern for this species.	Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available.	
Arizona Bell's		Pima County will monitor Arizona Bell's vireo nesting habitat, which is characterized by dense stands of xero-riparian and meso-riparian vegetation, particularly in the understory and midstory. Vegetation species of importance include hackberry, mesquite, and *Baccharis*. These species will be monitored by way of remote sensing tools such as orthophotography and/or LiDAR	Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available.	
Longfin dace	Pima County will monitor the species' occupancy in Buehman Canyon every 2 years. Pima County will rely on a monitoring effort in Cienega Creek that is part of a non-native	Presence of water will continue to be monitored at the Cienega Creek Preserve. Water quality (especially dissolved oxygen and water temperature) are regulated, in part, by vegetation, both hydro-riparian emergent vegetation and trees, which will be monitored by way of remote sensing tools such as orthophotography and/or LiDAR	Pima County will continue to monitor groundwater levels at the Cienega Creek Preserve; groundwater levels that are too low will threaten the presence of water and associated vegetation. In addition, fish surveys will target invasive species such as fish, crayfish, and bullfrogs. Finally, Pima County will monitor land cover change within the Cienega Creek watershed.	

Common Name	Single-Species Monitoring	Habitat Monitoring Summary	Threats Monitoring Summary	Other Notes
	monitoring program, but which also monitors relative abundance of native fish species.			
Desert sucker				Pima County will survey every 5 years along the Santa Cruz River downstream of the wastewater treatment plants for occupancy by this species.
Sonora sucker				Pima County will survey every 5 years along the Santa Cruz River downstream of the wastewater treatment plants for occupancy by this species.
Gila chub	Pima County will rely on a monitoring effort in Cienega Creek that is part of a non-native monitoring program, but which also monitors relative abundance of native fish species.	Presence of water will continue to be monitored at the Cienega Creek Preserve. Water quality (especially dissolved oxygen and water temperature) are regulated, in part, by vegetation, both hydro-riparian emergent vegetation and trees. Trees adjacent to the creek will be monitored at long-term monitoring plots, which will be located within the habitat of this species along Cienega Creek.	Pima County will continue to monitor groundwater levels at the Cienega Creek Preserve (Pima Association of Governments 1998) according to the recommendations by Fonseca (2008a); groundwater levels that are too low will threaten the presence of water and associated vegetation. In addition, biennial fish surveys will also target invasive species such as fish and crayfish. Finally, Pima County will monitor land cover change within the Cienega Creek watershed.	
Gila topminnow	Pima County will rely on a monitoring effort in Cienega Creek that is part of a non-native monitoring program, but which also monitors relative	Presence of water will continue to be monitored at Cienega Creek Preserve as part of the wet/dry mapping by Pima Association of Governments (Pima Association of Governments 1998). Water availability will also be monitored during sampling for fish. Water quality (especially dissolved oxygen and water temperature) are regulated, in part, by vegetation, both hydro-riparian emergent	Pima County will continue to monitor groundwater levels at the Cienega Creek Preserve (Pima Association of Governments 1998) according to the recommendations by Fonseca (2008a); groundwater levels that are too low will threaten the presence of water and associated vegetation. In addition, biennial fish surveys will also target invasive species such	

Common Name	Single-Species Monitoring	Habitat Monitoring Summary	Threats Monitoring Summary	Other Notes
	abundance of native fish species	vegetation and trees. Trees adjacent to the creek will be monitored at long-term monitoring plots (or using LiDAR), which will be located along Cienega Creek.	as fish and crayfish. Finally, Pima County will monitor land-cover change within the Cienega Creek watershed.	
Chiricahua leopard frog	Pima County will monitor any reintroduction effort for this species. Established populations on County owned and leased land will receive occupancy monitoring every year for the first 3 years, and thereafter every 3 years.	The presence of water is a key habitat feature for this species and, therefore, the availability of water at monitoring sites will be recorded during surveys for the species.	Pima County will periodically monitor for bullfrogs and crayfish on the Sands and Clyne ranches.	
Lowland leopard frog	Pima County will commit to monitoring for occupancy at 6 sites every 3 years.	The presence of water is a key habitat feature for this species and therefore the availability of water at monitoring sites will be recorded during each survey. During baseline surveys for this species, Pima County will map potential habitat for this species, with particular emphasis on mapping the location and dimensions of tinajas within the creek reaches that contain or could contain the species. In the Cienega Creek Preserve, Pima County and its partners (Pima Association of Governments) will continue to monitor stream flow (Pima Association of Governments 1998). Water quality (especially dissolved oxygen and water temperature) are regulated, in part, by vegetation, both hydro-riparian emergent vegetation and trees. Trees adjacent to the creek will be monitored by way of remote sensing tools such as orthophotography and/or LiDAR.	Pima County will continue to monitor groundwater levels at the Cienega Creek Preserve according to the recommendations by Fonseca (2008a); groundwater levels that are too low will threaten the presence of water and associated vegetation. In addition, surveys will look for target invasive species such as fish and crayfish that prey on the frog.	
Desert box turtle		Habitat features that are important for this species are semi-desert grasslands, from shrubless areas to grasslands moderately invaded by shrubs and trees such as mesquite. The desert box turtle is also associated with sparse to moderate densities of perennial	Pima County will periodically quantify loss and fragmentation of habitat in the species' PCA. Pima County will also monitor the location and extent of wildland fire within the County's preserve system, which could cause lethal take of individuals. Ultimately, however, fire is likely	

Common Name	Single-Species Monitoring	Habitat Monitoring Summary	Threats Monitoring Summary	Other Notes
		grasses. Pima County will monitor dominant perennial woody and grass species and vegetation density and volume at long-term monitoring plots within the County's preserve system, such as at the Sands and Clyne ranches where desert box turtles are known to occur. An increase in shrub cover in semi-desert grasslands will be of concern for this species.	a net positive for this species as fire helps to reduce shrub cover.	
Sonoran desert tortoise	Pima County will commit to monitoring at least 10 sites every 3 years within the County preserve system	Habitat features that are important for this species include the availability of shelters among boulders and rock outcrops, as well as incised caliche formations in wash sides, as well as shrubby desert upland vegetation. Pima County will monitor dominant perennial woody and grass species and vegetation density and volume at long-term monitoring plots within the County's preserve system where the species occurs, especially parts of the Altar Valley, Tucson Mountain Park, the A7 ranch, and the lower Cienega Valley. Changes in understory species composition, especially the increase in buffelgrass (which causes a reduction in food sources and can impact tortoise movements), are likely to impact this species, and therefore is a concern.	Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Pima County will continue to collect information on the spatial distribution and relative abundance of buffelgrass within the County's preserve system and provide this information to the Buffelgrass Coordination Center, which is standardizing the protocol for buffelgrass mapping and abundance estimates (Rogstad 2008).	
Tucson shovel-nosed snake		Habitat features that are important for this species are open, undeveloped areas with sandy to loamy soils. Soils type and consistency are part of initial assessments of long-term monitoring plots.	Fragmentation and degradation of habitat is key for this species and Pima County will periodically quantify loss and fragmentation of habitat in the species' PCA. As noted in the habitat element, off-road vehicle use in this species' habitat is very likely impacting this species. To monitor this, Pima County staff will note off-road vehicle (ORV) use during site visits to properties with the species' PCA. Buffelgrass is likely a significant threat to this species and Pima County will continue to collect information on the spatial distribution and relative abundance of buffelgrass within the County' preserve system and provide this information to the Buffelgrass Coordination Center, which is standardizing the protocol for buffelgrass mapping and abundance estimates	Pima County will investigate any credible sighting of this species within the County's preserve system.

Common Name	Single-Species Monitoring	Habitat Monitoring Summary	Threats Monitoring Summary	Other Notes
			(Rogstad 2008).	
Northern Mexican gartersnake		Habitat features that are important for this species are in close proximity to standing water, emergent vegetation, hydro-riparian streamside vegetation, and course woody debris. To monitor some of these habitat needs, Pima County and its partner Pima Association of Governments (PAG) will continue to monitor the distribution of standing water at Cienega Creek Preserve. Pima County will also monitor vegetation at the Preserve and other locations within the species' PCA in the County preserve system by way of remote sensing tools such as orthophotography and/or LiDAR.	The distribution and abundance of this species is known to be heavily impacted by aquatic invasive species (bullfrogs and crayfish, in particular, though non-native fish are also important predators). Pima County and our cooperators will monitor for these species at Cienega Creek Preserve through a variety of methods, such as during annual fish surveys and quarterly wet/dry mapping of Cienega Creek Preserve. Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Pima County will also monitor groundwater levels in select sites in eastern Pima County (e.g., Cienega Creek Preserve) using the protocol recommendations of Fonseca (2008a); groundwater levels that are too low will threaten the open water and associated vegetation that is so important to this species.	Pima County will investigate any credible sighting of this species with the County's preserve system.
Giant spotted whiptail		Habitat features that are important for this species are primarily mesic-riparian and xeric-riparian washes, as well as associated canyon slopes, often with dense stands of vegetation, small rock outcrops, and course woody debris. Pima County will monitor dominant perennial vegetation species, vegetation density and volume by way of remote sensing tools such as orthophotography and/or LiDAR.	Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available.	
Groundsnake (valley form)		Habitat features that are important for this species are open, undeveloped areas with sandy to loamy soils. Soil type and consistency are part of initial assessments of long-term monitoring plots.	Pima County will annually report the number and location of building permits issued within the species' PCA in unincorporated Pima County. Pima County will also report on trends in land-use change within the species' PCA as data become available. Buffelgrass is likely a threat to this species and Pima County will continue to collect information on the spatial distribution and relative abundance of buffelgrass within the County's preserve	Pima County will investigate any credible sighting of this species within the County's preserve system.

Common Name	Single-Species Monitoring	Habitat Monitoring Summary	Threats Monitoring Summary	Other Notes
			system and provide this information to the Buffelgrass Coordination Center, which is standardizing the protocol for buffelgrass mapping and abundance estimates (Rogstad 2008). Off-road vehicle use in this species' habitat is very likely impacting this species. To monitor this, Pima County staff will note off-road vehicle (ORV) use during site visits to properties. ORV use can also be detected with visual inspection of aerial images, and possibly with the use of LiDAR.	
Talussnails (all)		Talussnails are found only on talus deposits, where they live in the interstitial spaces between and under rocks. Inventory of talus slopes will be conducted within the County's preserve system. Site visits will include searching for evidence of talussnails (i.e., shells). Incidental observations of shell casings, (indicating occupancy) during periodic checks for threats to their habitat will be recorded and documented. Monitoring of talus deposits will focus on threats such as buffelgrass encroachment.	Pima County will monitor percent and/or extent of encroachment of buffelgrass and other non-native plants on select talus slopes within the County preserve system. Other threats such as anthropogenic disruption of sites and vandalism will be monitored.	

Other Program Elements

Adaptive Monitoring

Ecological monitoring is one of the most important aspects of the Pima County MSCP and will provide the bulk of the evidence to inform whether the County's mitigation efforts are effective at conserving Covered Species and their habitats. Ecological monitoring is also a challenging endeavor that requires considerable up-front planning and flexibility in implementation to be successful (Noon 2003).

The PCEMP has been in the planning stage since 2007 (RECON Environmental Inc. 2007; Powell 2010c), but on-the-ground monitoring activities have not begun and it is expected that the monitoring plan will evolve somewhat during early development of the MSCP, particularly with regards to sampling and survey methods, which are often modified as new information becomes available. Therefore, it is essential that the program be broad in scope, flexible in design, and responsive to unanticipated management issues and stressors as they arise (Ringold et al. 1996). Principles and examples of changes are noted in the Changed Circumstances section of the MSCP (Chapter 7). With regards to monitoring and modification of sampling design and data-collection protocols, there has been a greater awareness in recent years of the importance of modifying long-term monitoring protocols to effectively account for the variability of biological resources and the sampling error associated with monitoring those resources, as well as the importance of maximizing the ability to extend a monitoring program's findings (i.e., inferences) across the entire sampling frame (Urquhart et al. 1998). Significant changes in protocols to reflect on-the-ground realities will be made in coordination with the USFWS to ensure that any program changes will satisfy the Service's needs and concerns.

Establishing Management and Monitoring Objectives

Throughout the development of the PCEMP, Pima County has recognized that monitoring should inform management by alerting managers as expediently as possible to undesirable changes in the attribute of interest so that management action(s) can focus on reversing the trend. This is known as adaptive management and the principles and applications of adaptive management are discussed in Chapter 6 of the MSCP. An important first step in adaptive management (after the management context and measures are established) is to develop objectives, which are clearly articulated descriptions of a measurable standard, desired state, or trend, and are articulated in understandable units that identify trigger points (a.k.a., thresholds) for management actions (Elzinga et al. 2001; Atkinson et al. 2004; Tear et al. 2005). In the monitoring context of the MSCP, Pima County will focus attention on both monitoring and management objectives. *Management objectives* provide a measure of management success by describing a desired future state of a resource; they should be realistic, specific, and measurable and are often related to the change or condition of a resource (e.g., maintain the current population of Pima pineapple cactus within the reserve system). *Monitoring objectives* are companions to management objectives whenever monitoring employs sampling procedures. Monitoring objectives specify information

such as target levels of precision (a measurement of the repeatability of a sample), and the magnitude of change. The difference between management objectives and monitoring objectives is best summarized by Elzinga et al. (2001): "whereas a management objective sets a specific goal for attaining an ecological condition or change, monitoring objectives sets a goal for the measurement of that value." For example, a management objective might be to maintain the total number of Pima pineapple cactus within the reserve system. The companion monitoring objective might state a desire to be 90% confident that our sampling-based estimates of the population are within ±20% of the estimated true value.

