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# MEMORANDUM

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Date: August 28, 2009

To: The Honorable Chair and Members  
Pima County Board of Supervisors

From: C.H. Huckelberry  
County Administrator 

Re: **How effectively have open space acquisitions included Habitats and Landscape Features?**

## Background

This study paves the way for future strategic land purchases for the overall Sonoran Desert Conservation Plan by answering the question:

How effectively have the County's open space acquisitions included habitats and landscape features that were identified as important by the Science Technical Advisory Team for the Sonoran Desert Conservation Plan?

The scope of this study is beyond the County's Multi-Species Conservation Plan, which is a subset of the overall Sonoran Desert Conservation Plan.

## Method and Results

Basically three landscape types are analyzed from the regional perspective:

- (1) special elements;
- (2) species habitats for the entire regional reserve; and
- (3) configuration of ranch reserves.

Pages five through seven of the study show that in the area of special elements:

- "Pima County has made a significant commitment to acquiring native grasslands, with a total of over 60,000 acres in county management."
- "County land also includes 10 % of the protected mesquite bosque area" with rehabilitation projects adding 200 more acres.
- "Over sixteen percent of perennial streamsides are or soon will be under County management."
- "More than 2,000 of the 16,000 acres of intermittent streamside will be in the County preserve network, making Pima County second only to the Coronado National Forest as a steward of these areas."
- Improvements within the County system could be made in the areas of Ironwood forest, the Saltbush plant community, and talus slope.

Pages seven through nine show that in the area of regional species habitat:

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- By the end of this year, "tens of thousands of acres of land for individual species have been or will be managed for the lowland leopard frog, Mexican long-tongued bat, lesser long-nosed bat, pale Townsends's bat, cactus ferruginous pygmy-owl, rufous-winged sparrow, red bat, and Swainson's hawk."
- Regional goals which would require conservation efforts by jurisdictions beyond Pima County Government remain distant.

Pages nine through twelve of the study show that in the area of reserve configuration:

- While the overall reserve is still fragmented "Many of the County's ranch acquisitions have prevented the development or fragmentation of habitats next to the federally-owned parks and other reserves.
- If the County were to buy in fee only and not include grazing leases the distance between conserved patches of land "would more than double.
- On page 10 a chart shows the top County preserves by species, giving a sense of the range of species protected by County holdings.

**Recommendations**

Based on such findings, staff recommends the following actions in order to continue and increase the effectiveness of the open space acquisitions in meeting overall Sonoran Desert Conservation regional goals:

- "Pursue Habitat Protection Priorities along Brawley Wash and the Lower Santa Cruz River valley.
- Prioritize State Trust land acquisitions in low elevation valley floors and gently sloping piedmonts in the Avra and Altar and Tortolita piedmonts.
- Continue to acquire low-elevation Important Riparian areas and mesic canyons at the mountain front locations.
- Preferentially select for IRA, SSMA and Biological Core areas over Multiple Use areas.
- Continue to explore and support measures that would achieve biological conservation on State Trust lands.
- Continue the floodprone land acquisition program, as well as the open space bond program.

CHH

Attachment

# **Progress Report: Measuring Effectiveness of Open Space Land Acquisitions in Pima County, Arizona in Relation to the Sonoran Desert Conservation Plan**

Prepared by Julia Fonseca, Pima County Office of Conservation Science  
and Cory Jones, Pima County Geographic Information Services

## **Summary**

This report examines how effectively Pima County's natural open-space acquisitions have addressed priorities for conserving species' habitats and landscape features identified in the Sonoran Desert Conservation Plan (SDCP).

Significant progress has been made by Pima County and its partners toward achieving the Conservation Lands System (CLS) identified in the SDCP, and thereby protecting many of the species and special landscape elements identified by the SDCP. In particular, the amount of native upland grasslands in conserved status has improved as a result of County acquisitions and partnerships with local ranchers. Pima County has also protected a significant portion of the region's stream habitats, limestone outcrops, and bat caves.

Many of Pima County's ranches consist of a mix of County land with State and/or BLM grazing leases. Acquisitions at various ranches has reduced the potential of ranchland conversions to residential sprawl. County ranch acquisitions increase the effective size of management units. This is particularly important for restoring natural ecosystem functions and adapting to the effects of climate change.

Projected patterns of urban development, considered in relation to the current status of protected areas, suggest that additional acquisitions of upland habitat in the Avra and Altar Valleys, and the Tortolita piedmont are desirable. Continued acquisitions of Important Riparian Areas are also needed, particularly along Brawley Wash and the mountain canyons of the Baboquivari Range. Pima County, City of Tucson, Town of Marana and the State Trust Lands all have roles to play in closing gaps in habitat protection for species and special landscape elements.

## **Problem Statement**

The SDCP is an expression of the values placed on the rich cultural heritage, beauty and biodiversity of southern Arizona by the people of Pima County. The most significant element of the SDCP had been Pima County's use of land acquisition to greatly expand the protection of habitat for many at-risk plants and animals in the Sky Island and Sonoran Desert ecoregions.

This report was initiated at the request of Science Technical Advisory Team (STAT). It quantifies the relative contributions of various types of County open space to species' habitats and landscape features identified for conservation during the SDCP. The biological goal of the SDCP is to ensure the long-term survival of the full spectrum of plants and animals that are indigenous to Pima County by maintaining or improving the habitat conditions and ecosystem functions necessary for their survival.

Beginning in 1999, Pima County began purchasing and setting aside lands for an enlarged network of public land reserves, which made up the core elements of the CLS. A mixture of biological and cultural priorities and goals were used to guide land acquisitions. Purchases of land or development rights have been augmented with commitments of floodprone land by Pima County Regional Flood Control District (Flood Control District), and donations and dedications of lands from the private sector.

Ten years have passed since the first SDCP-driven land acquisitions. Pima County has or soon will have approximately 71,000 acres of deeded land for the purpose of long-term conservation under the Endangered Species Act (see also Connolly and Fonseca 2009), in addition to holding the grazing leases on approximately 124,000 acres of State and Federal lands. These conservation commitments are joined with other open-space lands such as Tucson Mountain Park to create a total over of 232,000 acres of County-managed preserves (Figure 1 and 2 map). The County's acquisitions provide an opportunity to review the configuration of these lands and assess their effectiveness in terms of accomplishing the SDCP goal of long-term conservation of biodiversity. This assessment can be used to assist Pima County and its partners in achieving conservation under the Endangered Species Act and meeting the broader, biological goals of the SDCP.

