DRAFT

Biological Stress Assessment

An Overview Discussion of Issues and Concerns

Sonoran Desert Conservation Plan

March 2000

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I. Introduction

The purpose of this work effort is to identify key potential threats and stressors to vulnerable species in Pima County, and to the biological and hydrological resources that support these species. Emphasis has been placed on identifying the specific components of past, existing, and proposed land and water uses that pose the greatest potential threats over the next 30 years to focal species and special habitats, plant associations, and communities as identified by the Science Technical Advisory Team (STAT). The stress assessment was developed in concert with the detailed evaluation of the Vulnerable Species List and development of detailed Species Accounts in order to incorporate information on specific stressors to individual species to the extent possible.

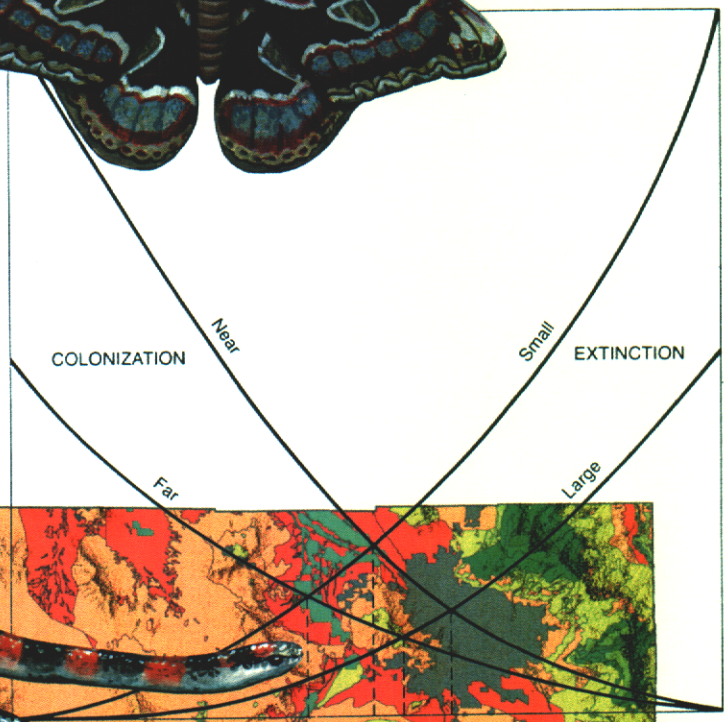
The importance of the stress assessment is its role in targeting areas to include in the development of reserve design alternatives. This analysis provides a mechanism to rank land areas in terms of the intensity of potential threats and stressors to biological resources. When developed, the reserve design alternatives will identify priority areas of the most valuable and vulnerable components, with focused consideration for "hot spot" areas of special habitats under relatively high levels of stress.

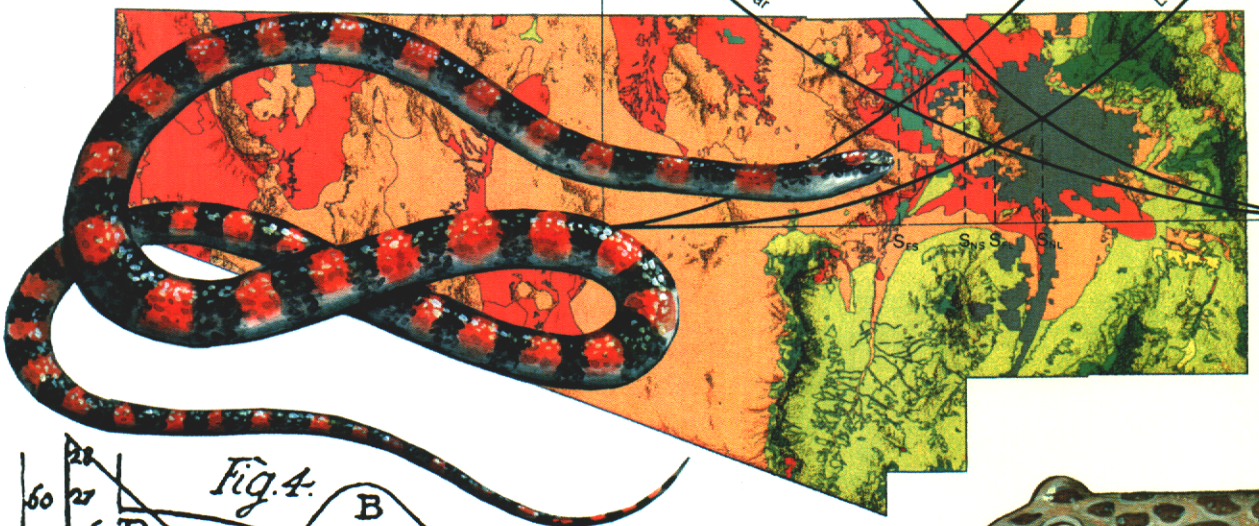
The stress assessment will also facilitate the development of corresponding potential conservation actions tailored to appropriately respond to the potential threats and stressors. The conservation and management actions to be developed in a future work effort will characterize the kinds and range of responses and strategies available to avoid, minimize, or mitigate the effects of each potential threat and stressor on populations and habitat areas in the plan area. The data will provide the County and other land managers with information upon which to develop, prioritize, and implement site-specific or issue-specific conservation actions that respond to individual stressors.