Pima County will develop both management and monitoring objectives as part of the detailed protocol development process for each of the proposed parameters. As a general rule, management objectives will be centered on maintaining or improving conditions or resources at or above the baseline conditions at the start of the monitoring program. Because baseline conditions have not been established for all parameters, Pima County needs to undertake the appropriate inventories or first sampling event (e.g., to establish what baseline conditions are) before committing to objectives. Both management and monitoring objectives will be realistic and any management action that may be employed to reverse an undesirable trend must have a reasonable chance for success and must be within Pima County's ability to affect the outcome. For example, impacts resulting from climate change are expected to accelerate the conversion of semi-desert grasslands to desert scrub communities. Any management objective related to semi-desert grasslands will recognize that Pima County cannot reverse or halt this climate-related trend. Furthermore, it should be recognized that objectives—though intuitively appealing—can be difficult to establish for many species and communities with naturally variable populations and distributions (Walker and Meyers 2004). Neither the occurrence of large-scale changes beyond Pima County's ability to control, nor the difficulty in monitoring to determine if an objective has been reached release Pima County from the need to establish objectives. Instead, Pima County will work closely with the USFWS during the protocol development phase, where appropriate, to help ensure that an appropriate balance is reached between promising too much and not promising enough so that management responses have the greatest chance for success.

Data Management

Data management will play an important role in the PCEMP and considerable resources will be devoted to the effort. As a first step, Pima County completed a data management plan (Powell 2010b), which is a strategy for ensuring that data are documented, secure, accessible, and useful for decades to come by future managers and members of the public. This data management plan is based on a set of core principles:

- **Quality:** Ensure that appropriate quality assurance measures are taken during all phases of data development: acquisition, processing, summary and analysis, reporting, documenting, and archiving.

- **Interpretability**: Ensure that complete documentation accompanies each data set so that users will be aware of its context, applicability, and limitations.
- **Security**: Ensure that both digital and analog data are maintained and archived in a secure environment that provides appropriate levels of access to project leaders, technicians, network staff, and other users.
- **Longevity:** Ensure that data sets are maintained in an accessible and interpretable format, accompanied by sufficient documentation.
- **Availability**: Ensure that the data are made available and easily accessible to managers and other users, as appropriate.

Work on the PCEMP database has already begun as part of a larger, County-wide project to integrate land management and monitoring activities by building systems architecture (including the applications, database systems, repositories, and software tools) that make up a contemporary data management enterprise.

Most data acquired by the program will be collected as field data or discovered through data mining initiatives such as through legacy or existing data. Methods of field data collection, such as paper field data forms, field computers, automated data loggers, and GPS units, will be specified in individual monitoring protocols and study plans. Field crew members will be trained in and closely follow the established standard operating procedures in the project protocol. These and other activities will be part of quality assurance and quality control procedures that will identify and reduce the frequency and significance of errors at all stages in the data life cycle. All elements of the County's data management plan will be reported to the USFWS within three years of permit issuance.

Covered Species Information Database

The monitoring activities for the PCEMP will form the foundation of the program and will be used to determine permit compliance and effectiveness. Yet the program stands to benefit from the fact that Tucson is a regional center for ecological research and monitoring activities, much of which could contribute to an understanding of the distribution and abundance of Covered Species. To provide an effective means of collecting and summarizing this information, Pima County will develop the Covered Species Information Database (CSID). Each year Pima County will query researchers and other governmental entities and non-governmental organizations regarding any data collected on covered species in the preceding year. Information would include a diverse range of information such as reports, sightings, or emergence of new threats. Information from these sources would be collated into and included as part of the annual report to the USFWS. Participating researchers and government and non-governmental entities would be encouraged to participate through public outreach activities and partnerships, but the program would be on a voluntary basis. Pima County would be careful to ensure that no sensitive information, such as locations of Threatened or Endangered species, would be released without permission of the

research entity and the relevant landowner. Data from this project will be stored using appropriate protocols that include metadata and appropriate archival structures.

Citizen-science monitoring

Pima County is fortunate to have a citizenry that is active in conservation, research, and education. This interest has been demonstrated by citizen engagement in large-scale planning efforts such as the SDCP, as well as their participation in many volunteer opportunities such as the Tucson Bird Count, and Sky Island Alliance's tracking and road monitoring programs. An important objective of the PCEMP will be to engage citizens in monitoring activities and their related products. Opportunities for citizen-science monitoring will be explored, such as for monitoring streamflow length. This has been done to great effect in Cienega Creek since 1999. These outings have been an extraordinary educational opportunity for participants and have contributed critical information for understanding the response of Cienega Creek to drought conditions, as well as for remaining vigilant to the spread of nonnative, invasive species. Other opportunities for citizens might include documenting sightings of Covered Species, as well as the location and extent of off-road vehicles and illegal dumping.

Though volunteers can be an effective model for achieving program goals, it does require more cost for oversight and management than most realize (Brudney 1990). It is often difficult to quantify, but some studies estimate that volunteers can cost organizations from $300-1,000 per year per volunteer (Public/Private Ventures 2002). For some PCEMP projects, most volunteer opportunities will have to be in and around where most volunteers live and recreate (i.e., mostly Tucson), but getting volunteers to more remote sites for projects such as wet/dry mapping may require that the County pay for travel expenses. Cost associated with recruiting, training, retaining, and recognizing volunteers will be factored into all protocols that will consider the use of volunteers.

Project Communication

The primary function of the PCEMP will be to collect, analyze, and archive long-term monitoring data. Another key element of the program will be in communicating program results to natural resource managers, the general public, and the media. An important step in the development of the PCEMP will be for Pima County to develop a communications plan that identifies target audiences and appropriate products (e.g., reports and presentations) for each of the audiences. Other items for the communication plan include standardizing data reporting formats, and outlining data sharing protocols.

Program Duration and Phasing

The PCEMP is being developed as part of the County's Section 10 permit, and as such monitoring will not get underway until after permit issuance. Because the Section 10 permit will be for 30 years, the PCEMP will also be for 30 years. (Monitoring after permit expiration is specified in the perpetual conservation easements). All key elements of the PCEMP will be implemented within 5 years of permit issuance and the

monitoring program will be implemented in three phases. The three program phases are articulated in the Chapter 6 of the MSCP. Within one year of permit issuance the County will enact an implementation plan to guide program development. The reason for the phasing, rather than starting all program elements and parameters at once, is to provide sufficient time to develop each piece with the appropriate care and attention. In this way, each program phase builds on the success and lessons learned from the previous phase(s).

Glossary

Abundance/Density: Abundance or density (abundance scaled by area) facilitates estimates of total population change (i.e., number of individuals lost or gained) over time (Buckland et al. 2001, Rosenstock et al. 2002). Abundance is often more sensitive than occupancy to underlying changes in population size. It is the most common choice for some species groups that are highly detectable such as land birds and for species that are abundant such as rodents, lizards, and fishes.

Adaptive monitoring: The monitoring program itself should be adaptable because new information on the function of the system, new threats, or new field methods may change program objectives or ways of collecting data (Ringold et al. 1996).

Design: The targets, attributes, and parameters to measure to achieve the objectives of the monitoring program, plus the timing and location of where those measurements will be made.

Index: An index (e.g., relative abundance) is a statistic assumed to be correlated to the true abundance of a population.

Occupancy: the proportion of area, patches, or sampling units that is occupied (i.e., species presence) (MacKenzie et al. 2003, Field et al. 2005, MacKenzie et al. 2006). Changes in occupancy can occur more slowly than abundance measures, because, for example, the number of individuals might be declining, but occupancy may be unchanged, a situation that is frequent for species that are common, widely distributed, long lived, and/or not at the edge of their geographic range. Occupancy is almost always the choice parameter for species that are rare and/or difficult to detect.

Parameter: Within the context of monitoring, parameter is often used to represent an attribute of the environment that can be measured or estimated to provide insight into the system of interest (Busch and Trexler 2003).

Protocol: The detailed methodology for measuring a parameter, including what to measure, how to measure it, and where and when to perform those measurements.

Sampling Design. The method of selecting where and how often to sample; these choices ultimately determine the power and precision, spatial and temporal inference, and overall cost of a monitoring program.

Sampling Frame: The complete collection of the possible sampling units from which samples can be drawn. Sampling frame determines the inference of results.

Appendix R. Procedure for Updating of Covered Species Suitability Models and PCAs adopted by the Science Technical Advisory Team

May 12, 2009

Throughout the development of the Pima County's Multiple Species Conservation Plan (MSCP) and the Sonoran Desert Conservation Plan (SDCP), STAT drew on the best available scientific information of proposed covered species for a variety of needs such as developing the CLS and prioritizing land acquisitions. As Pima County moves toward implementing the MSCP and related conservation measures, there will be a need to revisit the habitat models and PCAs as better information becomes available. The purpose of this memorandum is to recommend that the Science Technical Advisory Team (STAT) formalize the process for amending habitat models and PCAs.

Habitat models were developed by species experts during the development of the SCDP based on environmental features that were believed to control the distribution of potentially suitable habitat at the landscape level for a given species. Using these models, suitability was mapped by GIS analysts for the entirety of Pima County, without regard to political boundaries, though some areas were excluded from analysis due to biological factors identified by experts. Suitability was usually represented in GIS raster datasets as high, medium or low potentially suitable habitat. Habitat models make explicit assumptions about preferences of species for environmental features, and utilize more complete information about the variation of physical or biological characteristics over the landscape than would otherwise be available.

Priority Conservation Areas (PCAs) were defined by species experts to prioritize SDCP land acquisitions. PCAs are species-specific, but not all species have PCAs; where data to inform acquisition is lacking, experts declined to designate a priority. All PCAs are GIS polygons enclosing an area of significance; many represent an area encircling a smaller unit of potentially suitable habitat. PCAs were subdivided, if deemed appropriate by experts, using the following definitions developed:
PCA 1: Areas with populations which must be included in a reserve system (excluding the Tohono O'odham Nation);
PCA 2: Areas that would be of value to the reserve system;
PCA 3: Critical landscape linkages;
PCA 4: Areas with potential for habitat restoration or enhancement.

PCAs are based on local knowledge and integration of the differences between habitat conditions, threats, and species population distributions. PCA 1-3 should represent a prioritization of the area of potentially suitable habitat for regional conservation and acquisition.

PCAs and habitat models were periodically adjusted by species experts assembled by County staff. These adjustments have been reviewed at STAT meetings and generally

approved, but the process itself has not been reviewed and endorsed. Therefore, County staff requests approval of the following process:

1. Staff initiates a revision by soliciting and receiving input from at least two individuals with particular expertise in the distribution or habitat preferences of the species in question. Experts will be scientists who are engaged in inventory, research or monitoring of the taxon as it occurs in Pima County and the surrounding region. County staff would also solicit supporting documentation from amateur naturalists, consulting biologists, or scientists with particular knowledge of habitat preferences outside of Pima County.
2. Staff uses input from the experts to revise the habitat model parameters, limits of analysis, or the area or classification of the PCA. Staff obtains location or distribution information for the experts as appropriate. Staff prepares maps or other materials for review by the experts.
3. Staff presents revised models or PCAs based on the input of the experts at a meeting of the Science Technical Advisory Team or other appropriate advisory group. Notice of the meeting will be provided to interested parties.
4. The technical advisory group approves or recommends changes.
5. Staff replaces the preceding version of the model or PCA on official maps and uses the information in analyses, as appropriate.

In making its determination as to whether or not to initiate a review of a species, Pima County staff will be particularly interested in habitat models that are refined for more localized areas of the County, such as happened with the City of Tucson and Town of Marana HCP. In this review process, Pima County staff will determine the method(s) used to develop models.

Neither County staff nor STAT recommend revisions to the CLS in any future review of species' habitat or PCA. The habitat suitability models of priority vulnerable species were also used, along with many other inputs, for developing a biological reserve design for the entirety of Pima County. It would be incorrect to base revision of the Conservation Lands System upon new habitat suitability models alone. The Science Technical Advisory Team re-iterates its recommendation that any revision of the Conservation Lands System be based upon a similarly comprehensive review of available biological data, including fine-filter and coarse-filter information as well as review of the principles of reserve design by a similarly constituted advisory body.

Appendix S. Literature cited for all appendices

Abbate, D. J., W. S. Richardson, R. L. Wilcox, and S. Lantz. 2000. Cactus ferruginous pygmy-owl investigations in Pima and Pinal Counties, Arizona: 1999. Arizona Game and Fish Department, Phoenix, Arizona.