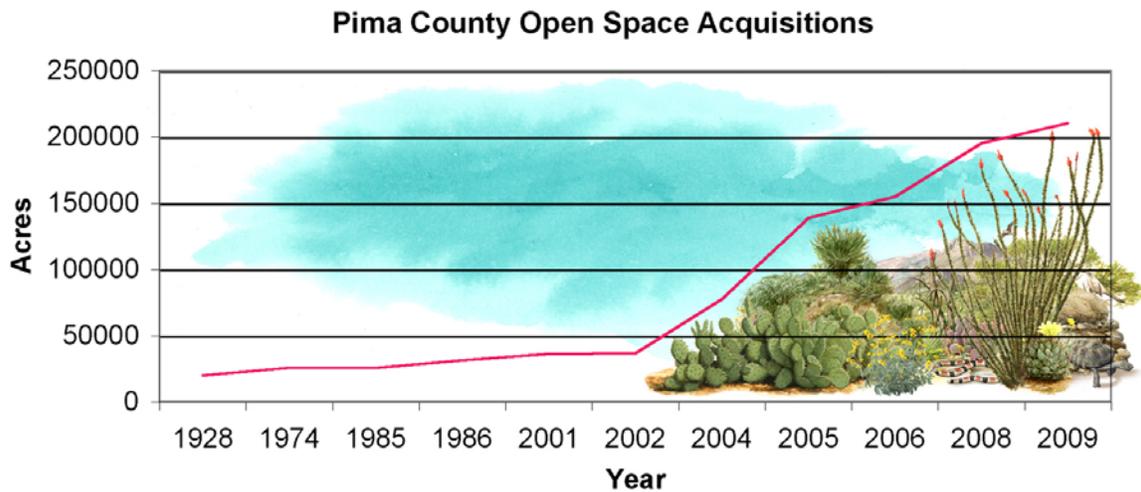


Figure 1. Pima County open space acquisitions have increased dramatically since the adoption of the Sonoran Desert Conservation Plan. This schematic chart depicts the acreage of all County open space at various times since inception of the program. Dates correspond to important votes or Board authorization dates. Graphic by Bill Singleton.

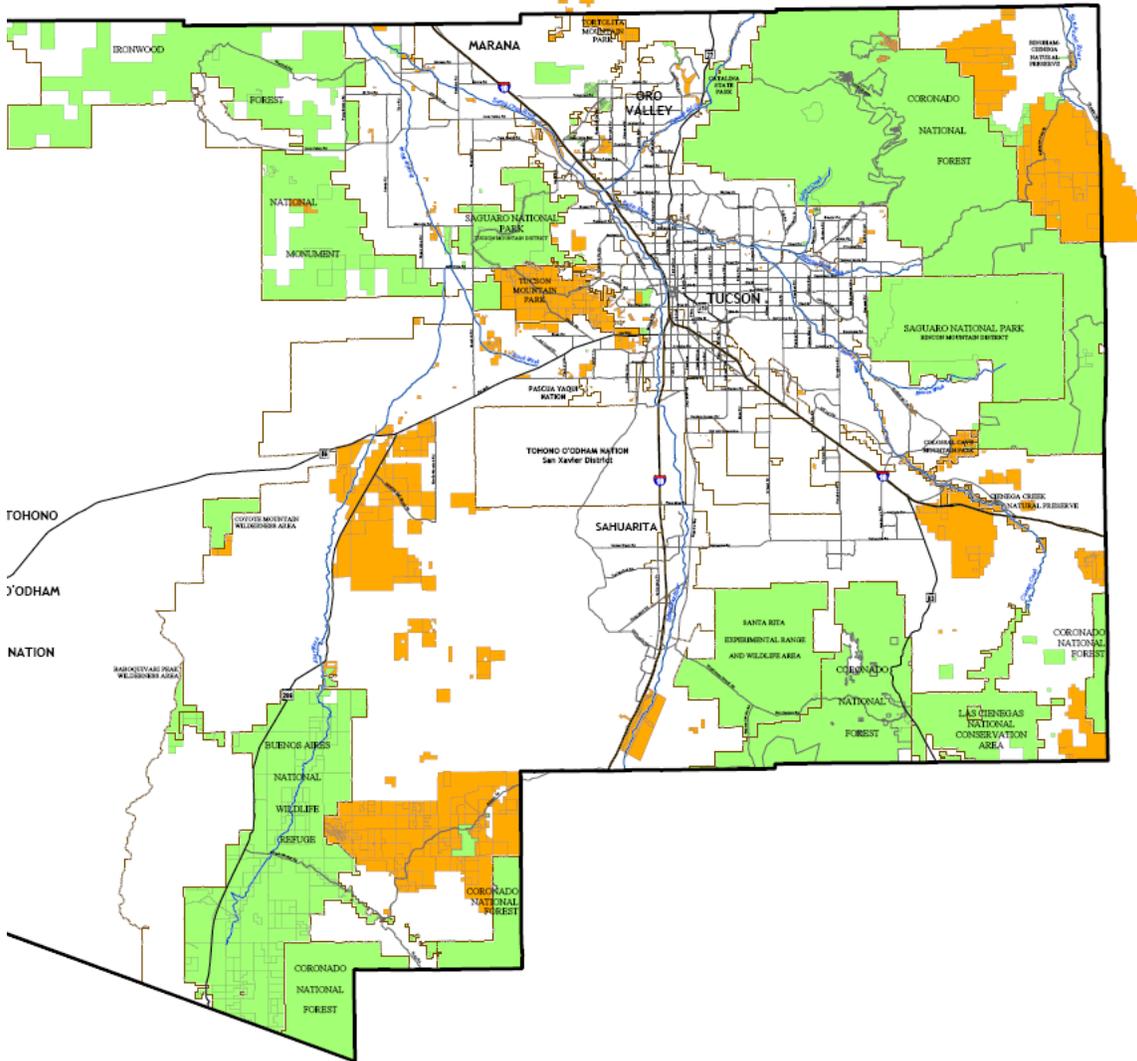


Figure 2. County lands managed for open space conservation, including funded acquisitions which have not yet been completed are shown in orange. Collectively, this is the County preserve network. Other federal, state and local preserves shown in green. Map by Cory Jones.