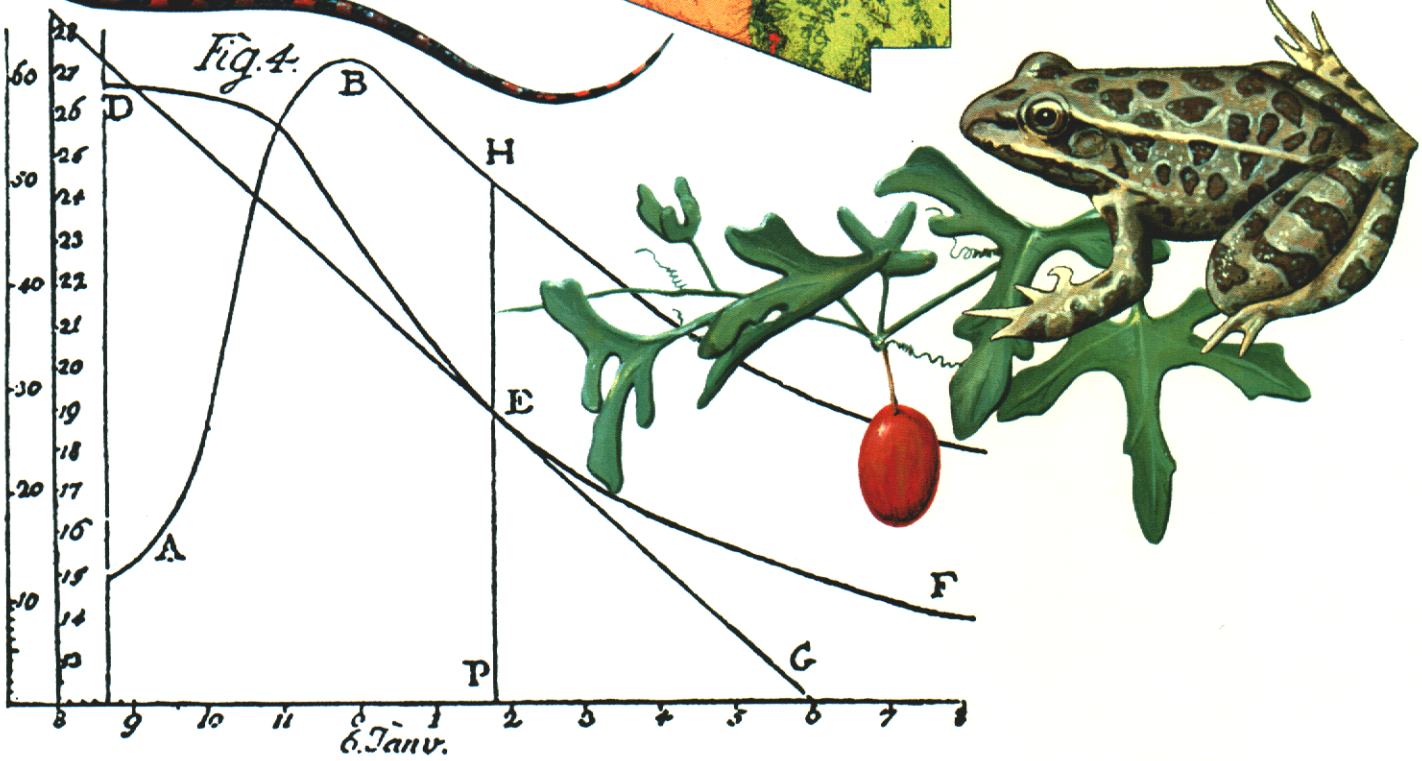
The stress assessment also identifies issues to be evaluated under future National Environmental Policy Act (NEPA) review. In the context of a Habitat Conservation Plan (HCP), some potential stressors may be considered as "otherwise lawful activities" that would be allowed and permitted under the terms and conditions of a federal Section 10(a) "Incidental Take" permit.