Alanen, M. 2003. Town of Marana burrowing owl surveys summary. Arizona Game and Fish Department report to the Town of Marana, Arizona.

Andersen, H. E., S. E. Reutebuch, and R. J. McGaughey. 2006. Chapter 3: Active remote sensing. *In* Computer applications in sustainable forest management, Edited by G. Shao and K. Reynolds. Springer-Verlag, Dordrecht.

Arizona Game and Fish Department. 2001a. *Aspidoscelis burti stictogrammus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

Arizona Game and Fish Department. 2001b. *Athene cunicularia hypugaea*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

Arizona Game and Fish Department. 2001c. *Buteo swainsoni*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

Arizona Game and Fish Department. 2001d. *Coryphantha scheeri var. robustispina*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

Arizona Game and Fish Department. 2001e. *Gopherus agassizzii*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

Arizona Game and Fish Department. 2001f. *Macrotus californicus.* Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department. Phoenix, Arizona.

Arizona Game and Fish Department. 2001g. *Peromyscus merriami*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

Arizona Game and Fish Department. 2001h. *Plecotus townsendii pallescens*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

Arizona Game and Fish Department. 2001i. *Poeciliopsis occidentalis occidentalis*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

Arizona Game and Fish Department. 2001j. *Thamnophis eques megalops*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

Arizona Game and Fish Department. 2002a. *Catostomus clarkii*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

Arizona Game and Fish Department. 2002b. *Catostomus insignis*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

Arizona Game and Fish Department. 2002c. *Coccyzus americanus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.
Arizona Game and Fish Department. 2002d. *Empidonax traillii extimus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.
Arizona Game and Fish Department. 2002e. *Gila intermedia*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.
Arizona Game and Fish Department. 2002f. *Vireo bellii*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.
Arizona Game and Fish Department. 2003a. Arizona Bat Conservation Strategic Plan. Nongame and Endangered Wildlife Program Technical Report 213. Arizona Game and Fish Department, Phoenix, Arizona.
Arizona Game and Fish Department. 2003b. *Coccyzus americanus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.
Arizona Game and Fish Department. 2003c. *Lasiurus blossevillii*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.
Arizona Game and Fish Department. 2003d. *Lasiurus xanthinus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.
Arizona Game and Fish Department. 2003e. *Leptonycteris curasoae yerbabuenae*. Unpublished abstract compiled and edited by the Heritage Data Management System. Arizona Game and Fish Department, Phoenix, Arizona.
Arizona Game and Fish Department. 2004. *Tumamoca macdougalii Rose*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.
Arizona Game and Fish Department. 2006a. *Agosia chrysogaster*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.
Arizona Game and Fish Department. 2006b. *Choeronycteris mexicana*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.
Arizona Game and Fish Department. 2006c. Draft. Arizona's comprehensive wildlife conservation strategy: 2005-2015. Arizona Game and Fish Department, Phoenix, Arizona.
Arizona Game and Fish Department. 2006d. *Lithobates yavapaiensis*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.
Arizona Game and Fish Department. 2009a. *Echinomastus erectocentrus* var. *erectocentrus*. Unpublished abstract compiled and edited by the Heritage Data Management System, Arizona Game and Fish Department, Phoenix, Arizona.

Arizona Game and Fish Department. 2009b. Unpublished species occurrence data provided by the Heritage Data Management System, Phoenix, Arizona.

Arizona Game and Fish Department and U.S. Fish and Wildlife Service. 2000. Cactus ferruginous pygmy-owl survey protocol (revised). Accessed on April 10, 2015 from: http://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/CFPO/FINAL_REV_PROTOCOL.pdf.

Arizona Game and Fish Department and U.S. Fish and Wildlife Service. 2006. Safe harbor agreement for the Chiricahua leopard frog in Arizona. Nongame and Endangered Wildlife Program, Arizona Game and Fish Department, and Arizona Ecological Services Office, U.S. Fish and Wildlife Service, Tucson, Arizona.

Arnold, L. W. 1940. An ecological study of the vertebrate animals of the mesquite forest. University of Arizona, Tucson, Arizona.

Arrowood, P. C., C. A. Finley, and B. C. Thompson. 2001. Analyses of burrowing owl populations in New Mexico. Journal of Raptor Research 35:362-370.

Arroyo-Cabrales, J., R. R. Hollander, and J. K. Jones, Jr. 1987. *Choeronycteris mexicana*. Mammalian Species:1-5.

Atkinson, A. J., P. C. Trenham, R. N. Fisher, S. A. Hathaway, B. S. Johnson, S. G. Torres, and Y. C. Moore. 2004. Designing monitoring programs in an adaptive management context for regional multiple species conservation plans. USGS Geological Survey Technical Report. USGS Western Ecological Research Center, Sacramento, California.

Averill-Murray, A., S. Lynn, and M. L. Morrison. 1999. Cowbird parasitism of Arizona Bell's vireos (*Vireo bellii arizonae*) in a desert riparian landscape: implications for cowbird management and riparian restoration. Studies in Avian Biology 18:109-120.

Averill-Murray, R. C., and C. M. Klug. 2000. Monitoring and ecology of Sonoran desert tortoises in Arizona. Nongame and Endangered Wildlife Program Technical Report 161. Arizona Game and Fish Department, Phoenix, Arizona.

Baker, M. A. 2000. Surveys for Pima pineapple cactus (*Coryphantha robustispina*) ssp. *robustispina* within sections 14, 15, 21, 22, 23, 27, and 32 of T16S R10E, and sections 22 & 23 of T16S R15E (near the Pima County Fairgrounds) and sections 10, 15, 14, 23, and 24 of T16S R16E (Cienega Creek Preserve), Pima County, Arizona. SWBR Project No. 00-0102FLORA. Southwest Botanical Research, Chino Valley, Arizona.

Baker, M. A. 2005a. Draft report on geographic distribution of *Coryphantha robustispina* ssp. *robustispina*. Report to the U.S. Fish and Wildlife Service. Tucson, Arizona.

Baker, M. A. 2005b. Geographic distribution and DNA analysis of *Coryphantha robustispina* ssp. *robustispina*. Unpublished report.

Baker, M. A. 2006. Geographic distribution of *Coryphantha robustispina* ssp. *robustispina* (Pima pineapple cactus) and *Echinomastus erectocentrus* var. *erectocentrus* (Needle-spined pineapple cactus) within the City of Tucson HCP planning area. Tucson, Arizona.

Baker, M. A. 2007. Geographic distribution of *Coryphantha robustispina* ssp. *robustispina* (Pima pineapple cactus) and *Echinomastus erectocentrus* var.

erectocentrus (Needle-spined pineapple cactus) within the extended City of Tucson HCP Southlands planning area. Report to the Office of Conservation and Sustainable Development, Tucson, Arizona.

Baker, M. A. 2010. A demographic study of *Coryphantha robustispina* ssp. *robustispina*: Progress report for the 2009 field season. Status report prepared for the U.S. Bureau of Reclamation, Phoenix Field Office, Phoenix, Arizona.

Baker, M. A., and C. A. Butterworth. 2013. Geographic distribution and taxonomic circumscription of populations within *Coryphantha* section *robustispina* (Cactaceae). American Journal of Botany 100:984-997.

Bakian, A. V., K. A. Sullivan, and E. H. Paxton. 2012. Elucidating spatially explicit behavioral landscapes in the Willow Flycatcher. Ecological Modelling 232:119-132.

Barbour, R. W., and W. H. Davis. 1969. Bats of America. University of Kentucky Press, Lexington, KY.

Bartok, N. D., and C. J. Conway. 2010. Factors affecting the presence of nesting burrowing owls in an agricultural landscape. Journal of Raptor Research 44:286-293.

Bednarz, J. C. 1988. Status report: Swainson's hawk *in* Proceedings of the Southwest Raptor Management Symposium and Workshop. National Wildlife Federation, Washington D. C.

Benson, L. 1969. The Cacti of Arizona. 3rd edition. University of Arizona Press, Tucson, Arizona.

Benson, L. 1982. The Cacti of United States and Canada. Stanford University Press, Stanford, California.

Bequaert, J. C., and W. B. Miller. 1973. The mollusks of the arid Southwest. University of Arizona Press, Tucson, Arizona.

Bestgen, K. R., D. A. Hedrickson, D. M. Kubly, and D. L. Propst. 1987. Movements and growth of fishes in the Gila River drainage, Arizona and New Mexico. Southwestern Naturalist 32:351-356.

Biota Information System of New Mexico. 2000. Species accounts New Mexico Department of Game and Fish, Santa Fe, New Mexico.

Biota Information System of New Mexico. 2008a. *Aspidoscelis burti xanthonotus.* New Mexico Department of Game and Fish, Santa Fe, New Mexico.

Biota Information System of New Mexico. 2008b. *Athene cunicularia hypugaea*. New Mexico Department of Game and Fish, Santa Fe, New Mexico.

Biota Information System of New Mexico. 2008c. *Catostomus insignis*. New Mexico Department of Game and Fish, Santa Fe, New Mexico.

Biota Information System of New Mexico. 2008d. *Coccyzus americanus occidentalis* (western population). New Mexico Department of Game and Fish, Santa Fe, New Mexico.

Biota Information System of New Mexico. 2008e. *Gila intermedia*. New Mexico Department of Game and Fish, Santa Fe, New Mexico.

Biota Information System of New Mexico. 2008f. *Peromyscus merriami*. New Mexico Game and Fish Department, Santa Fe, New Mexico.

Biota Information System of New Mexico. 2008g. *Terrapene ornata luteola*. New Mexico Game and Fish Department, Santa Fe, New Mexico.

Blair, R. B. 1999. Birds and butterflies along an urban gradient: Surrogate taxa for assessing biodiversity? Ecological Applications 9:164-170.

Bodner, G., J. Simms, and D. Gori. 2007. State of the Las Cienegas National Conservation Area: Gila topminnow population status and trends 1989-2005. The Nature Conservancy, Tucson, Arizona.

Booth, M. T., N. G. Hairston, and A. S. Flecker. 2013. How mobile are fish populations? Diel movement, population turnover, and site fidelity in suckers. Canadian Journal of Fisheries and Aquatic Sciences 70:666-677.

Booth, M. T., and A. J. Shipley. 2012. Spatial dynamics and growth of two native species of Catostomids: Are movements restricted? Southwestern Naturalist 57:248-256.

Bradley, G. A., P. C. Rosen, M. J. Sredl, T. R. Jones, and J. E. Longcore. 2002. Chytridiomycosis in native Arizona frogs. Journal of Wildlife Diseases 38:206-212.

Brand, L. A., J. C. Stromberg, and B. R. Noon. 2010. Avian density and nest survival on the San Pedro River: Importance of vegetation type and hydrologic regime. Journal of Wildlife Management 74:739-754.

Brown, B. T. 1993. Bell's Vireo (*Vireo bellii*). *In* A. Poole, P. Stettenheim, and F. Gill, editors. The Birds of North America, no 35. The Birds of North America, Inc, Philadelphia, Pennsylvania.

Brown, B. T., S. W. Carothers, and R. R. Johnson. 1983. Breeding range expansion of Bell's vireo in Grand Canyon, Arizona. The Condor 85:499-500.

Brown, J. H., T. J. Valone, and C. G. Curtin. 1997. Reorganization of an arid ecosystem in response to recent climate change. Proceedings of the National Academy of Sciences of the United States of America 94:9729-9733.

Brown, N. L., and R. W. Mannan. 2002. Status of burrowing owls in Arizona: Final report. Arizona Game and Fish Department, Phoenix, Arizona.

Brudney, J. L. 1990. Fostering volunteer programs in the public sector: planning, initiating, and managing voluntary activities. Jossey-Bass Publishers, San Francisco, California.

Brunson, E., D. Gori, and D. Backer. 2001. Watershed improvements to restore riparian and aquatic habitiat on the Muleshoe Ranch CMA. AWPF Project Number 97-035. The Nature Conservancy of Arizona, Tucson.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers, and L. Thomas. 2001. Introduction to distance sampling: Estimating abundance of biological populations. Oxford University Press, Oxford, England.

Bureau of Reclamation. 1998. Reinitiated Biological Opinion on transportation and delivery of Central Arizona Project water to the Gila River Basin in Arizona and New Mexico and its potential to introduce and spread nonindigenous aquatic species. Phoenix, Arizona.

Busch, D. E., and J. C. Trexler, editors. 2003. Monitoring ecosystems: Interdisciplinary approaches for evaluating ecoregional initiatives. Island Press, Washington, D.C.

Caldwell, D. 2002. SAWAMP Ranid frog monitoring results for the winter of 2001-2002. Unpublished report. Tucson, Arizona.

Calvert, A. W., and S. A. Neiswenter. 2012. Bats in riparian restoration sites along the lower Colorado River, Arizona. Southwestern Naturalist 57:340-342.