## **Purpose**

In this report we analyze the biological conservation effectiveness of lands that have been set aside for long-term protection under the SDCP. The objectives of this analysis are to:

- Quantify and describe the contributions of Pima County's acquisition and management to the conservation of special landscape elements identified in the SDCP.
- Quantify and describe the contributions of Pima County's acquisition and management to the conservation of species proposed for coverage in Pima County's Multiple-Species Conservation Plan (MSCP) application under the Endangered Species Act.
- Provide repeatable methods for understanding the benefits of potential future acquisitions and management in addressing deficits in mitigating species take for the MSCP, and conserving special elements for the SDCP.

A detailed [ecological monitoring plan](#) specific to Pima County's obligations is nearing completion, however a number of effectiveness measures have already been adopted for use.

## **Methods**

We analyzed effectiveness using three typical conservation biology approaches. Several measures of effectiveness were developed during the SDCP, tailored to match great diversity of physical and biological features of our region. Special landscape elements were considered the first approach, also known as the "coarse filter". The second, or "fine filter" approach, uses Priority Conservation Areas (PCAs) and species habitat as a metric. The third metric, reserve configuration, is related to shape and size of the County reserves, taken together as a network. Reserves are defined as any area where the natural landscape is managed for long-term conservation.

Special Elements were defined by the STAT. These are typically either vegetation types such as "saltbush plant community" or "saguaro-mixed cacti desert scrub", or physical features such as springs (Figure 3, Appendix 1). Maps of their distribution across the region have been maintained by Pima County (see Connolly and Fonseca, 2002). The current maps are available on the [SDCP mapguide site](#). STAT assigned conservation goals to each special element for the entirety of Pima County outside tribal lands.



Figure 3. Examples of Special Elements include spring ecosystem (left), saltbush plant community (right). Photographs by Julia Fonseca.

The fine filter, or species metric, was developed by those who have expert knowledge of a particular species. These experts prioritized the habitat for each species for inclusion in a regional reserve system based on local experts' knowledge of the differences between potentially suitable habitat, habitat conditions, and the distribution of species' population.

The configuration (size, adjacency, connectedness) of the reserves was analyzed using the CLS as a metric. The CLS represents the desired configuration of a biological reserve system which has been adopted into the land use plan of Pima County. We also examined the contribution of State Trust Lands managed by Pima County to the reserve configuration.

## **Results**

### **Special Elements**

Table 1 lists the amount of each Special Element that is managed by Pima County, and the percentage conserved in the overall reserve network. Percentages are expressed relative to the total amount of the Special Element in Pima County. Following the advice of STAT, Pima County has made a significant commitment to acquiring native grasslands, with a total of over 60,000 acres in county management (Appendix 2). This is particularly notable because a 2005 analysis found that Pima County had not acquired any high-quality grasslands (Fonseca and RECON, 2005).

County land also includes 10% of the protected mesquite bosque area. In addition, projects at Cortaro Mesquite Bosque, Bingham Cienega Natural Preserve, Kino Wetlands, and the Big Wash are rehabilitating disturbed areas, thereby adding another

200 acres of mesquite bosque. This contributes to STAT’s restoration goal for this Special Element. Over 16% (800 of a total 5,124 acres) of perennial streamsid es are or soon will be under County management. More than 2,000 of the 16,000 acres of intermittent streamside will be in the County preserve network, making Pima County second only to the Coronado National Forest as a steward of these areas.

**Table 1. Protection of Special Elements (Acres) in Pima County**

	County Preserves (ac.)	Non-County Reserves (ac.)	County Preserves (%Total Occurrence)	Regional Reserves (% Total Occurrence)	STAT goal
Cattail	0	23	0	80%	100%
cottonwood-willow forest	250	2,125	7%	70%	protect and restore
creosote-bursage	8,940	488,777	1%	51%	None
douglas fire-mixed conifer	0	698	0%	99%	100%
unincised grassy floodplain	6,746	50,814	8%	69%	None
mixed broadleafed riparian forest	211	5,277	3%	80%	100%
intermittent stream	2,029	8,807	12%	65%	100%
ironwood forest	2,180	71,552	1%	18%	Preference*
limestone outcrop	9,315	17,985	17%	51%	Preference*
mesquite bosque	3,373	5,030	13%	32%	Preference* and restore
native upland grass	63,535	145,591	15%	48%	Preference*
oak savanna-grassland ecotone	1,953	68,948	1%	54%	Preference*
perennial stream	819	3,136	16%	77%	100%
palo verde-mixed cacti	58,228	452,464	2%	17%	None
Sacaton	543	7,366	5%	78%	Restore
Saltbush	290	9,963	1%	29%	100%
Springs	68	1,195	4%	76%	100%
Sonoran riparian scrub	10,152	50,384	6%	36%	Preference*
talus (PAG)	905	664	25%	42%	100%
Talus &colluvium (AZGS)	0	592	0%	17%	100%
Valley floor	4,726	247,955	0%	22%	None
caves and bat occupied	127 sites	637 sites	17%	Not available	100%

\*A preference goal means STAT suggested including as many sites as possible in the reserve system, in larger management units only.

Considering the amount of regional protection recommended by the STAT (Table 1) and the distribution of the special elements relative to the non-County reserve system, acquisitions of ironwood forest, saltbush, and talus slopes have been underrepresented in the County program:

- Ironwood forest. Most of the unprotected areas are on State Trust Land on the Tortolita piedmont, which has not been available for purchase.
- Saltbush plant community. There are no mapped saltbush occurrences which are available for purchase. However, patches of this plant community are being established by Pima County, most recently along Rillito Creek near Swan Road. Small, unmapped purchases may be found along the Santa Cruz River.
- Talus slopes. Pima County has acquired 25% of the talus deposits originally mapped by Pima Association of Governments, but more protection is needed. Most deposits are not mapped.

Acquisition of palo verde-mixed cacti desert scrub and low-elevation valley floors has lagged, but STAT did not set a goal for these two Special Elements.

### Species Habitat

Table 2 lists, by species, the amount of habitat that is managed by Pima County, and what percentage is conserved in the regional reserve system. The County preserve acreages include State Trust lands leased to Pima County. Regional reserves (column 5, Table 2) include all lands managed at least in part for the protection of natural land characteristics, whether state, federal or local. Tables in Appendix 2 provide acreages of specific habitat types by land ownership category and other information.