The association of potential threats and stressors to existing land ownership and management in Pima County provides the basis for the development of a geographic information system (GIS) database that will be used subsequently for more detailed analysis. Specifically, the GIS database assembled in this effort will allow the intersection of data on potential threats and stressors and existing conservation status with the distribution of vulnerable species and habitats and communities of concern, or other sensitive resources.

Methods and Limitations







II. Methods and Limitations

A. Methods

As part of the work program, RECON identified potential threats and stressors within each subarea and for each species and habitat under consideration. A list of primary biological stressors has been developed and is shown as Table 1. The information on stressors was obtained from consideration of existing and future land uses, recreational and economic activities allowed within particular land areas, and infrastructure barriers that could affect the habitats and associated species. The following sources were reviewed:

- Technical reports prepared by Pima County for the Sonoran Desert Conservation Plan
- Land use plans prepared by Pima County, Marana, Oro Valley, and Sahuarita
- Management plans prepared for most local, state, and federal reserves occurring in Pima County
- Previous studies and reports on environmental threats and stressors
- Information from meeting with and interviewing local knowledgeable persons

GIS analyses were used to summarize potential threat in terms of patterns of land ownership, land management, land use, and conservation status. In order to understand where potential threats and stressors may occur we first evaluated patterns of land ownership and land management since these determine which activities are permitted. Land ownership and land management information were compiled by combining GIS coverages for administrative boundaries, land ownership, reserves, and open space. Each of these coverages contained attribute information which were used to derive ownership and management descriptions in the composite coverage. Because each coverage was digitized by different agencies from different base maps, there are many inconsistencies in ownership and management designations for the same areas. It was more important to choose the most accurate boundaries and classification than to resolve inconsistencies, so final ownership and management assignments were made by allowing attribute data from one coverage to take precedence over the others. Since the reserves coverage boundaries were most recently verified by land managers and provided the basis for the assessment in the Land Stewardship report, reserve coverage attributes were given priority in assigning ownership, management in the composite coverage. Administrative coverage attributes were used to assign remaining land owners. For polygons with no reserve management, polygons were assigned the management designation "unreserved," unless these overlapped with the open space coverage in which case polygons were designated "open space." Unreserved lands were further classified as state trust lands or private lands based on ownership coverage attributes.

Land ownership/management categories were generally assessed for level of threat by assessing the conservation management status of each category. Conservation status is adapted from the system devised for Natural Heritage Database System developed by

TABLE 1
PRIMARY BIOLOGICAL STRESSORS

General Categories of Stressors to Biological Resources	Representative Examples of Stress Sources
Habitat loss, alteration, and degradation	Drought, flooding, fires, fire suppression; land clearing, mining, wood cutting, timber harvest, urbanization, groundwater overdraft, diversion of stream flows, channelization, change in land use, livestock grazing, cultivated agricultural lands, and clearing and grading for urbanization
Habitat fragmentation	Roads, utility corridors, trails, wash channelization, canals, and urbanization
Conversion of vegetative cover	Climate change, frost events and drought, flooding, fire suppression, livestock grazing, and invasive species
Human use and overuse	Off-road-vehicle use, hiking, plant collecting, camping, hiking, hunting, shooting, fishing, trapping, wood cutting, wildlife, and bird watching
Decline in groundwater levels	Excessive groundwater pumping
Decline in stream surface flows	Groundwater pumping, diversion of stream flows
Decline in water quality and changes in stream flow characteristics	Dredging, agricultural runoff, mining, wash channelization, atmospheric deposition
Competition and predation by invasive species	Introduction and spread of exotic species, fire suppression, land disturbance, livestock grazing, urbanization, and "islands" of imbalanced predator/prey relationships
Disease	Introduction and spread of exotic species, over-concentrated populations of species, and climate changes

SOURCES: Discussion with RECON team and STAT members, Flather et al. 1994, Nabhan and Holdsworth 1998, and SWCA 2000.

The Nature Conservancy (TNC) and utilized in the National Gap Analysis Program (GAP) (Table 2). This classification system uses a scale of 1 through 4 to represent the degree of management commitment to biodiversity maintenance (Connolly et al. 2000). A status of 1 represents the highest, most permanent level of commitment, while a status of 4 represents the lowest level of commitment or unknown status (Connolly et al. 2000).

Additional categories which further define level 4 have been added. These categories are meant primarily to represent the theoretical potential for modification of existing conservation management, but also reflect the existing potential for modification for uses that are not consistent with conservation goals. Conservation status was assigned to all reserve areas by Pima County staff for the Land Stewardship report.