Carman, S. M. 2006. Colorado River Basin chubs: Roundtail Chub (*Gila robusta)*, Gila Chub (*Gila intermedia)*, Headwater Chub *(Gila nigra)*; Recovery plan. Conservation Services Division, New Mexico Game and Fish Department, Santa Fe, New Mexico.

Carter, D. E., Jr., and W. D. Peachey. 1996. Population study of Mexican long-tongued bats in southeast Pima County, Arizona. Pima County Parks and Recreation Department, Heritage Grant I96024 report for Arizona Game and Fish Department.

Cartron, J. E., and D. M. Finch, tech. eds. 2000. Ecology and conservation of the cactus ferruginous pygmy-owl in Arizona. General Technical Report RMRS-GTR-43. USDA Forest Service, Rocky Mountain Research Station, Albuquerque, New Mexico.

Cartron, J. E., E. W. Richardson, and G. A. Proudfoot. 2000. The cactus ferruginous pygmy owl: taxonomy, distribution, and natural history. Pages 5-15. *In* J. E. Cartron and D. M. Finch, editors. Ecology and conservation of the cactus ferruginous pygmy-owl in Arizona. General Technical Report RMRS-GTR-43. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, Utah.

Carveth, C. J., A. M. Widmer, and S. A. Bonar. 2006. Comparison of Upper Thermal Tolerances of Native and Nonnative Fish Species in Arizona. Transactions of the American Fisheries Society 135:1433-1440.

Center for Biological Diversity. 2003. Petition to list the Mexican garter snake, *Thamnophis eques megalops*, as an endangered or threatened species under the Endangered Species Act. Center for Biological Diversity, Tucson, Arizona.

Childs, M. R. 2006. Comparison of Gila topminnow and western mosquitofish as biological control agents of mosquitoes. Western North American Naturalist 66:181-190.

Christensen, N. S., A. W. Wood, N. Voisin, D. P. Lettenmaier, and R. N. Palmer. 2004. The effects of climate change on the hydrology and water resources of the Colorado River Basin. Climatic Change 62:337-363.

City of Tucson. 2008. City of Tucson draft Avra Valley Habitat Conservation Plan. City of Tucson Office of Sustainability. Tucson, Arizona.

City of Tucson Burrowing Owl Working Group. 2007. Burrowing owl management guidelines for municipalities in Arizona. Arizona Game and Fish Department, Tucson, Arizona.

Clark, D. R., Jr. 1988. Environmental contaminants and the management of bat populations in the United States.*in* Management of amphibians, reptiles, and small mammals in North America. Proceedings of the symposium. USDA Forest Service General Technical Report RM-166. Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado, Flagstaff, Arizona.

Clarkson, R. W., B. R. Kesner, and P. C. Marsh. 2011. Long-term monitoring plan for fish populations in selected waters of the Gila River Basin, Arizona: Revision 3. Unpublished report to the U.S. Fish and Wildlife Service, Arizona Ecological Services, Phoenix, Arizona. Accessed on April 10, 2015 from: http://www.usbr.gov/lc/phoenix/biology/azfish/monitoringPlan.html.

Cockrum, E. L. 1981. Bat populations and habitats at the Organ Pipe Cactus National Monument. Technical Report No. 7. Cooperative National Park Resource Studies Unit Arizona, University of Arizona, Tucson, Arizona.

Cockrum, E. L., and Y. Petryszyn. 1986. Mammals of the Organ Pipe Cactus National Monument, Arizona. Technical Report No. 5. Cooperative National Park Resources Studies Unit Arizona, University of Arizona, Tucson, Arizona.

Cockrum, E. L., and Y. Petryszyn. 1991. The long-nosed bat, *Leptonycteris*: An endangered species in the Southwest? Ocassional Papers of the Museum of Texas Tech University 142:1-32.

Connolly, N., and J. Fonseca. 2009. Pima County mitigation lands: Commitments for multi-species conservation. Pima County Administrator's Office, Tucson Arizona. Accessed on April 10, 2015 from: http://www.pima.gov/cmo/sdcp/MSCP/PDF/Mitigation_lands.pdf.

Constantz, G. D. 1979. Life history patterns of a livebearing fish in contrasting environments. Oecologia 40:189-201.

Corman, T. E., and R. T. Magill. 2000. Western yellow-billed cuckoo in Arizona: 1998 and 1999 survey report to the Nongame and Endangered Wildlife Program, Arizona Game and Fish Department. Technical Report 150. Phoenix, Arizona.

Corman, T. E., and C. Wise-Gervais. 2005. Arizona breeding bird atlas. University of New Mexico Press, Albuquerque, New Mexico.

Crawford, C. 2005. Summary of yellow-billed cuckoo survey on the Simpson property. Arizona Game and Fish Department, Phoenix, Arizona.

Cryan, P. M., and M. A. Bogan. 2003. Recurrence of the Mexican long-tongued bats at historical sites in Arizona and New Mexico. Western North American Naturalist 63:314-319.

Davis, R., and R. Sidner. 1992. Mammals of woodland and forest habitats in the Rincon Mountains of Saguaro National Monument, Arizona. Technical Report NPS/WRUA/NRTR-92/06. U.S. Department of the Interior, National Park Service, University of Arizona, Tucson, Arizona.

Degenhardt, W. G., and J. L. Christiansen. 1974. Distribution and habitats of turtles in New Mexico. Southwestern Naturalist 19:21-46.

Degenhardt, W. G., C. W. Painter, and A. H. Price. 1996. Amphibians and reptiles of New Mexico. University of New Mexico Press, Albuquerque, New Mexico.

Dudley, R. K., and W. J. Matter. 2000. Effects of small Green Sunfish (*Lepomis cyanellus*) on recruitment of Gila Chub (*Gila intermedia*) in Sabino Creek, Arizona. The Southwestern Naturalist 45:24-29.

Durst, S. L. 2004. Southwestern Willow Flycatcher potential prey base and diet in native and exotic habitats. Northern Arizona University, Flagstaff, Arizona.

Durst, S. L., M. K. Sogge, S. D. Stump, S. O. Williams, B. E. Kus, and S. J. Sferra. 2007. Southwestern Willow Flycatcher breeding site and territory summary-2006. USGS Open File Report 2007-1391. U.S. Department of the Interior, U.S. Geological Survey, Reston, VA.

Eby, L. A., W. F. Fagan, and W. L. Minckley. 2003. Variability and dynamics of a desert stream community. Ecological Applications 13:1566-1579.

Ecosphere Environmental Services Inc. 1992. A range study of *Coryphantha scheeri* var. *robustispina*. Final report prepared for the U.S. Bureau of Reclamation, Phoenix, Arizona.

Edwards, T., C. R. Schwalbe, D. E. Swann, and C. S. Goldberg. 2004. Implications of anthropogenic landscape change on inter-population movements of the desert tortoise (*Gopherus agassizii*). Conservation Genetics 5:485-499.

Edwards, T., and D. E. Swann. 2003. Madrona Pools "PULSE" study: The collected reports from a rapid environmental assessment and workshop conducted at the Madrona Pools, Chimenea Creek, Saguaro National Park, Tucson, Arizona.

Ehrlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The birder's handbook: A field guide to the natural history of North American birds. Simon and Schuster, New York, New York.

Ellis, L. A., D. M. Weddle, S. D. Stump, H. C. English, and A. E. Graber. 2008. Southwestern willow flycatcher final survey and nest monitoring report. Research Technical Guidance Bulletin #10. Arizona Game and Fish Department, Phoenix, Arizona.

Elzinga, C. L., D. W. Salzar, J. W. Willoughby, and J. P. Gibbs. 2001. Monitoring plant and animal populations. Blackwell Publishing, Malden, Massachusettes.

Engineering and Environmental Consultants Inc. 2001. Final report: Huachuca water umbel surveys of Cienega Creek Preserve, Bingham Cienega Preserve, and La Cebadilla Property, Pima County, Arizona. Report to the Pima County Regional Flood Control District.

England, A. S., M. J. Bechard, and C. S. Houston. 1997. Swainson's Hawk (*Buteo swainsoni*). *In* A. Poole and F. Gill, editors. The Birds of North America, No. 165. The Academy of Natural Sciences, Philadelphia, Pennslyvania, and The American Ornithologists, Washington, D.C.

Environmental Planning Group. 2001. Priority Conservation Areas 2001. Report for the Sonoran Desert Conservation Plan. Report to Pima County Board of Supervisors. Accessed April 10, 2015 from: http://www.pima.gov/cmo/sdcp/reports/d10/014PRI.PDF.

Esque, T. C., A. M. Búrquez, C. R. Schwalbe, T. R. V. Devender, M. J. M. Nijhuis, and P. Anning. 2003. Effects of fire on desert tortoises and their habitats. Pages 119-132. *In* T. R. V. Devender, editor. The Sonoran Desert tortoise: natural history, biology and conservation. Arizona-Sonora Desert Museum Press, Tucson, Arizona.

Estabrook, T. S., and R. W. Mannan. 1998. Urban habitat selection by burrowing owls: Final report. Arizona Game and Fish Department, Phoenix, Arizona.

Fahey, T. J. 1997. *Lasiurus ega* (yellow bat) species account. University of Michigan Museum of Zoology.

Field, S. A., A. J. Tyre, and H. P. Possingham. 2005. Optimizing allocation of monitoring effort under economic and observational constraints. Journal of Wildlife Management 69:473-482.

Finch, D. M., and S. H. Stoleson. 2000. Status, ecology, and conservation of the southwestern willow flycatcher. General Technical Report RMRS-GTR-60. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado.

Findley, J. S., A. H. Harris, D. E. Wilson, and C. Jones. 1975. Mammals of New Mexico. University of New Mexico Press, Albuquerque, New Mexico.

Fleishman, E., and R. Mac Nally. 2003. Distinguishing between signal and noise in faunal responses to environmental change. Global Ecology and Biogeography 12:395-402.

Flesch, A. 2008a. Population and demographic trends of ferruginous pygmy-owls in northern Sonora, Mexico 2000-2008. University of Arizona, Tucson, Arizona.

Flesch, A. D. 2008b. Population and demographic trends of cactys ferruginous pygmy-owls in northern Sonora 2000-2007 and implications for recovery in Arizona. University of Arizona, Tucson, Arizona.

Flesch, A. D., and R. J. Steidl. 2006. Population trends and implications for monitoring cactus ferruginous pygmy owls in northern Mexico. Journal of Wildlife Management 70:867-871.

Flesch, A. D., and R. J. Steidl. 2007. Detectability and response rates of ferruginous pygmy-owls. Journal of Wildlife Management 71:981-990.

Flesch, A. D., D. E. Swann, and B. F. Powell. 2006. Amphibians and Reptiles. Pages 27-44. *In* B. F. Powell, W. L. Halvorson, and C. A. Schmidt, editors. Vascular plant and vertebrate inventory of Saguaro National Park, Rincon Mountain District. U. S. Geological Survey Open File Report 2006-1075. Reston, VA.

Flesch, A. D., D. E. Swann, and B. F. Powell. 2007. Amphibians and Reptiles. Pages 21-35. *In* B. F. Powell, W. L. Halvorson, and C. A. Schmidt, editors. Vascular plant and vertebrate inventory of Saguaro National Park, Tucson Mountain District. U. S. Geological Survey Open File Report 2007-1296. Reston, VA.

Fonseca, J. 2008a. Aquifer monitoring for groundwater-dependant ecosystems, Pima County, Arizona. Unpublished report to the Pima County Board of Supervisors, Tucson, Arizona. Accessed April 10, 2015 from: http://www.pima.gov/cmo/sdcp/Monitoring/PDF/Fonseca_2008_Groundwater_Monitoring.pdf.

Fonseca, J. 2008b. Remote sensing to monitor land cover change, Pima County, Arizona. Unpublished report to the Pima County Board of Supervisors, Tucson, Arizona. Accessed April 10, 2015 from http://www.pima.gov/cmo/sdcp/Monitoring/PDF/Fonseca_2008_Land_Cover.pdf.

Fonseca, J. 2009. Habitat mitigation in the Pima County Multiple Species Conservation Plan. County Administrator's Office. Report accessed on February April 10, 2015 from: http://www.pima.gov/cmo/sdcp/reports/d52/Habitat_Report.pdf.

Fonseca, J., and C. Jones. 2009. Progress report: Measuring effectiveness of open space land acquisitions in Pima County, Arizona in relation to the Sonoran Desert Conservation Plan. Accessed on April 10, 2015 from: http://www.pima.gov/cmo/sdcp/reports/d52/Acquisition_Analysis.pdf.

Fonseca, J., M. List, C. Jones, and J. R. M. Probsfeld. 2009. Projected imacts of uban growth for Pima County's Multiple-Species Conservation Plan. Draft report to the Pima County Board of Supervisors. Accessed on April 10, 2015 from: http://www.pima.gov/cmo/sdcp/reports/d51/Urban%20Growth%20Projection.pdf.

Fonseca, J., D. Scalero, and N. Connolly. 2000. Springs in Pima County, Arizona. Report to the Pima County Board of Supervisors for the Sonoran Desert Conservation Plan, Tucson Arizona. Tucson, Arizona.