By the end of 2009, tens of thousands of acres of land for individual species have been or will be managed by Pima County, most notably for the lowland leopard frog, Mexican long-tongued bat, lesser long-nosed bat, pale Townsend's bat, cactus ferruginous pygmy-owl, rufous-winged sparrow, red bat, and Swainson's hawk (Table 2). Over 30,000 acres of pygmy-owl habitat has been acquired in fee as mitigation under the MSCP, for a total of ~120,000 acres in County preserves (Appendix 2). Pima Pineapple Cactus habitat includes ~18,000 acres in fee, and almost 90,000 acres under County management (Appendix 2).

Goals for the protection of nearly all species have not yet been met by the region as a whole, except for the California leaf-nosed bat. This can be seen by comparing the fifth column (regional protection) with the sixth column (STAT goal) of Table 2. Nonetheless, County acquisitions have contributed to progress on nearly all species' goals, except for those species which do not already occur in Pima County such as desert sucker and Sonoran sucker. (See Appendix 2 for more information about the distribution of the species habitat relative to land ownership).

**Table 2 Species Habitat Protection.**

Species Common Name	County Preserves (acres)	Non-County Reserves (acres)	County Preserves (% Total in Reserves)	Regional Reserves (% Total Habitat)	STAT goal
Allen's big-eared bat	2,263	25,390	8%	55%	75%
Burrowing owl	3,962	27,198	13%	<b>14%</b>	75%
Desert box turtle	6,684	150,928	4%	52%	75%
Cal. leaf-nosed bat	30,988	458,020	6%	86%	75%
Cuckoo, yellow-billed	11,992	11,165	52%	41%	75%
Desert sucker	99	5033	2%	56%	95%
Desert tortoise	114,092	610,534	16%	38%	75%
Flycatcher, Southwest willow	314	6199	5%	45%	95%
Gila Chub	3,931	11,745	25%	49%	100%
Ground snake	1,021	765	57%	<b>5%</b>	75%
Chiricahua leopard frog	28,609	212,085	12%	60%	95%
Lowland leopard frog	80,807	158,508	34%	41%	75%
Lesser long-nosed bat	178,623	568,743	24%	47%	75%
Longfin dace	80,807	7,218	36%	57%	75%
Mexican long-tongued bat	84,913	187,833	31%	49%	75%
Gila topminnow	5,439	5,634	49%	51%	95%
Merriam's mouse	9,163	53,725	15%	51%	75%
Mexican Gartersnake	13,274	12,686	51%	<b>18%</b>	75%
Needle-spined.cactus	17,182	2,161	89%	44%	75%
Pima Pineapple Cactus	51,024	133,051	28%	32%	75%
Pale Townsend Bat	60,397	74,614	45%	43%	75%
Cactus ferruginous pygmy-owl	101,079	522,143	16%	48%	75%
Red-back whiptail lizard	641	246030	0%	65%	90%
Red bat	35,866	227,245	14%	51%	75%
Sonoran sucker	138	5219	3%	51%	95%
Rufous-winged sparrow	78,806	291,180	21%	41%	90%
Giant spotted whiptail lizard	13,078	158,123	8%	52%	75%
Swainson's hawk	101,356	282,449	26%	41%	95%
Abert's towhee	12,211	18,525	40%	39%	75%
Tucson shovel-nosed snake	1,316	18,892	7%	<b>23%</b>	75%
Tumamoc globeberry	61,318	823,120	7%	<b>23%</b>	75%
Huachuca water umbel	5,230	6,421	45%	33%	75%
Bell's vireo	10,414	17,543	37%	44%	75%
Yellow bat, western	12,258	57,107	18%	47%	75%

Pima County preserves are especially important to the conservation of the ground snake and Mexican garter snake, two species which have an exceptionally low percentage of protected habitat in the regional reserve network. Habitat for these species is primarily on private lands along streams. Because Pima County acquires private land, the County's land acquisition efforts are vital to the conservation of these species.

Regional protection levels for burrowing owl, Tumamoc globeberry and Tucson shovel-nosed snake are notably low (bolded in column 6, Table 2). In the case of the burrowing owl, STAT has not favored acquisition as a primary strategy for conservation of the species, since the species uses agricultural and other disturbed settings. County acquisitions are disproportionately low for Tumamoc globeberry and Tucson shovel-nosed snake, even taking into consideration the low overall representation of habitat for these in the regional reserve network.

Table 3 notes the County preserves that contribute the most to conservation of each species. Ranch acquisitions, because of their large size, figure prominently, however some of the smaller preserves (Cienega Creek Natural Preserve in particular) are notable.

### Reserve Configuration

The SDCP is concerned with all species, not just those which are proposed as covered species. To that end, the configuration of the reserves is also important, because conservation biology has found that reduction in the size of habitat patches and restrictions on movement of species and their genes can affect how long species will persist in a given area. When viewed in isolation, the Pima County preserve network is highly fragmented. However, many of the County's ranch acquisitions have prevented the development or fragmentation of habitats next to the federally-owned parks and other reserves.

Ranchlands owned in fee simple by Pima County, are dispersed in 47 different patches (contiguous groupings of land parcels), with an average patch area of approximately 800 acres. The ranch conservation element of the SDCP involves managing entire ranches, inclusive of fee-owned parcels, state trust grazing leases, and in a few cases, associated BLM lands. By considering the fee simple and leased lands as a single unit, the number of patches decreases to 21 and the average patch area increases to 7,500 acres (Figure 4). The perimeter to area ratio would be doubled if the County did not hold grazing leases, and the nearest neighbor distance from patch to patch would more than double.