Conservation status was assigned to areas outside of reserves as follows:

- Bureau of Land Management (BLM) and Arizona State Parks unreserved lands and open space in all jurisdictions were assigned a status of 3b;
- Unreserved state trust lands were assigned a status of 4a.;
- Roads within reserves were assigned a status of 4b; and
- Unreserved lands in Tohono O'odham and Pascua Yaqui Nations were assigned status 4e.

Unreserved private lands were assumed to be level 4 (denoted as "4x" in Table 3). Parcel data was combined with the composite management coverage and used to refine the status of unreserved private lands. Use codes in the parcel coverage were assigned a conservation status shown in Table 4.

The occurrence of species on the Pima County Vulnerable Species List in each subarea was evaluated using Heritage Data Management System (HDMS) records.

In addition to assigning a summary conservation status to land ownership/management, each ownership/management category may also be evaluated in terms of threats associated with permitted activities. For each subarea a matrix of permitted land uses and activities for each ownership/management category was developed. For each ownership/management category, activities (i.e., groundwater pumping, mining, livestock grazing) were evaluated for occurrence, potential occurrence, or historic but not present occurrence. This matrix can then be used to associate land uses which are potential stressors with management polygons in the GIS coverage in order to assess patterns of threats on the landscape.

B. Limitations

There are areas of concern for which the time constraints of the project did not allow a full exploration or which were not revealed during the course of our literature search and interview process. We fully anticipate additional areas of concern and issues relating to biological stress will be identified by RECON team members, STAT staff, and Subarea

TABLE 2
GAP STATUS CATEGORIZATION

GAP Status	Status Description	Examples
1a	Primarily public lands with permanent protection from conversion of natural cover and a mandated management plan to maintain a natural state within which disturbance events are allowed or mimicked through management.	Some USFWS Wildlife Refuges; some Pima County Natural Preserves; some USFS RNAs; most USFS, BLM, and NPS Wilderness Areas.
1b	Primarily public lands with permanent protection from conversion of natural land cover and a mandated management plan to maintain a natural state within which disturbance events are allowed or mimicked through management, but may contain uses that detract from quality of land such as visitor centers, high levels of traffic through land, heavily used trails and campgrounds. A maximum of 5 percent of the land is allowed to be managed in an unnatural state.	Some USFWS Wildlife Refuges; some USFS RNAs; some USFW Wilderness Areas; TNC deeded lands; some NPS National Parks
2	Primarily public lands with permanent protection from conversion of natural land cover and mandated management plan in operation, but receives uses or management practices that degrade the quality of existing natural communities, including suppression of natural disturbance. Over 5 percent of the land is managed in an unnatural state.	Some BOR lands; State Parks; some Pima County Mountain Park lands; NPS National Monument; some BLM ACECs.
3a	Primarily pubic lands managed to maintain biodiversity, but not subject to permanent protection.	Some TNC Nature Preserves; some Pima County Natural Preserves.
3b	Primarily public lands with permanent protection from conversion of natural land cover for the majority of the area, and subject to extractive uses of either broad, low-intensity type (logging), or localized intensive type (mining, bombing, residential). It also confers protection to federally endangered and threatened species throughout the area.	Most Pima County Parks; most USFS unreserved land; most BLM undesignated land; U of A Experimental Range land.
4a	Private or public lands without existing easements or irrevocable management agreements to maintain native species and natural communities; but without existing development or land uses which limit the lands value for conservation purposes, and without entitlements or existing plans for changes in land use intensity.	Grazing lands.

TABLE 2
GAP STATUS CATEGORIZATION
(continued)

GAP Status	Status Description	Examples
4b	Private or public lands without existing easements or irrevocable management agreements to maintain native species and natural communities; with no existing development but with existing uses which limit the lands value for conservation purposes.	Grazing lands.
4c	Private or public lands without existing easements or irrevocable management agreements to maintain native species and natural communities, with no existing development, but with existing land use designations for increased intensity of land uses.	Vacant private lands, with anticipated future land uses.
4d	Private or public lands with entitlements to increased intensity of land uses.	Vacant private lands with approved or planned development projects, recreation-oriented parks, agriculture.
4e	Native American lands	Undetermined
4f	Private or pubic lands with existing development or other uses which minimize value for conservation purposes.	Existing residential, commercial, industrial, transportation, etc.