Forrest, M. J., and M. A. Schlaepfer. 2011. Nothing a hot bath won't cure: Infection rates of amphibian Chytrid fungus correlate negatively with water temperature under natural field settings. Plos One 6.

Garcia, V., and C. J. Conway. 2007. Glyphosate applications to control buffelgrass in Pima County: Effects on burrowing owls. Wildlife Research Report #2007-07. USGS Arizona Cooperative Fish and Wildlife Research Unit, University of Arizona, Tucson, Arizona.

Glass, J. K. 1972. Feeding behavior of the western shovel-nosed snake *Chionactis occipitalis klauberi* with special reference to scorpions. Southwestern Naturalist 16:445-447.

Glinski, R. L., and R. S. Hall. 1998. Swainson's Hawk. Pages 92-95. *In* R. L. Glinski, editor. Raptors of Arizona. The University of Arizona Press, Tucson, Arizona.

Groschupf, K. D., B. T. Brown, and R. R. Johnson. 1988. An annotated checklist of birds of Organ Pipe Cactus National Monument, Arizona. Southwest Parks and Monument Association, Tucson, Arizona.

Hall, D. H., and R. J. Steidl. 2007. Ecology and conservation of desert box turtles (*Terrapene ornata luteola*). Unpublished report to the Arizona Game and Fish Department, Phoenix, Arizona.

Hamilton, W. J., and M. E. Hamilton. 1965. Breeding characteristics of yellow-billed cuckoos in Arizona. Proceedings of the California Academy of Sciences 32:405-432.

Harding, E. K., E. E. Crone, B. D. Elderd, J. M. Hoekstra, A. J. Mckerrow, J. D. Perrine, J. Regetz, L. J. Rissler, A. G. Stanley, and E. L. Walters. 2001. The scientific foundations of habitat conservation plans: A quantitative assessment. Conservation Biology 15:488-500.

Hardy, P. C., D. J. Griffin, A. J. Kuenzi, and M. L. Morrison. 2004. Occurrence and habitat use of passage Neotropical migrants in the Sonoran Desert. Western North American Naturalist 64:59-71.

Hatten, J. R., and C. E. Paradzick. 2003. A multiscaled model of southwestern willow flycatcher breeding habitat. Journal of Wildlife Management 67:774-788.

Hatten, J. R., and M. K. Sogge. 2007. Using a remote sensing/GIS model to predict southwestern willow flycatcher breeding habitat along the Rio Grande, New Mexico. Open File Report 2007-1207. U.S. Department of the Interior, U.S. Geological Survey, Reston, VA.

Haug, E. A., B. A. Millsap, and M. S. Martell. 1993. Burrowing owl (*Speotyto cunicularia*). *In* A. Poole and F. Gill, editors. The Birds of North America, No. 61. The Academy of Natural Sciences, Philadelphia, PA.

Hendrickson, D. A., and W. L. Minckley. 1984. Cienegas-vanishing climax communities of the American southwest. Desert Plants 6:131-175.

Hevly, R. H. 1979. Dietary habits of two nectar and pollen feeding bats in southern Arizona and northern Mexico. Journal of the Arizona-Nevada Academy of Science 14:13-18.

Heyer, W. R. 1994. Measuring and monitoring biological diversity. Smithsonian Institution Press, Washington, D.C.

Higginbotham, J. L., M. T. Dixon, and L. K. Ammerman. 2000. Yucca provides roost for *Lasiurus xanthinus* (Chiroptera: Vespertilionidae) in Texas. Southwestern Naturalist 45:338-340.

Hobbs, R. J. 2004. Breeding biology and spatial relationships of desert grassland raptors and corvids. PhD Dissertation ,. University of Arizona, Tucson, Arizona.

Hoffman, J. E., L. H. Gilbertson, and R. S. Fritz. 2012. Synonymy of *Sonorella rosemontensis* Pilsbry, 1939 with *Sonorella walkeri walkeri* Pilsbry and Ferriss, 1915 (Pulmonata: Helminthoglyptidae) from the Santa Rita Mountains, Arizona, USA. American Malacological Bulletin 30:309-314.

Hoffmeister, D. F. 1986. Mammals of Arizona. University of Arizona Press: Arizona Game and Fish Department, Tucson, Arizona.

Howell, D. J. 2007. Peer review comments submitted 3/21/2007 to FWS related to the 5-year review for the lesser long-nosed bat.

Hubbard, J. A., C. L. McIntyre, S. E. Studd, T. Nauman, D. Angell, K. Beaupré, B. Vance, and M. K. Connor. 2012. Terrestrial vegetation and soils monitoring protocol and standard operating procedures: Sonoran Desert and Chihuahuan Desert networks, version 1.1. Natural Resource Report NPS/SODN/NRR—2012/509. National Park Service, Fort Collins, Colorado. Accessed on March 31, 2015: http://science.nature.nps.gov/im/units/sodn/assets/docs/ProtocolDocs/P_Uplands.pdf.

Hudak, A. T., N. L. Crookston, J. S. Evans, D. E. Hall, and M. J. Falkowski. 2008. Nearest neighbor imputation of species-level, plot-scale forest structure attributes from LiDAR data. Remote Sensing of Environment 112:2232-2245.

Hughes, J. M. 1999. Yellow-billed cuckoo (*Coccyzus americanus*). *In* A. Poole and F. Gills, editors. The Birds of North America, no. 418. The Birds of North America, Inc, Philadelphia, Pennsylvania.

Jason, A. W., M. J. O'Farrell, and B. R. Riddle. 2006. Habitat use by bats in a riparian corridor of the Mojave desert in southern Nevada. Journal of Mammology 87:1145-1153.

Johnson, R. R., J.-L. E. Catron, L. T. Haight, R. B. Duncan, and K. J. Kingsley.J.-L. M. Catron and D. M. Finch, Eds. 2000. A historical perspective on the population decline of the cactus ferruginous pygmy-owl in Arizona. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Ogden, Utah.

Jones, C. A., C. R. Schwalbe, D. E. Swann, D. B. Prival, and W. W. Shaw. 2005. *Mycoplasma agassizii* in desert tortoises: Upper respiratory tract disease in captive and free-ranging populations in greater Tucson, Arizona. Final report to the Arizona Game and Fish Department. Heritage Fund Urban Project No. U03005. Phoenix, Arizona.

Jones, K. B. 1988. Distribution and habitat associations of herpetofauna in Arizona: comparisons by habitat type. *In* R. C. Szaro, K. E. Severson, and D. R. Patton, editors. Management of amphibians, reptiles, and small mammals in North America. Proceedings of the Symposium, July 19-21, Flagstaff, Arizona. USDA Forest Service General Technical Report RM-166.

Kats, L. B., and R. P. Ferrer. 2003. Alien predators and amphibian declines: Review of two decades of science and the transition to conservation. Diversity and Distributions 9:99-110.

Katz, G. L., J. C. Stromberg, and M. W. Denslow. 2009. Streamside herbaceous vegetation response to hydrologic restoration on the San Pedro River, Arizona. Ecohydrology 2:213-225.

Kingsley, K. J. 1989. Biological and social repercussions of irrigated pecan agriculture in southern Arizona. Pages 131-150. *In* J. O. Schmidt, editor. Special biotic relationships in the arid southwest. University of New Mexico Press, Albuquerque, New Mexico.

Kingsley, K. J. 2006. Evaluation of mesquite mouse (*Peromyscus merriami*) status in Pima County, Arizona. Unpublished report to the Arizona Game and Fish Department, Phoenix, Arizona.

Kirkpatrick, C., C. J. Conway, and D. LaRoche. 2007. Quantifying impacts of groundwater withdrawal on avian communities in desert riparian woodlands of the southwestern U.S. Unpublished report to the Department of Defense, Legacy Resource Management Program, Arlington, VA.

Klute, D. S., L. W. Ayers, M. T. Green, W. H. Howe, S. L. Jones, J. A. Shaffer, S. R. Sheffield, and T. S. Zimmerman. 2003. Status assessment and conservation plan for the western burrowing owl in the United States. Biological Technical Report Publication FWS/BTP-R6001-2003. U.S. Department of Interior, Fish and Wildlife Service, Washington, D. C.

Knopf, F. L., R. R. Johnson, T. Rich, F. B. Samson, and R. C. Szaro. 1988. Conservation of riparian ecosystems in the United States. Wilson Bulletin 100:272-284.

Krebbs, K., and J. Moss. 2009. Continued surveys for the yellow-billed cuckoo (*Coccyzus americanus occidentalis*) at Tumacacori National Historical Park. Unpublished report for the National Park Service, Tumacacori, Arizona.

Krueper, D., J. Bart, and T. D. Rich. 2003. Response of vegetation and breeding birds to the removal of cattle on the San Pedro River, Arizona (USA). Conservation Biology 17:607-615.

Latta, M. J., C. J. Beardmore, and T. E. Corman. 1999. Arizona Partners in Flight: Bird conservation plan. Technical Report 142, Nongame and Endangered Wildlife Program, Arizona Game and Fish Department, Phoenix Arizona.

Laymon, S. A., and M. D. Halterman. 1987. Can the western species of yellow-billed cuckoo be saved from extinction? Western Birds 18:19-25.

Leopold, L. B., M. G. Wolman, and J. P. Miller, editors. 1964. Fluvial processes in geomorphology. W. H. Freeman Publishers, San Francisco, California.

Lips, K. R., F. Brem, R. Brenes, J. D. Reeve, R. A. Alford, J. Voyles, C. Carey, L. Livo, A. P. Pessier, and J. P. Collins. 2006. Emerging infectious disease and the loss of biodiversity in a Neotropical amphibian community. Proceedings of the National Academy of Sciences of the United States of America 103:3165-3170.

Lite, S. J., and J. C. Stromberg. 2005. Surface water and ground-water thresholds for maintaining *Populus-Salix* forests, San Pedro River, Arizona. Biological Conservation 125:153-167.

Llewellyn, R., and S. Zetlan. 2007. A baseline herpetological inventory within the Audubon Esperanza Ranch Santa Cruz river restoration site: 2005 and 2006 final report. Report prepared for the Tucson Audubon Society, Tucson, Arizona.

Lloyd, J., R. W. Mannan, S. Destefano, and C. Kirkpatrick. 1998. The effects of mesquite invasion on a southeastern Arizona grassland bird community. Wilson Bulletin 110:403-408.

Lohr, S. 1999. Sampling: Design and analysis. Duxbury Press, Pacific Grove, California.

Lowe, C. H. 1964. The vertebrates of Arizona. The University of Arizona Press, Tucson, Arizona.

Lowther, P. E., K. D. Groschupf, S. M. Russell, and D. F.Stotz. 1999. Rufous-winged sparrow (*Aimophila carpalis*). *In* A. Poole and F. Gill, editors. The Birds of North America, No. 422. The Academy of Natural Sciences, Philadelphia, PA.

MacKenzie, D. I., J. D. Nichols, J. E. Hines, M. G. Knutson, and A. B. Franklin. 2003. Estimating site occupancy, colonization, and local extinction when a species is detected imperfectly. Ecology 84:2200-2207.

MacKenzie, D. I., J. D. Nichols, J. A. Royle, K. H. Pollock, L. L. Bailey, and J. E. Hines. 2006. Occupancy estimation and modeling: Inferring patterns and dynamics of species. Elsevier Press, Burlington, Massachusettes.

Manley, P. N., B. V. Horne, J. K. Roth, W. J. Zielinski, M. M. McKenzie, T. J. Weller, F. W. Weckerly, and C. Vojta. 2006. Multiple species inventory and monitoring technical guide, Version 1.0. General Technical Report WO-73. USDA Forest Service, Washington Office, Washington, D.C.

Marsh, P. C., B. R. Kesner, J. A. Stefferud, and S. E. Stefferud. 2009. Fish monitoring of selected streams of the Gila River Basin, 2008. Unpublished report to the Bureau of Reclamation, Phoenix Area Office, Phoenix, Arizona.

Marsh, P. C., B. R. Kesner, J. A. Stefferud, and S. E. Stefferud. 2010. Fish monitoring of selected streams of the Gila River Basin, 2009. Unpublished report to the Bureau of Reclamation, Phoenix Area Office, Phoenix, Arizona.

Martin, B. T., N. P. Bernstein, R. D. Birkhead, J. F. Koukl, S. M. Mussmann, and J. S. Placyk. 2013. Sequence-based molecular phylogenetics and phylogeography of the American box turtles (*Terrapene* spp.) with support from DNA barcoding. Molecular Phylogenetics and Evolution 68:119-134.

Mau-Crimmins, T., A. Hubbard, D. Angell, C. Filippone, and K. Kline. 2005. Sonoran Desert Network vital signs monitoring plan. Technical Report NPS/IMR/SODN-003. National Park Service, Denver, Colorado.

McCaffrey, R. E., W. R. Turner, and A. J. Borens. 2012. A New Approach to Urban Bird Monitoring: The Tucson Bird Count. Urban Bird Ecology and Conservation 45:139-153.

McCasland, C. 2005. Comments submitted 5/3/2005, in response to Federal Register Notice of Review (70 FR 5460) for the lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*).