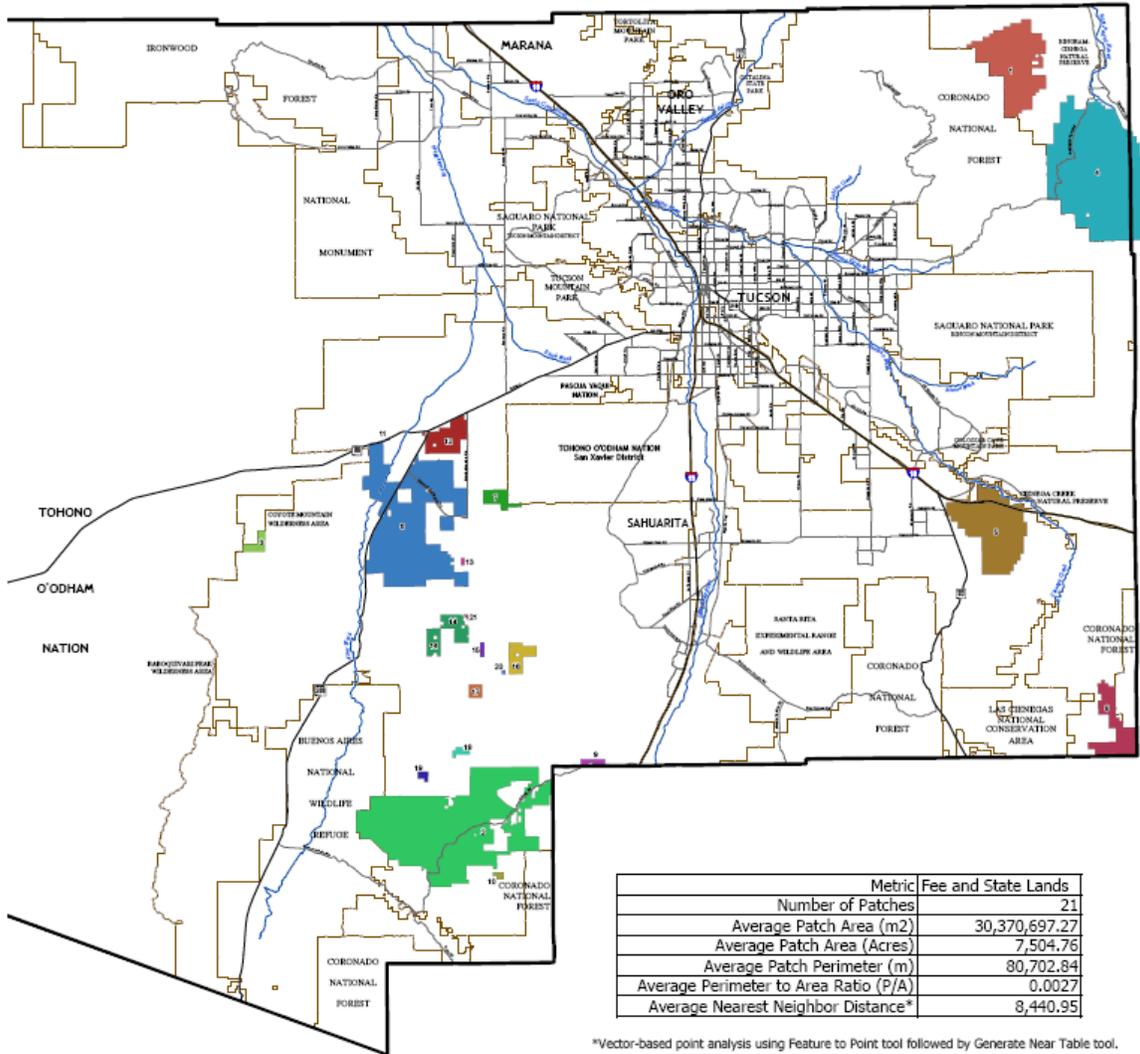
County ranch acquisitions are also important for diminishing the potential fragmentation of habitat in federal reserves. Examples include:

- Sands and Clyne Ranches located next to the Coronado National Forest and Las Cienegas National Conservation Area.
- Lord's Ranch is embedded within Ironwood Forest National Monument.
- Rancho Seco includes BLM multiple-use lands.
- Six-Bar, A7 and Sopori adjoin Coronado National Forest.

**Table 3. Top County Preserves by Species**

<b>Species</b>	<b>Top County Preserves</b>
Allen's big-eared bat	Empirita Ranch
Burrowing owl	Floodprone Land*, Brawley
Desert box turtle	A7 Ranch, Sopori Ranch
Cal. Leaf-nosed bat	Rancho Seco
Cuckoo, yellow-billed	Cienega Creek, Sopori R.
Desert sucker	NA
Desert tortoise	A7 Ranch, Rancho Seco
Flycatcher, Southwest willow	Bingham Preserve
Gila Chub	Cienega Creek Preserve
Ground snake	Floodprone Land*
Chiricahua leopard frog	Rancho Seco, Sands Ranch
Lowland leopard frog	Cienega Creek, Bar V
Lesser long-nosed bat	A7 Ranch
Longfin dace	Cienega Creek
Mexican long-tongued bat	Cienega Creek
Gila topminnow	Cienega Creek
Merriam's mouse	Canoa, Cienega Creek
Mexican Gartersnake	Cienega Creek
Needle-spined.cactus	Bar V Ranch
Pima Pineapple Cactus	Diamond Bell, Canoa, Madera Highlands
Pale Townsend Bat	Rancho Seco
Pseudoscorpion	Colossal Cave
Red-back whiptail lizard	Lords Ranch
Red bat	Rancho Seco, Six Bar R.
Sonoran sucker	NA
Rufous-winged sparrow	Rancho Seco, Sopori Ranch
Giant spotted whiptail lizard	Six Bar Ranch, Canoa
Swainson's hawk	Bar V, Empirita Ranches
Abert's towhee	Canoa, Bar V Ranch
Talus Snails	Tucson, Rancho Seco
Tumamoc globeberry	Diamond Bell R., King98 R., Tucson Mountain Park
Huachuca water umbel	Cienega Creek
Bell's vireo	Cienega Creek, Bar V
Yellow bat, western	Cienega Creek, Empirita

\*Floodprone Land= unnamed parcels purchased by the Regional Flood Control District and managed as open space



\*Vector-based point analysis using Feature to Point tool followed by Generate Near Table tool.

Figure 4. Each color represented a unique ranchland “patch” analyzed in relation to the more fragmented parcels of land wholly owned by Pima County and located within each ranch. Map by Cory Jones

In terms of the CLS goals, the region has protected an adequate amount of Multiple Use Lands (Table 4). Additional acquisitions of Biological Core, Special Species Management Area, and Important Riparian Area are needed. Because of the disproportionate distribution of Important Riparian Areas on private lands, Pima County's land acquisition programs are particularly important for the region as a whole.