TABLE 3
CONSERVATION STATUS AS IT RELATES TO LAND OWNERSHIP/MANAGEMENT CATEGORIES

Owner/Manager	Management	Management Categories								
		1a	1b	2	3a	3b	4a	4b	4e	4x
Arizona State Parks Board	Catalina State Park			x						
	Unreserved					4				
BLM	Baboquivari Wilderness Area	97								
	Coyote Mountain Wilderness Area	11								
	Empire-Cienega Resource Conservation Area					72				
	Silverbell Resource Conservation Area					19				
	Unreserved					59				
	Waterman Mountains ACEC			x						
BOR	BOR Wildlife Corridor			x						
DOD	Barry M. Goldwater Range					4				
Marana	Open Space					9				
	Unreserved - Private Lands									9
	Unreserved - State Trust Lands						30			
NPS	Organ Pipe Cactus National Monument			x						
	Organ Pipe Cactus NM Roads							15		
	Organ Pipe Cactus NM Wilderness Area	198								
	Saguaro National Park East		47							
	Saguaro National Park West		38							
	Saguaro National Park West Wilderness Area	32								
	Saguaro National Park Wilderness Area	19								
Oro Valley	Unreserved - Private Lands									10
	Unreserved - State Trust Lands						9			

TABLE 3
CONSERVATION STATUS AS IT RELATES TO LAND OWNERSHIP/MANAGEMENT CATEGORIES
(continued)

Owner/Manager	Management	Management Categories								
		1a	1b	2	3a	3b	4a	4b	4e	4x
Pascua Yaqui Nation	Unreserved								8	
Pima County	Cienega Creek Natural Preserve				61					
	Cienega Creek Natural Preserve (CC&R)	20								
	Colossal Cave Mountain Park					29				
	Empirita Ranch					4				
	Open Space					78				
	Tortolita Mountain Park					10				
	Tucson Mountain Park			x						
	Unreserved - Private Lands									1302
	Unreserved - State Trust Lands						414			
Sahuarita	Unreserved - Private Lands									1
	Unreserved - State Trust Lands						2			
South Tucson	Unreserved - Private Lands									1
TNC	Bingham Cienega Natural Preserve				2					
	The Nature Conservancy (deeded land)		24							
	The Nature Conservancy (easements)					3				
Tohono O'Odham Nation	Unreserved								294	
Tucson	Open Space					8				
	Unreserved - Private Lands									69
	Unreserved - State Trust Lands						21			
UofA	Santa Rita Experimental Range					58				
USFS	Butterfly Research Natural Area		1							

TABLE 3
CONSERVATION STATUS AS IT RELATES TO LAND OWNERSHIP/MANAGEMENT CATEGORIES
(continued)

Owner/Manager	Management	Management Categories								
		1a	1b	2	3a	3b	4a	4b	4e	4x
	Coronado National Forest (unreserved)					227				
	Mt. Wrightson Wilderness Area	4								
	Pusch Ridge Wilderness Area		25							
	Rincon Mountain Wilderness Area	30								
	Santa Catalina Research Natural Area	1								
USFWS	Buenos Aires National Wildlife Refuge	131								
	Cabeza Prieta National Wildlife Refuge		6							
	Cabeza Prieta Roads							1		
	Cabeza Prieta Wilderness Area	9								

TABLE 4
CONSERVATION STATUS OF LAND USE CODES IN PARCEL DATABASE

Conservation Status	Parcel Land Use Code	Land Use Code Description
4a	0000	Vacant land
	9400	Federal property
	9500	State property
	9600	County property
	9700	Municipal property
4b	2400	Golf course
	4100	Field crops
	4700	Ranch properties
	4800	Pasture land
	8700	Large lot residential
	9000	Not used
	9200	Religious properties
4c	0001	Vacant residential
	0002	Vacant commercial
	0003	Vacant industrial
	0004	No code
	0010	Residential
	0020	Commercial
	0030	Industrial
	0040	Rural, non-subdivided
	0080	Mobile home
4e	9800	Indian land
4f	0100	Single-family residential
	0200	Not used
	0300	Multiple residential
	0400	Hotel
	0500	Motel
	0600	Resort
	0700	Condos and townhouses
	0800	Mobile home sites
	0900	Salvage property
	1000	Commercial property
	2000	Restaurants, bars, etc.
	2100	Hospitals, vet clinics
	2200	Race tracks, air fields
	2300	Cemetery
	2500	Theaters and amusement
	2600	Parking facilities
	2700	Clubs, lodges, and recreation centers
	2800	Partially complete structure
	2900	Private schools

TABLE 4
CONSERVATION STATUS OF LAND USE CODES
IN PARCEL DATABASE
(continued)

Conservation Status	Parcel Land Use Code	Land Use Code Description
	3000	Industrial property
	4000	Agricultural property
	4300	Crop trees and tree farms
	4400	Citrus crop trees
	4500	High density agriculture
	5000	Non-operating water utilities
	6000	Telecommunications property
	8000	Dairy cattle
	8600	Not used
	8800	Limited use properties

panels as we move forward in our analysis. We particularly look forward to gaining a deeper understanding of the issues and threats, as each Subarea report becomes available. These reports will provide a broader perspective of biological concerns as effected by the Ranch Conservation, Cultural Resources, Land Use, and Riparian Elements.