McConnell, W. J., and E. F. Moran. 2000. Meeting in the middle: The challenge of meso-level integration. An international workshop. October 17-20, 2000, Ispra, Italy. Anthropological Center for Training and Research on Global Environmental Change, Indiana University, Bloomington, IN.

McCord, R. D. 1994. Phylogeny and biogeography of the land snail, *Sonorella*, in the Madrean Archipelago. Pages 317-324 *In* L. F. Debano, P. F. Ffolliott, A. Ortega-Rubio, G. J. Gottfried, R. H. Hamre, and C. B. Edminster, editors. Biodiversity and management of the Madrean Archipelago: The Sky Islands of southwestern United States and northwestern Mexico. USDA Forest Service General Technical Report RM-GTR-264, Fort Collins, Colorado.

McDonald, C. J. 2005. Conservation of the rare Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*): Recruitment after fires and pollination in the Altar Valley of southern Arizona. Master of Science Thesis, School of Natural Resource, University of Arizona, Tucson, Arizona.

McGann and Associate Inc. 1994. Cienega Creek Natural Preserve Management Plan. Prepared for the Pima County Regional Flood Control District. Tucson, Arizona.

Medellín, R. A. 2005. Comments submitted 4/27/05 and 10/5/05, in response to Federal Register Notice of Review (70 FR 5460) for the lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*).

Meyer, W. B., and I. B. L. Turner. 1994. Changes in land use and land cover: A global perspective. Cambridge University Press, Cambridge, UK.

Mills, G. S., J. Dunning, J. B., and J. M. Bates. 1989. Effects of urbanization on breeding bird community structure in southwestern desert habitats. The Condor 91:416-428.

Minckley, W. L. 1973. Fishes of Arizona. Arizona Game and Fish Department, Phoenix, Arizona.

Morrison, M. L., W. M. Block, M. D. Strickland, and W. L. Kendall. 2001. Wildlife study design. Springer Press, New York, New York.

Morrison, M. L., B. G. Marcot, and R. W. Mannan. 1998. Wildlife-habitat relationships: Concepts and applications. The University of Wisconsin Press, Madison, WI.

Moulton, C. E., R. S. Brady, and J. R. Belthoff. 2006. Association between wildlife and agriculture: Underlying mechanisms and implications in burrowing owls. Journal of Wildlife Management 70:708-716.

Mpoame, M., and J. R. Rinne. 1983. Parasites of some fishes native to Arizona and New Mexico. The Southwestern Naturalist 28:399-405.

Murray, R. C. 1996. Amphibian and reptile inventory of the Saguaro National Park Expansion Area. L. K. Harris, editor. Unpublished report to Saguaro National Park, Tucson, Arizona.

Naiman, R. J., and H. Decamps. 1997. The ecology of interfaces: Riparian zones. Annual Review of Ecology and Systematics 28:621-658.

National Biological Service. 1995. Organ Pipe Cactus National Monument ecological monitoring program monitoring protocol manual. Special Report 11. Cooperative Park Studies Unit, University of Arizona, Tucson, Arizona.

Nishida, C., S. DeStefano, and C. Boal. 2001. Status of Swainson's hawks in southeastern Arizona. Unpublished report to the Arizona Game and Fish Department, Phoenix, Arizona.

Noel, D., and T. B. Johnson. 1993. Bats of Arizona. Arizona Wildlife Views 36:1-36.

Noon, B. R. 2003. Conceptual issues in monitoring ecological resources. Pages 27-71. *In* D. E. Busch and J. C. Trexler, editors. Monitoring ecosystems: Interdisciplinary approaches for evaluating ecoregional initiatives. Island Press, Washington, DC.

Oakley, K. L., L. P. Thomas, and S. G. Fancy. 2003. Guidelines for long-term monitoring protocols. Wildlife Society Bulletin 31:1000-1003.

Ober, H. K., and R. J. Steidl. 2004. Foraging rates of L*eptonycteris curasoae* vary with characteristics of *Agavi palmeri*. The Southwestern Naturalist 49:68-74.

Ober, H. K., R. J. Steidl, and V. M. Dalton. 2005. Resource and spatial-use patterns of an endangered vertebrate pollinator, the lesser long-nosed bat. Journal of Wildlife Management 69:1615-1622.

Organ Pipe Cactus National Monument. 1999. Ecological Monitoring Program annual report 1996. National Park Service, Ajo, Arizona.

Organ Pipe Cactus National Monument. 2006a. Ecological Monitoring Program project report 1997-2005. Unpublished report. Ajo, Arizona.

Organ Pipe Cactus National Monument. 2006b. Ecological Monitoring Program report 1997-2005. Organ Pipe Cactus National Monument, Arizona.

Paradzick, C. E. 2005. Southwestern Willow Flycatcher habitat selection along the Gila and lower San Pedro rivers, Arizona: Vegetation and hydrogeomorphic considerations. Arizona State University, Tempe, Arizona.

Paradzick, C. E., R. F. Davidson, J. W. Rourke, M. W. Sumner, A. M. Wartell, and T. D. McCarthey. 2000. Southwestern willow flycatcher. 1999 survey and nest monitoring report. Nongame and Endangered Wildlife Program Technical Report 151. Arizona Game and Fish Department, Phoenix, Arizona.

Paxton, E. H., M. K. Sogge, S. L. Durst, T. C. Theimer, and J. R. Hatten. 2007. The ecology of the southwestern willow flycatcher in central Arizona: A 10 year synthesis report. U.S. Geological Survey Open File Report 2007-1381. U.S. Department of the Interior, U.S. Geological Survey, Reston, VA.

Paxton, E. H., T. C. Theimer, and M. K. Sogge. 2011. Tamarisk biocontrol using tamarisk beetles: Potential consequences for riparian birds in the southwestern United States. Condor 113:255-265.

Peterman, R. M. 1990. The importance of reporting statistical power: The forest decline and acidic deposition example. Ecology 71:2024-2027.

Petryszyn, Y., and E. L. Cockrum. 1990. Mammals of the Quitobaquito Management Area, Organ Pipe Cactus National Monument, Arizona. Technical Report No. 36. Cooperative National Park Resources Studies Unit Arizona, University of Arizona, Tucson, Arizona.

Phillips, A., J. Marshall, and G. Monson. 1964. The birds of Arizona. University of Arizona Press, Tucson, Arizona.

Pierson, E. D., W. E. Rainey, and C. J. Corben. 1999. The western red bat, *Lasiurus blossevillii*: Implications of distribution for conservation. Bat Research News 40:187.

Pilsbry, H. A., and J. H. Harris. 1915. The Dragoon, Mule, Santa Rita, Baboquivari, and Tucson Ranges, Arizona. Part VII of Mollusca of the southwestern states. Proceedings of the Academy of Natural Sciences of Philadelphia 67:363-418.

Pilsbry, H. A., J. H. Harris. 1918. The Santa Catalina, Rincon, Tortillita, and Caliuro Mountains and the mountains of the Gila headwaters. Parts IX and X in Mollusca of the southwestern states *in* Proceedings of the Academy of Natural Sciences of Philadelphia 70:282-333.

Pima Association of Governments. 2009. Cienega Creek Natural Preserve surface water and groundwater monitoring. Annual report for the 2007-2008 fiscal year. Unpublished report to the Pima County Regional Flood Control District, Tucson, Arizona.

Pima County. 2000a. Draft preliminary Sonoran Desert Conservation Plan. Report to the Pima County Board of Supervisors for the Sonoran Desert Conservation Plan. Tucson, Arizona.

Pima County. 2000b. Preliminary riparian protection, management and restoration element. A report to the Pima County Board of Supervisors in support of the Sonoran Desert Conservation Plan. Tucson, Arizona.

Pima County. 2011. Protecting our land, water, and heritage: Pima County's voter-supported conservation efforts. Accessed on April 10, 2015 from: http://www.pima.gov/cmo/admin/Reports/ConservationReport/.

Powell, B. F. 2000. Results of yellow-billed cuckoo surveys adjacent to Tumacacori National Historical Park in Arizona: A report on the 2000 breeding season. U.S. Geological Service, Sonoran Desert Field Station. University of Arizona, Tucson, Arizona.

Powell, B. F. 2004. Assessment of the bird community along the Middle Reach of Rincon Creek, Saguaro National Park. Unpublished report to Saguaro National Park, Tucson, Arizona.

Powell, B. F. 2006. Birds. Pages 45-68. *In* B. F. Powell, W. L. Halvorson, and C. A. Schmidt, editors. Vascular plant and vertebrate inventory of Saguaro National Park, Rincon Mountain District. U. S. Geological Survey Open File Report 2006-1075. Reston, VA.

Powell, B. F. 2007a. Birds. Pages 37-46. *In* B. F. Powell, W. L. Halvorson, and C. A. Schmidt, editors. Vascular plant and vertebrate inventory of Saguaro National Park, Tucson Mountain District. U. S. Geological Survey Open File Report 2007-1296. Reston, VA.

Powell, B. F. 2007b. A new approach for monitoring multiple species. Endangered Species Bulletin Year in Review: 2007:44-45.

Powell, B. F. 2010a. Climate change and natural resources in Pima County: Anticipated impacts and management challenges. Unpublished report of the Pima County Office of Sustainability and Conservation, Tucson, Arizona. Accessed on April 10, 2015 from: http://www.pima.gov/cmo/sdcp/reports/d52/Ecological_Impacts.pdf.

Powell, B. F. 2010b. Data management plan for the Pima County Ecological Monitoring Program. Pima County Office of Conservation Science and Environmental Policy, Tucson, Arizona. Accessed on April 10, 2015 from: http://www.pima.gov/cmo/sdcp/Monitoring/PDF/Supplement_E_Data_Management_Plan.pdf.

Powell, B. F. 2010c. Pima County Ecological Monitoring Program: Final Monitoring Plan and Report. Unpublished report of the Arizona Game and Fish Department, Phoenix, Arizona. Accessed on April 10, 2015 from: http://www.pima.gov/cmo/sdcp/Monitoring/index.html.

Powell, B. F. 2011. Status of Pima pineapple cactus at Southeast Regional Park, Pima County, Arizona. Unpublished report by the Pima County Office of Sustainability and Conservation, Tucson, Arizona.

Powell, B. F., E. W. Albrecht, W. L. Halvorson, C. A. Schmidt, P. Anning, and K. Docherty. 2005. Vascular plant and vertebrate inventory of Tumacacori National Historic Park. USGS Open-File Report 2005-1142. U.S. Geological Survey, Southwest Biological Science Center, Sonoran Desert Research Station, University of Arizona, Tucson, Arizona.

Powell, B. F., and R. J. Steidl. 2000. Nesting habitat and reproductive success of southwestern riparian birds. Condor 102:823-831.

Powell, B. F., and R. J. Steidl. 2002. Habitat selection by riparian songbirds breeding in southern Arizona. Journal of Wildlife Management 66:1096-1103.

Powell, B. F., D. E. Swann, and D. E. Hall. 2013. Results of a comprehensive survey for lowland leopard frogs in the Rincon and Catalina mountain complex. Final report to the Desert Southwest Coorperative Ecosystems Study Unit, Tucson, Arizona.

Preston, K., J. T. Rotenberry, R. A. Redak, and M. F. Allen. 2008. Habitat shifts of endangered species under altered climate conditions: Importance of biotic interactions. Global Change Biology 14:2501-2515.

Proudfoot, G. A., J. L. Usener, and P. D. Teel. 2005. Ferruginous Pygmy-Owls A new host for Protocalliphora sialia and Hesperocimex sonorensis in Arizona. Wilson Bulletin 117:185-188.

Public/Private Ventures. 2002. Making the most of volunteers.

Rahn, M. E., H. Doremus, and J. Diffendorfer. 2006. Species coverage in multispecies habitat conservation plans: Where's the science? Bioscience 56:613-619.

RECON Environmental Inc. 2007. Ecological effectiveness monitoring plan for Pima County: Phase 1 final report. Report to the Pima County Board of Supervisors for the Sonoran Desert Conservation Plan. Accessed on April 10, 2015 from: http://www.pima.gov/cmo/sdcp/reports/d30/EEMP.pdf. Tucson, Arizona.

Reichenbacher, F. W. 1990. Tumamoc globeberry studies in Arizona and Sonora, Mexico. Bureau of Reclamation, Arizona Projects Office. Phoenix, Arizona.

Reichenbacher, F. W. 2008. Revisiting the Tumamoc globeberry (*Tumamoca macdougalii* Rose). Unpublished report, Scottsdale, Arizona.

Reichenbacher, F. W. 2009. Monitoring the Tumamoc globeberry: 2009. Unpublished report, Scottsdale, Arizona.

Reichenbacher, F. W., and R. H. Perrill. 1991. Monitoring transplanted *Tumamoca macdougalii*: Tucson Aquaduct, Phase B, Central Arizona Project. Bureau of Reclamation, Arizona Projects Office. Phoenix, Arizona.