**Table 4 Protection of Conservation Lands System (CLS)**

CLS Component	County Preserves (Ac.)	Regional Reserves (Ac.)	County Preserves	Regional Reserves	Total Acres in Pima County	Protection Goal (in %)
Agriculture within the CLS	17	17	0%	0%	9,691	NA
Biological Core	84,032	450,757	9%	50%	899,915	80
Multiple Use	64,248	667,325	7%	70%	950,505	67
Important Riparian	16,306	65,680	10%	42%	158,178	95
SSMA (Special Species Management Area)	51,854	582,776	5%	58%	997,582	80
Outside the CLS	4,783	5,207	1%	1%	456,513	NA

**Discussion**

Pima County's open space acquisitions under the SDCP have filled gaps in protection provided by federally protected lands. Pima County's initial report on [land stewardship](#) (Connolly and Fonseca 2000) found that the federal reserves were biased toward protection of high and mid-elevation forests; they poorly protected grasslands, desert scrub and riparian areas. Pima County's land acquisitions since that time have contributed to the protection of native grasslands and wet riparian areas, as well as specific habitats required by some of the plants and animals most vulnerable to extinction.

Table 3 shows that Flood Control District's Floodprone Land Acquisition Program (FLAP) has been particularly important for the ground snake and burrowing owl, two species with low levels of regional habitat protection. FLAP acquisitions are based primarily on social and hydrological criteria, not biological criteria. They tend to be smaller in size and higher in cost, sometimes including flood-damaged housing that is demolished after acquisition. Collectively this program has been protecting and restoring habitat that would not be acquired under the open space program.

The importance of the ranch conservation program is also evident. The ranch conservation program works at the other end of the size spectrum, increasing the effective size and maintaining connectivity of the landscape. Many of the County

ranches offer the most habitat for species of concern listed in Table 3. Cooperative projects with ranchers and federal agencies will assist a number of these species.

When viewed in relation to past and [projected habitat losses](#) for Pima County's permit area and the County's ability to avoid and minimize impacts to species actually present, priorities for future acquisitions emerge. Acquisitions may be directed toward habitat for the species listed in Table 5.

**Table 5. Underrepresented species habitats in Pima County, in relation to proposed future County bond acquisitions**

Species	Known occurrences susceptible to loss of habitat	Priority Conservation Areas 1 and 2	Proposed 2010 acquisitions of most use to the species
Giant spotted whiptail lizard	Coronado N. F. and certain mesic riparian areas outside the Forest	Periphery of Catalinas, Rincon Valley, south of Arivaca Creek, Baboquivari Mtn front, and periphery of northern Santa Rita Mtns.	Arivaca and Baboquivari Habitat Protection Priorities (HPP) (private land portions only)
Ground snake (valley form)	Blanco Wash vicinity in Avra Valley	Lower Santa Cruz Valley	Marana Mound, Lower Santa Cruz HPP
Tucson-shovel nosed snake	None known in Pima County	Aguirre Valley and northern Avra Valley	Boa Sorte, Brawley Wash corridor
Pima pineapple cactus	Altar Valley, and piedmonts of the Sierrita and Santa Rita Mountains	None defined; FWS prefers dense populations which are part of or adjacent to larger reserves	Marley Phase 3, Altar Valley wildlife corridor, West Desert Preserve
Tumamoc globeberry	Avra Valley bajada, Tucson Mtns bajada	None have been defined	Tucson Mtns Community Open Space

Most of the under-represented habitats are found on low-elevation, gently sloping bajadas. Giant spotted whiptail lizards and Pima pineapple cactus are found at somewhat higher elevations. The lizard prefers moist canyon and riparian bottomlands.

Proposed 2010 acquisitions do include substantial areas of habitat for species in need of a greater proportion of regional conservation (Column 4, Table 5). However, gaps in species protection can only partially be addressed by acquisition of private lands. Reform of the state constitution to allow conservation on State Trust Land would improve the ability of Pima County and others to protect the habitat of many species, including two species whose habitat is found on more State Trust Land than private land: Pima pineapple cactus and Tumamoc globeberry. In addition, City of Tucson's Avra Valley lands offer substantial habitat acreage for the Tucson shovel-nosed snake, ground snake, and Tumamoc globeberry.

In considering recommendations for acquisition priorities, it is important to consider scientific uncertainties. Our ability to detect, define, and map species habitat varies greatly. In addition, climate change and climate variability will cause changes to the landscape that will cause changes to habitat. Reserves that are designed solely around extant populations of organisms, or even around our current understanding of habitat may fail. Conversely we may find and indeed already have found rare species on lands purchased using predominantly non-biological criteria such as scenic beauty, cultural resource protection, or flood hazard mitigation.

The geographic and ecological diversity of Pima County's acquisitions is an important asset to species' abilities to adapt to climate change. By using a combination of habitat, special elements, the CLS and community-defined priorities for open space conservation, the regional reserve system is becoming more varied, more redundant and more flexible in accommodating alternative scenarios for the future, whether those are driven by shifts in climate or socio-economic factors.

### **Draft recommendations for Pima County**

1. Pursue Habitat Protection Priorities along Brawley Wash and the Lower Santa Cruz River valley
2. Prioritize State Trust land acquisitions in low-elevation valley floors and gently sloping piedmonts in the Avra and Altar, and Tortolita piedmonts.
3. Continue to acquire low-elevation Important Riparian areas and mesic canyons at the mountain front locations.
4. Preferentially select for IRA, SSMA and Biological Core areas, not Multiple Use areas.
5. Continue to explore and support measures that would achieve biological conservation on State trust lands.
6. Continue the floodprone land acquisition program, as well as the open space bond program.

## References:

Connolly, N., and J. Fonseca 2000. [Land Stewardship in Pima County](#). Sonoran Desert Conservation Plan, Pima County Administrator's Office.

Fonseca, J. and N. Connolly, 2002. [Representation of Vegetation Communities and Special Elements in Reserve Design](#). Sonoran Desert Conservation Plan, Pima County Administrator's Office.

Fonseca, J. and RECON 2005 Preliminary Assessment of Pima County Acquisition Parcels. Technical Memorandum prepared for the Conservation Acquisition Commission.

## Acknowledgments

Brian Powell and Mike Stofko of Pima County reviewed the drafts and provided many helpful suggestions. Bill Singleton, Graphics Design, provided illustrations. Dave Burnham prepared the cover.