With regard to threats to individual species, the tables in this report reflect the very beginning of a more detailed assessment of Vulnerable Species that is currently being conducted as a separate task. Information generated from that work effort will enable a more focused evaluation of threats, conservation opportunities, and management strategies. Spatial distribution of species will be identified and added to the GIS database to the extent possible as part of that process. We will then be able to identify areas and levels of threats to individual species and plant communities as part of the GIS analysis.

For these reasons we consider this assessment to be a basis for further discussion and analysis as we continue to identify areas and patterns of biological stress that will be incorporated in the preserve design process for the Sonoran Desert Conservation Plan.

Stressors to biological resources stem from events, activities, changes over time and other factors that affect individual plant and wildlife species and the biological and hydrological systems that support them. Stressors to wildlife include those factors that either directly or indirectly affect their ability to find or provide for their basic needs of food, water, and cover. Primary stressors to plants include reduction in water availability, removal of or direct damage to plants, competition with invasive species, and loss of pollinator species.

Preliminary research of the Status 1 and 2 Vulnerable species in Pima County conducted by the RECON team reveals categories of stressors as well as specific sources of stress that are known to affect those species. Sources of stress are specific activities, events, or other factors. This information can be generally summarized as follows.

Each of these sources of stress has the potential to effect biological resources in numerous ways—some positive, some negative. Further, many of these sources of stress are directly linked with specific land and water use activities. Effects of land use and water use activities are summarized in Table 5 and are presented here in order to serve as a basis for further discussion in each of the eight subareas in the following sections. Sources for this information include the management plans for the preserves within Pima County, interviews with land managers, review of information on vulnerable species, and discussions with RECON team, STAT members, and Pima County staff.

The following sections discuss specific components of existing and proposed land or water uses within each subarea, which pose the greatest potential for biological stress over the next 30 years to focal species and special habitats, plant associations, and communities identified by the STAT. The information available on various components within each subarea varies, as does the level of detail.

TABLE 5
EFFECTS OF LAND AND WATER USE ACTIVITIES ON BIOLOGICAL RESOURCES

Stress Sources	Potential Negative Impact	Potential Benefit
	WATER-RELATED ACTIVITIES	
Groundwater pumping	Lowers groundwater table, thereby reducing or eliminating springs and perennial surface water flows and the associated wetland and riparian vegetation communities and wetland- and riparian obligate species; aquifer overdraft has resulted in subsidence, economic loss, and the long-term degradation of the regional landscape, with particular damage to and decline of riparian ecosystems	Can provide water to isolated landscape restoration areas not served by water delivery system
Channelization and Bank Protection	Removal or subsequent loss of riparian vegetation, loss of instream cover, increased velocity of flows and other altered hydraulic characteristics, increased scour, increased sediment loads downstream, separation of stream flow from the floodplain, and fragmentation of habitat; often serve barriers to wildlife movement Channelization and bank protection is frequently coupled with an increase in land use intensity of areas that are no longer in the floodplain (e.g., conversion of agricultural lands to higher intensity residential and commercial developments) Downstream areas are impacted by increased velocity and volumes of stormwater runoff, causing erosion and damage or removal of riparian and other vegetation within the floodway.	

TABLE 5
EFFECTS OF LAND AND WATER USE ACTIVITIES ON BIOLOGICAL RESOURCES
(continued)

Stress Sources	Potential Negative Impact	Potential Benefit
Recharge and Release of CAP water	Potential to introduce and transports non-indigenous fishes and other aquatic species, some of which prey upon and compete with native species (e.g., Endangered Gila topminnow); aquatic community disruption, and habitat alteration; potential for transfers of diseases, parasites and contaminants; can contribute to abundant growth of nonnative plants species which can reduce or displace available habitat for native species, cause loss of water surface.	Decreased reliance on groundwater. CAP water is a valuable renewable water supply and a viable source of water for recharge restoring riparian and wetland habitats; reduces dependence on groundwater for watering large turf areas (golf courses, parks)
Recharge and Release of treated effluent water	Nutrient loading of downstream conditions; potential for introduction and transfer of diseases, parasites and contaminants; can contribute to abundant growth of nonnative plants species which can reduce or displace available habitat for native species, cause loss of water surface.	Decreased reliance on groundwater. Treated effluent water is the only growing water source we have, and it is a viable source of water for recharge and restoring riparian and wetland habitats; reduces dependence on groundwater for watering large turf areas (golf courses, parks)
Stock tanks, Impoundments,	Reduce or eliminate the historic source of water supporting downstream habitats and ecosystems; nutrients and sediments are trapped rather than transported and dispersed; diversions can result in erosion and cutting of watercourse channels.	Stock tanks offer a low-tech method of providing a water source for wildlife over an extended seasonal time frame; support water dependent