Richardson, W. S., J. E. Cartron, D. J. Krueper, L. Turner, and T. H. Skinner. 2000. The status of the cactus ferruginous pygmy-owl in Arizona: Population surveys and habitat assessment. Pages 27-39. *In* J. E. Cartron and D. M. Finch, editors. Ecology and conservation of the cactus ferruginous pygmy-owl in Arizona. USDA Forest Service. Gen. Tech. Rep. RMRS-GTR-43, Ogden, Utah.

Ringold, P. L., J. Alegria, R. L. Czaplewski, B. S. Mulder, T. Tolle, and K. Burnett. 1996. Adaptive monitoring design for ecosystem management. Ecological Applications 6:745-747.

Rodden, I. 2010. 2010 Southwestern willow flycatcher survey in lower Cienega Creek, Pima County, Arizona. Unpublished report of the Pima County Natural Resources, Parks, and Recreation Department, Tucson, Arizona.

Roller, P. 1996a. Pima pineapple cactus recommended survey protocol: Three tier survey methods. Accessed on May 30, 2014 from: http://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/PimaPineappleCactus/ppc_survey_protocol.pdf.

Roller, P. S. 1996b. Distribution, growth, and reproduction of Pima pineapple cactus (*Coryphantha scheeri* Kuntz var. *robustispina* Schott). M. S. Thesis. University of Arizona, Tucson, Arizona.

Rondeau, R., T. R. Van Devender, C. D. Bertelsen, P. Jenkins, R. K. Wilson, and M. A. Dimmitt. 1996. Annotated flora and vegetation of the Tucson Mountains, Pima County, Arizona. Desert Plants 12:2-47.

Rosen, P. C. 2000. Aquatic vertebrate conservation in Pima County: Concepts and planning development. Draft report to the Pima County Board of Supervisors, Tucson, Arizona.

Rosen, P. C. 2003. Biological survey of Ironwood Forest National Monument. Unpublished report to the Bureau of Land Management, Tucson, Arizona.

Rosen, P. C. 2004. Avra Valley snakes: Marana survey report for ground snakes (*Sonora semiannulata*). Draft final report to the Town of Marana, Arizona.

Rosen, P. C. 2007. Survey results for the Tucson shovel-nosed snake (*Chionactis occipitalis klauberi*), with evidence for the ecological change in south-central Arizona. Unpublished report to the School of Natural Resources, University of Arizona, Tucson, Arizona.

Rosen, P. C. 2008a. Habitat and distributional notes on the western ground snake in metropolitan Phoenix and Tortolita Mountains: Implications for preservation in Marana, Arizona. Interim report to the Town of Marana, Arizona. Marana, Arizona.

Rosen, P. C. 2008b. Survey results for Tucson Shovel-nosed Snake in South-Central Arizona, 2008: Summary Report to the Town of Marana. Marana, AZ.

Rosen, P. C. 2008c. Urban amphibian and reptile biodiversity: Report to the Technical Advisory Committee (TAC) for City of Tucson Habitat Conservation Plan (HCP). University of Arizona, Tucson, Arizona.

Rosen, P. C., and D. J. Caldwell. 2004. Aquatic and riparian herpetofauna of Las Cienegas National Conservation Area, Pima County, Arizona. Unpublished report to Pima County Board of Supervisors for the Sonoran Desert Conservation Plan, Tucson, Arizona.

Rosen, P. C., and C. H. Lowe. 1994. Highway mortality of snakes in the Sonoran Desert of Southern Arizona. Biological Conservation 68:143-148.

Rosen, P. C., and C. H. Lowe. 1996. Ecology of the amphibians and reptiles at Organ Pipe Cactus National Monument. U.S. Department of the Interior,, National Park Service, and Organ Pipe Cactus National Monument. University of Arizona, Tucson, Arizona.

Rosen, P. C., and C. R. Schwalbe. 1988. Status of the Mexican and narrow-headed garter snakes (*Thamnophis eques megalops* and *Thamnphis rufipunctatus*) in

Arizona. Unpublished report from Arizona Game and Fish Department to U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

Rosen, P. C., N. Steklis, D. Caldwell, and D. E. Hall. 2013. Restoring leopard frogs and habitat in Sky Island grasslands (Arizona). Final report to the National Fish and Wildlife Foundation, Washington, D.C.

Rosen, P. C., E. J. Wallace, and C. R. Schwalbe. 2001. Resurvey of the Mexican garter snake (*Thamnophis eques*) in southeastern Arizona. Unpublished report.

Rosenberg, K. V., R. D. Ohmart, W. C. Hunter, and B. W. Anderson. 1991. Birds of the lower Colorado River Valley. University of Arizona Press, Tucson, Arizona.

Rosenstock, S. S., D. R. Anderson, K. M. Giesen, T. Leukering, and M. F. Carter. 2002. Landbird counting techniques: Current practices and an alternative. Auk 119:46-53.

Routson, R., M. Dimmitt, and R. C. Brusca. 2004. A demographic study of *Coryphantha scheeri* var*. robustispina*. Final report to USFWS. NFWF contract # 2000-0015.

Royle, J. A., J. D. Nichols, and M. Kery. 2005. Modeling occurrence and abundance of species when detection is imperfect. Oikos 110:353-359.

Sada, D. W., E. Fleischman, and D. D. Murphy. 2005. Associations among spring-dependent aquatic assemblages and environmental and land use gradients in a Mojave Desert mountain range. Diversity and Distributions 11:91-99.

Sage Landscape Architecture and Environmental Inc. 2003. Yellow-billed cuckoo (*Coccyzus americanus*) survey results from portions of the Santa Cruz River and Tanque Verde Creek, Pima County, Arizona. Unpublished report submitted to Pima Count Department of Transportation and Flood Control District.

Salafsky, N., and R. Margoluis. 1999. Threat reduction assessment: A practical and cost-effective approach to evaluating conservation and development projects. Conservation Biology 13:830-841.

Sartorius, S. S., and P. C. Rosen. 2000. Breeding phenology of the Lowland leopard frog (*Rana yavapaiensis*): Implications for conservation and ecology. The Southwestern Naturalist 45:267-273.

Savage, A. E., M. J. Sredl, and K. R. Zamudio. 2011. Disease dynamics vary spatially and temporally in a North American amphibian. Biological Conservation 144:1910-1915.

Schmalzel, B. 2004. Morphometric variation in *Coryphantha robustispina* (Cactaceae). WestLand Resources, Inc, Tucson, Arizona.

Schmalzel, B. 2008. Some considerations and observations regarding the natural history of the Pima pineapple cactus. WestLand Resources, Inc, Tucson, Arizona.

Schmidt, C. A., B. F. Powell, and W. L. Halvorson. 2005. Vascular plant and vertebrate inventory of Tuzigoot National Monument. OFR 2005-1347. USGS Southwest Biological Science Center, Sonoran Desert Research Station, University of Arizona, Tucson, Arizona.

Schmidt, C. A., B. F. Powell, and W. L. Halvorson. 2007. Vascular plant and vertebrate inventory of Organ Pipe Cactus National Monument. USGS Open-File Report 2006-1076. U.S. Geological Survey, Southwest Biological Science Center, Sonoran Desert Research Station, University of Arizona, Tucson, Arizona.

Scott, C. T. 1998. Sampling methods for estimating change in forest resources. Ecological Applications 8:228-233.

Shaw, W. 2006. Guidance document to develop the effectiveness monitoring plan for the Sonoran Desert Conservation Plan and Multi-species Conservation Plan for Pima County. Memo to Chuck Huckelberry, Pima County Administrator. February 21, 2006.

Sheller, F. J., W. F. Fagan, and P. J. Unmack. 2006. Using survival analysis to study translocation success in the Gila topminnow (Poeciliopsis occidentalis). Ecological Applications 16:1771-1784.

Shump, K. A., and A. U. Shump. 1982. *Lasiurus borealis*. Mammalian Species 183:1-6.

Sidner, R. 2005. Fifteen years of monitoring the endangered lesser long-nosed bat (*Leptonycteris curasoae*) and other bat species on the Fort Huachuca Military Installation, Cochise County, Arizona. June-November 2004. EEC Project Report to Commander, U.S. Army Garrison, Fort Huachuca, Arizona.

Simms, J. R., K. M. Simms, and D. K. Duncan. 2006. An assessment of long-term aquatic habitat change and Gila Topminnow population trends for Cienega Creek, Pima County, Arizona. Page 75. Borders, boundaries, and time scales. Extended abstracts from the Sixth Conference on Research and Resource Management in the Southwestern Deserts, May 2-5, Tucson, Arizona.

Snow, T. K., S. V. Castner, and D. C. Noel. 1996. Bat inventory of abandoned mines: Bureau of Land Management, Tucson Resource Area. Nongame and Endangered Wildlife Program Technical Report 104. Arizona Game and Fish Department, Phoenix, Arizona.

Sogge, M. K., D. Ahlers, and S. J. Sferra. 2010. A natural history summary and survey protocol for the southwestern willow flycatcher. U.S. Geological Survey Techniques and Methods 2A-10. Accessed on April 10, 2015 from: http://pubs.usgs.gov/tm/tm2a10/.

Sogge, M. K., E. H. Paxton, and A. Tudor. 2005. Saltcedar and southwestern willow flycatchers: Lessons from long-term studies in central Arizona. *In* C. Aguirre-Bravo and others, editors. Monitoring science and technology symposium: Unifying knowledge for sustainability in the Western Hemisphere. Proceedings RMRS-P037CD. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado.

Soranno, P. A., S. L. Hubler, S. R. Carpenter, and R. C. Lathrop. 1996. Phosphorus loads to surface waters: A simple model to account for spatial pattern of land use. Ecological Applications 6:865-878.

Spencer, S. G., P. C. Choucair, and B. R. Chapman. 1988. Northward expansion of the southern yellow bat, *Lasiurus ega*, in Texas. Southwestern Naturalist 33:493.

Sredl, M. J., and J. M. Howland. 1994. Conservation and management of Madrean populations of the Chiricahua leopard frog. *In* L. F. Debano, P. F. Ffolliott, A. Ortega-Rubio, G. J. Gottfried, R. H. Hamre, and C. B. Edminster, editors. Biodiversity and management of the Madrean Archipelago: The sky islands of southwestern United States and northwestern Mexico. USDA Forest Service General Technical Report RM-GTR-264. Fort Collins, Colorado.

Stantec Inc., Pima County, City of Tucson, and Curtis Lueck and Associates. 2009. Location of growth, urban form, and cost of infrastructure. White paper supporting Phase 2 of the Water and Wastewater Infrastructure, Supply and Planning study. Accessed on April 10, 2015 from: http://www.tucsonpimawaterstudy.com/Reports/Phase2/GrowthReport.pdf.

Stebbins, R. C. 1985. A field guide to western reptiles and amphibians. Second edition. Houghton Mifflin Company, Boston, Massachusettes.

Steidl, R. J., J. P. Hayes, and E. Schauber. 1997. Statistical power analysis in wildlife research. Journal of Wildlife Management 61:270-279.

Steidl, R. J., A. R. Litt, B. F. Powell, and S. Mann. 2010. Selecting parameters for ecological monitoring programs: A case study of Pima County, Arizona. Supplement to a final report to the Arizona Game and Fish Department, Phoenix, Arizona. Accessed on April 10, 2015 from: http://www.pima.gov/cmo/sdcp/Monitoring/PDF/Supplement_B_Detailed_Design_Process.pdf

Stoleson, S. H., and D. M. Finch. 2000. Landscape-level effects on habitat use, nesting success, and brood parasitism in the southwestern willow flycatcher. Grant No. 99-254. Report to the National Fish and Wildlife Foundation, Washington, D.C.

Streutker, D. R., and N. F. Glenn. 2006. LiDAR measurement of sagebrush steppe vegetation heights. Remote Sensing of Environment 102:135-145.

Stromberg, J. C., S. J. Lite, T. J. Rychener, L. R. Levick, M. D. Dixon, and J. M. Watts. 2006. Status of the riparian ecosystem in the Upper San Pedro River, Arizona: Application of an assessment model. Environmental Monitoring and Assessment 115:145-173.

Stromberg, J. C., R. Tiller, and B. Richter. 1996. Effects of groundwater decline on riparian vegetation of semiarid regions: The San Pedro River, Arizona. Ecological Applications 6:113-131.

Sublette, J. E., M. D. Hatch, and M. Sublette. 1990. The fishes of New Mexico. University of New Mexico Press. Albuquerque, New Mexico.

Swann, D. E., and B. F. Powell. 2006. Mammals. Pages 69-88. *In* B. F. Powell, W. L. Halvorson, and C. A. Schmidt, editors. Vascular plant and vertebrate inventory of Saguaro National Park, Rincon Mountain District. U. S. Geological Survey Open File Report 2006-1075. Reston, VA.

Swann, D. E., and B. F. Powell. 2007. Mammals. Pages 47-60. *In* B. F. Powell, W. L. Halvorson, and C. A. Schmidt, editors. Vascular plant and vertebrate inventory of Saguaro National Park, Tucson Mountain District. U. S. Geological Survey Open File Report 2007-1296. Reston, VA.