## Appendix 1. Additional Information Regarding Methods

### Special Elements

Goals for conservation of Special Element landscape targets were chosen by the STAT. Special Elements are typically either vegetation types such as “saltbush plant community” or “saguaro-mixed cacti desert scrub”, or physical features such as springs (Figure 3, Appendix 1). STAT assigned conservation goals to each Special Element for the entirety of Pima County outside tribal lands.

For some Special Elements, STAT recommended encompassing all occurrences of that feature in the public reserve system. A preference goal meant that they suggested including as many sites as possible in the reserve system, in larger management units only. Special Element constraints and preferences were used in part to define the biological core of the conservation lands system (see RECON, 2001). A restoration goal was intended to show elements that have been so reduced over time that there is now a desire to restore them or to manage them against further loss. An accounting goal meant that no special acquisition efforts were recommended, but monitoring of the acreage in the reserve system was recommended. These are listed as “none” in the goal column of Table 1.

During the reserve design process, GIS representations for some Special Elements were defined. Since then, new information about the distribution of Special Elements has been incorporated as it becomes available on the publically-accessible SDCP [Mapguide](#) site.

### Species Habitat

The fine filter (i.e., species metric) was developed by those who have expert knowledge of individual species. These experts prioritized land for inclusion in a regional preserve network for each taxon during the SDCP. These areas, called Priority Conservation Areas or PCAs are based on local experts’ knowledge of the differences between potentially suitable habitat, habitat conditions, and species population distributions from place to place. All PCAs are polygons enclosing an area of significance; many are bubbles which enclose a smaller area of potentially suitable habitat. For this analysis, we used all PCA subcategories to represent the habitat recommended for acquisition. The subcategories are as follows:

- PCA 1 Must be included in a reserve system
- PCA 2 Recommended for inclusion in a reserve system
- PCA 3 Areas thought to be important for connectivity
- PCA 4 Areas important for habitat restoration

Experts did not prioritize acquisitions for Tumamoc globeberry and desert tortoise, so for these species we examined acquisitions relative to extant habitat models. Most habitat models and PCAs were developed in 2001-2003, with exception of the desert tortoise model which was developed in 2007. We solicited expert assistance for updating the burrowing owl PCA in light of recent surveys, but there was no interest. We revised the PCA4 for the box turtle based on input from Drs. Cecil Schwalbe and Philip Rosen, and David Hall and Marty Tuegel for this effort.

### Reserve Configuration

The configuration (size, adjacency, connectedness) of the reserve network was analyzed using the CLS as a metric. The CLS is the proposed biological reserve system which has been adopted into the land use plan of Pima County and represents the “desired future condition”. The CLS does not extend into the tribal lands of various Native American nations. A separate analysis was performed to examine the contribution of State Trust Lands managed by Pima County to the MSCP.

Reserve configuration was analyzed using the following metrics: average patch area, edge to area ratio (perimeter to area), average patch perimeter, and nearest neighbor distance (interpatch distance). In addition, the amount of different CLS categories in preserves was calculated.

Adjacent ranch parcels owned in fee or through conservation easement by Pima County were joined together and considered as a patch. A parcel that was not adjacent to another parcel counted as a separate patch (see Figure 4). The class of all ranch lands owned in fee or through conservation easement was compared to the class of ranch fee lands joined together with their associated state trust grazing leases (Figure 2). Patch metrics were calculated without regard to federal lands or reserves managed by other entities.

### Reserve Definition

In the context of this report, County preserves are the open space lands which are managed for retention of natural cover or for which there is some conservation intent. For this analysis, Pima County Geographic Information Services (GIS) prepared GIS layers representing the County preserve network as it is expected to be in fall 2009. The layer includes imminent fee acquisitions, grazing leases managed by Pima County, County mountain parks, developer dedications to Pima County in fee simple, certain Floodprone Land Acquisitions, and BLM lands which are likely to be obtained by Pima County under existing applications through the Recreation and Public Purposes Act (R&PPA) (Figure 3).

Fee-simple acquisitions that would be committed to conservation under the Pima County Multiple-Species Conservation Plan (labeled “mitigation”) are a subset of the County open-space preserve network, as are state grazing leases (“lease”).

Another GIS layer included all protected lands located in Pima County, regardless of ownership, otherwise known as the regional reserve system, including those projected additions to the County preserve network as described above.

Various classifications of reserves were analyzed with reference to the distribution of habitat and Special Element layers. We calculated the amount of each located in reserves of various types. This was simplified as shown in the sample table below:

Conservation Target	County preserves(Ac) <sup>1</sup>	Non-County reserves (Ac.) <sup>2</sup>	Percentage protected <sup>3</sup>
Species X			
Species Y			
Species Z			
Special Element 1			

<sup>1</sup> Acres protected by Pima County, including existing and soon-to-be acquired County open space preserves.

<sup>2</sup> Acres conserved in all reserves outside of tribal lands.

<sup>3</sup> Relative to total occurrence of the conservation target in Pima County.

All units are in GIS acres, as springs and streams each have 300-foot buffers, with the exception of bat caves, which are sites.