TABLE 5
EFFECTS OF LAND AND WATER USE ACTIVITIES ON BIOLOGICAL RESOURCES
(continued)

Stress Sources	Potential Negative Impact	Potential Benefit
Surface water diversions	Diversions have historically been associated with irrigation for agriculture, a high water use. Impoundments affect and disrupt wildlife populations and serve as points of introduction and breeding grounds for mosquitoes, bacteria, microbes, and other disease-causing organisms.	support water-dependent vegetation, insect population and other wetland species. Many aquatic organisms are adapted to fulfill their life cycles in temporary waters and perform critical ecosystem functions. Impoundments can provide valuable opportunities for riparian restoration projects and creation of wetland habitats.
Canals	Serve as barriers to wildlife movement	Canals can provide water to landscape areas and restoration areas not served by water delivery system.
Water-based recreation	Habitat disruptions, increased turbidity and direct effects on fish foods, spawning sites and populations; potential for water contamination and the introduction and spread of non-native aquatic and riparian species	

TABLE 5
EFFECTS OF LAND AND WATER USE ACTIVITIES ON BIOLOGICAL RESOURCES
(continued)

Stress Sources	Potential Negative Impact	Potential Benefit
	LAND USE-RELATED ACTIVITIES	
Urbanization	Loss and displacement of habitat; requires associated roadways and infrastructure of utilities which contribute to habitat fragmentation. Watercourses in urbanized areas are typically channelized, diverted and/or impounded, and the associated indigenous habitats and riparian obligate species are frequently removed, displaced or extirpated.	
Lot-splitting/ Wildcat subdivisions	Low-density distribution of homes and outbuildings disperses human impact over a greater area than standard subdivisions; individual reliance on ground wells increases decline in water table profoundly affecting surface waters and riparian vegetation; allowed livestock uses can eliminate native vegetation within property boundaries.	Many lots retain significant areas of undisturbed natural open space
Commercial development	Displacement of habitat, requires associated roadways and infrastructure of utilities	
Residential subdivisions	Displacement of habitat, requires associated roadways and infrastructure of utilities; places greater number of humans in proximity to potentially sensitive habitat areas	

TABLE 5
EFFECTS OF LAND AND WATER USE ACTIVITIES ON BIOLOGICAL RESOURCES
(continued)

Stress Sources	Potential Negative Impact	Potential Benefit
Mining	Removal of vegetation and overburden, road construction and dredging or channelization of streams; potential for water contamination (groundwater and downstream), siltation of downstream conditions; required rehabilitation efforts are rarely equivalent to restoration.	Smaller mine adits can provide opportunities for bat roosting sites
Aggregate or fill removal	Extracting large volumes of sand, gravel and other materials from watercourses and floodplains often requires the removal of riparian or xeririparian habitat and can destabilize channels, alter hydrological patterns, channel and bed configuration. Potential for progressive and deleterious effects on floodplain biota	Post-use opportunities for water impoundments, created wetlands, and riparian restoration projects.
Livestock grazing	If poorly managed or overstocked can result in loss of grass and forb cover, erosion, damage or removal of other vegetation (trees are frequently damaged); potential damage to young, cacti (e.g., saguaro) and small cacti; potential damage to riparian and wetland vegetation and wildlife dependent on such habitat types. Has had a major role in transforming grasslands to scrublands, erosion and downcutting of washes throughout watersheds, spread of exotic grasses and other plants, and damage to riparian habitats. Introduction of non-native grasses (e.g., buffelgrass, red brome, lovegrass) has changed the fire regime in many areas and lower-elevation fire-intolerant vegetation is damaged or killed as a result. Historically has resulted in the long-term degradation of the regional landscape. More recently controlled and managed for long-term health sustainability of the grazing allotment.	Ranching and grazing permit areas provide for the conservation of open space and an edge to urban form; potential for recovery and protection of sensitive habitat areas; on-site land stewardship. Ranching can result in the recovery and improvement of range conditions over time.