Swann, D. E., and J. E. Wallace. 2008. Management strategy for the lowland leopard frog (*Rana yavapaiensis*) in Saguaro National Park. Final report to Saguaro National Park and Desert Southwest Cooperative Ecosystem Studies Unit, Tucson, Arizona.

Swetnam, T., and B. F. Powell. 2010. Example of the use of LiDAR for monitoring vegetation characteristics: An example from the Cienega Creek Nature Preserve. Unpublished report to the Pima County Office of Conservation Science and Environmental Policy, Tucson, Arizona. Accessed on April 10, 2015 from:

http://www.pima.gov/cmo/sdcp/Monitoring/PDF/Supplement_D_Examing_Use_of_LiDAR_For_Monitoring_Vegetation.pdf.

Tear, T. H., P. Kareiva, P. L. Angermeier, P. Comer, B. Czech, R. Kautz, L. Landon, D. Mehlman, K. Murphy, M. Ruckelshaus, J. M. Scott, and G. Wilhere. 2005. How much is enough? The recurrent problem of setting measurable objectives in conservation. Bioscience 55:835-849.

Terkanian, B. 1999. Conservation plans for the San Xavier Talussnail, *Sonorella eremita*. Sonoran Arthropods Studies Institute, Tucson, Arizona.

Tetra Tech. 2011. 2011 Biological survey on U.S. Forest Service, Arizona State, and Pima County Lands. Report to the Oracle Ridge Mine, LLC, Oro Valley, Arizona.

The National Geographic Society. 1987. Field guide to the birds of North America, 2nd edition. Washington, D. C.

Theobald, D. M., D. L. Stevens, D. White, N. S. Urquhart, A. R. Olsen, and J. B. Norman. 2007. Using GIS to generate spatially balanced random survey designs for natural resource applications. Environmental Management 40:134-146.

Thompson, S. K. 2002. Sampling. Second edition. John Wiley and Sons, New York, New York.

Thompson, S. K., and G. A. F. Seber. 1996. Adaptive sampling. John Wiley and Sons, New York, New York.

Titus, J. H., and P. J. Titus. 2008a. Assessing the reintroduction potential of the endangered Huachuca water umbel in southeastern Arizona. Ecological Restoration 26:311-320.

Titus, P. J., and J. H. Titus. 2008b. Ecological monitoring of the endangered Huachuca water umbel (*Lilaeopsis schaffnerjana* ssp*. recurva*: Apiaceae). Southwestern Naturalist 53:458-465.

Town of Marana. 2009. Draft Habitat Conservation Plan for Marana, Arizona. U.S. Fish and Wildlife Service, Marana, Arizona.

Tucson Bird Count. 2012. Unpublished data of the Tucson Bird Count, 2001-2011. Tucson, Arizona.

Turner, B. L. I., D. Skole, S. Sanderson, G. Fisher, L. Fresco, and R. Leemans. 1995. Land use and land cover change science/research plan. IHDP Report No. 7. International Geosphere-Biosphere Programme, International Council of Scientific Unions, Stockholm, Sweden.

Tweit, R. C., and D. M. Finch. 1994. Abert's towhee (*Pipilo aberti*). *In* A. Poole and F. Gill, editors. The Birds of North America, No. 111. The Birds of North America, Inc, Philadelphia, PA.

Tweit, R. C., and J. C. Tweit. 1986. Urban development effects on the abundance of some common resident birds of the Tucson area of Arizona. American Birds 40:431-436.

U. S. Fish and Wildlife Service. 2014a. Endangered and threatended wildlife and plants: Designation of Critical Habitat for western distinct population segment of the yellow-billed cuckoo; Proposed rule. Docket No. FWS–R8–ES–2013–0011; 4500030114. Federal Registry Volume 79 No. 158, Washington, D.C.

U. S. Fish and Wildlife Service. 2014b. Huachuca water umbel (*Lilaeopsis schaffneriana* spp *recurva*) 5-year review: Summary and evaluation. U.S. Fish and Wildlife Service, Arizona Ecological Services Office, Phoenix, Arizona.

U.S. Bureau of Reclamation. 2008. Species accounts for the Lower Colorado River Multi-Species Conservation Program. Lower Colorado Region, Bureau of Reclamation, Boulder City, Nevada.

U.S. Fish and Wildlife Service. 1993. Endangered and threatened wildlife and plants: Determination of endangered status for the plant Pima pineapple cactus (*Coryphantha scheeri* var*. robustispina*); final rule. Federal Register Vol. 58 No. 183. Federal Register.

U.S. Fish and Wildlife Service. 1995a. Final rule determining endangered status for the southwestern willow flycatcher. Federal Register Vol. 60 No. 38. Federal Register.

U.S. Fish and Wildlife Service. 1995b. Lesser long-nosed bat recovery plan. U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

U.S. Fish and Wildlife Service. 1997a. Endangered and threatened wildlife and plants: determination of endangered status for three wetland species found in southern Arizona and northern Sonora, Mexico; final rule. Federal Register Vol. 62 No. 3.

U.S. Fish and Wildlife Service. 1997b. Endangered and threatened wildlife and plants; determination of endangered status for the cactus ferruginous pygmy-owl in Arizona; Final rule. Federal Register Vol. 62 No. 46.

U.S. Fish and Wildlife Service. 1999a. Designation of critical habitat for the Huachuca water umbel, a plant. Federal Register Vol. 64 No. 132.

U.S. Fish and Wildlife Service. 1999b. Endangered and Threatened Wildlife and Plants; designation of critical habitat for the Huachuca water umbel, a plant; final rule. 50 CFR § 17.

U.S. Fish and Wildlife Service. 2000a. Final addendum to the handbook for habitat conservation planning and Incidental Take Permit. Washington, D.C.

U.S. Fish and Wildlife Service. 2000b. Species abstract for needle-spined pineapple cactus (*Sclerocactus erectocentrus*).

U.S. Fish and Wildlife Service. 2002. Endangered and threatened wildlife and plants: Listing of the Gila chub as endangered with critical habitat. Federal Register Vol. 67 No. 154.

U.S. Fish and Wildlife Service. 2005a. Endangered and threatened wildlife and plants: Listing Gila chub as endangered with critical habitat: Final Rule. Federal Register, Vol. 70 No. 211.

U.S. Fish and Wildlife Service. 2005b. Lesser long-nosed bat 5-year review: Summary and evaluation. U.S. Fish and Wildlife Service, Phoenix, Arizona.

U.S. Fish and Wildlife Service. 2006. Chiricahua leopard frog (*Rana chiricahuensis*) draft recovery plan. Southwest Region, Albuquerque, New Mexico. Accessed on April 10, 2015 from: http://www.fws.gov/southwest/es/arizona/Documents/SpeciesDocs/CLF/DraftRP/Draft_CLF_Plan.pdf.

U.S. Fish and Wildlife Service. 2007a. 5-Year review: Pima pineapple cactus. Albuquerque, New Mexico.

U.S. Fish and Wildlife Service. 2007b. Five-year review: Pima pineapple cactus. Albuquerque, New Mexico. U. S. Fish and Wildlife Service.
U.S. Fish and Wildlife Service. 2008. Petition to list the Sonoran sesert torroise (*Gopherus agassizii*) under the U.S. Endangered Species Act. United States Department of Interior, Washington, D.C.
U.S. Fish and Wildlife Service. 2011. Endangerd and threatened wildlife and plants; Proposed 12-month finding on a petition to list the cactus ferruginous pygmy-owl as threatened or endangered with critical habitat. Federal Register Vol. 76 No. 193.
U.S. Fish and Wildlife Service. 2012. Listing and designation of critical habitat for the Chiricahua leopard frog; Final rule. Federal Register Vol. 77 No. 54.
U.S. Fish and Wildlife Service. 2013a. Endangerd and threatened wildlife and plants; Designation of critical habitat for Southwestern Willow Flycatcher: Final rule. Federal Register Vol. 78 No. 2, January 3, 2013.
U.S. Fish and Wildlife Service. 2013b. Endangered and threatened wildlife and plants; Designation of critical habitat for the northern Mexican gartersnake and narrow-headed gartersnake. Federal Register Vol. 78 No. 132.
U.S. Fish and Wildlife Service. 2014a. Endangerd and threatened wildlife and plants; Determination of threatened status for the western distinct population segment of the yellow-billed cuckoo (*Coccyzus americanus*). Federal Register Vol. 79 No. 192.
U.S. Fish and Wildlife Service. 2014b. Endangered and threatended wildlife and plants: Designation of Critical Habitat for western distinct population segment of the yellow-billed cuckoo; Proposed rule. Federal Registry Volume 79 No. 158.
U.S. Fish and Wildlife Service. 2014c. Endangered and threatened wildlife and plants; Threatened status for the northern Mexican gartersnake and narrow-headed gartersnake. Federal Register Vol. 79 No. 130.
U.S. Forest Service. 2013. Final environmental impact statement for the Rosemont Copper project: A proposed mining operation, Coronado National Forest, Pima County, Arizona. U.S. Department of Agriculture, Forest Service, Southwestern Region. Document number MB-R3-05-6a.
Urquhart, N. S., S. G. Paulsen, and D. P. Larsen. 1998. Monitoring for policy-relevant regional trends over time. Ecological Applications 8:246-257.
Voeltz, J. B., and R. H. Bettaso. 2003. 2003 status of the Gila topminnow and desert pupfish in Arizona. Technical Report #226. Arizona Game and Fish Department, Nongame and Endangered Wildlife Program, Phoenix, Arizona.
Walker, B., and J. A. Meyers. 2004. Thresholds in ecological and social-ecological systems: A developing database. Ecology and Society 9.
Wallace, J. E., R. J. Steidl, and D. E. Swann. 2010. Habitat characteristics of lowland leopard frogs in mountain canyons of Southeastern Arizona. Journal of Wildlife Management 74:808-815.
Warren, P. L., D. F. Gori, S. Anderson, and B. S. Gebow. 1991. Status report of the taxon *Lilaeopsis schaffneriana* subspecies *recurva*. Submitted to U.S. Fish and Wildlife Service. The Nature Conservancy, Tucson, Arizona.
Weedman, D. A., A. L. Girmendonk, and K. L. Young. 1996. Status review of Gila chub, *Gila intermedia*, in the United States and Mexico. Nongame and

Endangered Wildlife Program Technical Report 91. Arizona Game and Fish Department, Phoenix, Arizona.

Weedman, D. A., A. L. Girmendonk, and K. L. Young. 1998. Revised recovery plan for the Gila topminnow (*Poeciliopsis occidentalis occidentalis*). Unpublished report to the U.S. Fish and Wildlife Service, Albuquerque, New Mexico.

Weedman, D. A., and K. L. Young. 1997. Status of the Gila topminnow and desert pupfish in Arizona. Arizona Game and Fish Department, Phoenix, Arizona.

WestLand Resources Inc. 2004. A preliminary population estimate of Pima pineapple cactus (*Coryphantha robustispina*) in south-central Arizona. Tucson, Arizona.

WestLand Resources Inc. 2008. 2008 Ranid frog survey of the Rosemont holdings and vicinity. Report to Rosemont Copper Company, Tucson, Arizona.

WestLand Resources Inc. 2009. Lesser long-nosed bat survey of the Rosemont holdings and vicinity. Report to Rosemont Copper Company, Tucson, Arizona.

Wiggins, D. 1998. Yellow-billed cuckoo (*Coccyzus americanus*): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region.

Wiggins, D. 2005. Yellow-billed cuckoo (*Coccyzus americanus*): a technical conservation assessment. USDA Forest Service, Rocky Mountain Region. Accessed on April 10, 2015 from: http://www.fs.fed.us/r2/projects/scp/assessments/yellowbilledcuckoo.pdf.

Wilhere, G. F. 2002. Adaptive management in habitat conservation plans. Conservation Biology 16:20-29.

Wirt, E. B., P. A. Holm, and R. H. Robichaux. 1999. Survey and monitoring of the desert tortoise at Organ Pipe Cactus National Monument. Final Report to the National Park Service, Ajo, Arizona.

Wood, D., J. Meik, A. Holycross, R. Fisher, and A. Vandergast. 2008. Molecular and phenotypic diversity in *Chionactis occipitalis* (Western shovel-nosed snake), with emphasis on the status of *C. o. klauberi* (Tucson shovel-nosed snake). Conservation Genetics 9:1489-1507.

Wood, D. A., R. N. Fisher, and A. G. Vandergast. 2014. Fuzzy boundaries: Color and gene flow patterns among parapatric lineages of the western shovel-nosed snake and taxonomic implication. Plos One 9.

Zylstra, E. R. 2008. Evaluating monitoring strategies and habitat for tortoises in the Sonoran desert. Master of Science thesis. School of Natural Resources and the Environment, University of Arizona, Tucson, Arizona.

Zylstra, E. R., and R. J. Steidl. 2009. Designing a framework for monitoring Sonoran Desert tortoise (*Gopherus agassizii*) in Arizona. Final report to the Arizona Game and Fish Department, Phoenix, Arizona.