**Appendix 2 Supplemental Tables: Special Elements (Acres)**

<b>ELEMENT</b>	<b>COUNTY Mitigation</b>	<b>COUNTY LEASES</b>	<b>COUNTY Preserves</b>	<b>NONCOUNTY Reserves</b>	<b>PRIVATE LAND</b>	<b>FEDERAL LAND</b>	<b>TRIBAL LAND</b>	<b>STATE LAND</b>	<b>TOTAL IN CO.</b>
<b>Cattail</b>	0	0	0	23	5	21	0	0	29
<b>cottonwood-willow forest</b>	171	16	250	2,125	686	1,885	0	451	3,405
<b>creosote-bursage</b>	1,863	6,049	8,940	488,777	13,474	567,486	350,442	41,306	978,696
<b>douglas fire-mixed conifer</b>	0	0	0	698	11	672	0	0	709
<b>unincised grassy floodplain</b>	5,701	927	6,746	50,814	12,188	51,359	0	14,528	83,188
<b>mixed broadleafed riparian forest</b>	143	68	211	5,277	1,137	4,731	0	802	6,872
<b>intermittent stream</b>	1,254	458	2,029	8,807	4,572	8,161	0	1,633	16,639
<b>ironwood forest</b>	931	0	2,180	71,552	42,039	76,172	231,503	49,110	403,569
<b>limestone outcrop</b>	2,722	4,389	9,315	17,985	11,949	21,055	2,493	14,052	53,806
<b>mesquite bosque</b>	2,504	290	3,373	5,030	10,637	4,787	181	5,170	26,470
<b>native upland grass</b>	23,259	33,996	63,535	145,591	53,986	152,188	43,399	167,906	435,558
<b>oak savanna-grassland ecotone</b>	1,819	0	1,953	68,948	12,008	61,511	27,551	26,013	130,388
<b>perennial stream</b>	438	261	819	3,136	918	2,690	0	639	5,124
<b>palo verde-mixed cacti</b>	9,239	25,371	58,228	452,464	227,876	544,734	2,026,413	222,081	3,084,136
<b>Sacaton</b>	403	143	543	7,366	984	7,392	0	1,359	10,145
<b>Saltbush</b>	94	0	290	9,963	510	9,875	24,049	93	34,872
<b>Springs</b>	59	3	68	1,195	196	1,188	104	98	1,672
<b>Sonoran riparian scrub</b>	3,749	4,302	10,152	50,384	44,882	69,086	4,578	37,104	169,560
<b>talus (PAG)</b>	166	0	905	664	545	669	1,550	154	3,694
<b>talus &amp; colluvium (AZGS)</b>	0	0	0	592	172	631	1,549	1,118	3,473
<b>low elevation valley floor</b>	2,757	0	4,726	247,955	75,034	291,250	724,257	38,474	1,161,802

**Appendix 2 Supplemental Table: Acres of Species Habitat (mainly using Priority Conservation Areas)**

Species	COUNTY Mitigation	COUNTY LEASES	COUNTY Preserves	NONCOUNTY Reserves	PRIVATE LAND	FEDERAL LAND	TRIBAL LAND	STATE LAND	TOTAL IN CO.
<b>Allen's big-eared bat</b>	2,263	0	2,263	25,390	7,250	27,216	0	15,400	50,112
<b>Burrowing owl</b>	2,663	0	3,962	27,198	98,741	36,876	10,622	37,575	226,897
<b>Desert box turtle</b>	5,554	80	6,684	150,928	50,936	152,785	5,900	76,180	301,295
<b>Cal. leaf-nosed bat</b>	10,049	10,332	30,988	458,020	35,160	465,377	24,110	25,402	567,283
<b>Cuckoo, yellow-billed</b>	7,930	4,127	<i>11,992</i>	11,165	21,503	10,956	0	15,217	56,990
<b>Desert sucker</b>	99	0	99	5,033	1,389	5,243	0	2,341	9,167
<b>Desert tortoise*</b>	31,616	53,879	114,092	610,534	169,195	711,837	682,842	308,487	1,925,938
<b>Flycatcher, Southwest willow</b>	314	0	314	6,199	4,472	6,179	0	3,213	14,364
<b>Gila Chub</b>	3,342	490	<i>3,931</i>	11,745	4,824	12,474	0	11,153	32,225
<b>Ground snake</b>	809	0	1,021	765	23,164	763	0	8,952	39,600
<b>Chiricahua leopard frog</b>	10,175	13,185	28,609	212,085	42,767	208,970	447	140,599	403,871
<b>Lowland leopard frog</b>	26,624	48,011	<i>80,807</i>	158,508	162,493	161,956	8,743	188,774	584,093
<b>Lesser long-nosed bat</b>	52,469	107,322	<i>178,623</i>	568,743	217,335	623,392	54,939	626,008	1,588,132
<b>Longfin dace</b>	2,762	1,246	4,009	7,218	4,002	6,251	0	6,656	19,853
<b>Mexican long-tongued bat</b>	32,498	47,898	84,913	187,833	104,391	185,683	13	241,049	561,920
<b>Gila topminnow</b>	4,161	1,277	5,439	5,634	1,092	5,976	0	10,384	21,877
<b>Merriam's mouse</b>	8,163	789	9,163	53,725	32,668	54,791	2,665	21,317	122,286
<b>Mexican Gartersnake</b>	10,100	1,856	13,274	12,686	69,641	13,694	5,548	31,911	146,442
<b>Needle-spined.cactus</b>	5,866	11,154	17,182	2,161	6,481	2,581	0	28,001	44,172
<b>Pima Pineapple Cactus</b>	9,063	38,562	51,024	133,051	130,464	94,505	1,097	329,078	582,828
<b>Pale Townsend Bat</b>	18,994	28,717	60,397	74,614	61,469	82,128	5,595	136,873	311,002

<b>Cactus ferruginous pygmy-owl</b>	27,883	55,649	101,079	522,143	265,955	537,265	19,473	387,614	1,285,530
<b>Red-back whiptail lizard</b>	0	0	641	246,030	16,845	317,372	3,884	39,012	378,707
<b>Red bat</b>	17,818	12,130	35,866	227,245	77,099	223,400	4,040	191,919	513,477
<b>Sonoran sucker</b>	50	0	138	5,219	2,335	5,451	0	2,436	10,492
<b>Rufous-winged sparrow</b>	26,005	44,928	78,806	291,180	191,461	263,412	9,038	405,842	902,625
<b>Giant spotted whiptail lizard</b>	6,183	4,529	13,078	158,123	81,013	154,083	12,562	64,041	329,722
<b>Swainson's hawk</b>	40,431	53,211	101,356	282,449	159,739	264,077	7,627	458,416	930,920
<b>Abert's towhee</b>	9,838	1,513	12,211	18,525	28,267	18,547	0	14,841	78,081
<b>Tucson shovel-nosed snake</b>	1,175	0	1,316	18,892	23,302	22,295	1,422	29,537	89,209
<b>Tumamoc globeberry*</b>	13,449	31,267	61,318	823,120	225,142	979,537	2,178,967	325,858	3,786,132
<b>Huachuca water umbel</b>	3,885	685	5,230	6,421	10,270	6,441	0	11,268	35,608
<b>Bell's vireo</b>	7,396	2,112	10,414	17,543	21,650	17,602	0	14,845	63,672
<b>Yellow bat, western</b>	7,553	3,294	12,258	57,107	38,270	51,760	0	49,676	147,749

\*\*No PCA available; habitat model is used instead

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