TABLE 5
EFFECTS OF LAND AND WATER USE ACTIVITIES ON BIOLOGICAL RESOURCES
(continued)

Stress Sources	Potential Negative Impact	Potential Benefit
Landfills	Removal of habitat, potential for water contamination (groundwater and downstream), siltation of downstream conditions, airborn dust; attractive nuisance (birds and rodents)	
Wastewater treatment	Associated access and infrastructure replaces/removes habitat; potential for water contamination;	Potential for secondary uses of treated water
Roadways	Removal of surface cover, habitat; potential barriers to wildlife movement; requires volumes of sand, gravel and other materials extracted from watercourses and floodplains; cumulative additions to "edge effect" and habitat fragmentation; unpaved roads contribute to dust and downstream siltation	Access for monitoring conditions
New Utilities	Removal of surface cover, habitat; potential barriers to wildlife movement; potential for electrocution of birds from perching on overhead lines	
Farming & Agricultural uses	Removal of surface cover, habitat; potential barrier to wildlife movement; associated groundwater pumping can reduce water table; irrigation runoff high in nitrates & salts. Agriculture can introduce and spread exotic weeds and non-grasses.	Crops sometimes serve as a source of food for birds and other wildlife
Abandonment or Conversion of agricultural lands	Can result in abandoned fields that are a source of exotic weeds and non-grasses, dust, wind erosion, and siltation; can result in an influx of higher-intensity land uses such as commercial and residential.	Can possibly reduce groundwater pumping

TABLE 5
EFFECTS OF LAND AND WATER USE ACTIVITIES ON BIOLOGICAL RESOURCES
(continued)

Stress Sources	Potential Negative Impact	Potential Benefit
Conversion of desert lands to crop lands	Displaces native vegetation communities and habitat; see above notes under farming.	Crops sometimes serve as a source of food for birds and other wildlife
Golf Courses	Displacement of habitat, requires associated roadways and infrastructure of utilities, places greater number of humans in proximity to potentially sensitive habitat areas; encourages large population of certain species (e.g., rabbits)	Serve as an attraction to certain species; providing them with a reliable source of water during dry months
Parks	Access, parking, use areas and associated fields displace native habitat.	Provides for valuable open space; design can result in preservation of critical habitats, watercourse areas and wildlife corridors
	RECREATION AND OTHER ACTIVITIES/FACTORS	
Hunting and trapping	Direct kill or injury to wildlife, noise, "Flushing", chase/harass,	On-site land stewardship potential; can help achieve healthy wildlife populations and predator/prey balance
Archery, target shooting	Direct kill, noise, "Flushing",	On-site land stewardship potential
Fishing	Direct kill or injury to fish; potential damage to riparian habitat due to access and overuse	On-site land stewardship potential

TABLE 5
EFFECTS OF LAND AND WATER USE ACTIVITIES ON BIOLOGICAL RESOURCES
(continued)

Stress Sources	Potential Negative Impact	Potential Benefit
	Stocking can introduce non-native species that aggressively compete with native aquatic wildlife for habitat	
Hiking	Disturbance to wildlife, loss of vegetative cover and topsoil, trail erosion	On-site land stewardship potential
Horseback riding	Disturbance to wildlife, loss of vegetative cover and topsoil, trail erosion	On-site land stewardship potential
Off-road driving	Roadkill and disturbance to wildlife, noise, erosion, degradation or loss of habitat and contributes to habitat fragmentation; loss of protective desert "varnish" rock cover, vegetative cover, topsoil and reduction in substrate stability. Can increase vandalism to native plants.	On-site land stewardship potential
Mountain biking	Disturbance to wildlife, trail erosion, degradation or loss of habitat, vegetative cover, topsoil	On-site land stewardship potential
Picnicking & Camping	Disturbance to wildlife, degradation or loss of habitat, potential for water contamination of live streams. Requirements for access roads increase habitat fragmentation. Associated loss of habitat often occurs in riparian or other special habitat areas. Attractive nuisance of garbage and water sources can contribute to conflicts between humans and wildlife.	On-site land stewardship potential
Wood cutting	Loss of vegetative volume and cover, damage or death to trees;	Reducing fuel load

TABLE 5
EFFECTS OF LAND AND WATER USE ACTIVITIES ON BIOLOGICAL RESOURCES
(continued)

Stress Sources	Potential Negative Impact	Potential Benefit
Logging/Timber Management	Removal of vegetation and habitat, associated road use and construction, creation of multiple edges; opening of access to otherwise remote areas to vehicular, recreational and other uses; potential for watershed alteration	Reducing fuel load, triggering regeneration cycle
Fire suppression	Interruption of natural cycles of renewal for grasslands and other fire-dependent species, periodic wildfires resulting from fuel build-up	Safe-guarding protected areas or newly revegetated areas
Organized recreational and sports use	Removal of surface cover and habitat, disturbance to wildlife in adjacent natural open space areas, attractive nuisance of garbage and water source, potential conflicts between humans and wildlife.	Serve as an attraction to certain species; often providing them with a reliable source of water during dry months
Increase in illegal immigration and drug trafficking	Has required an increased level of on the ground surveillance of the border in areas previously not used due to lack of roads. Border Patrol access and use of jeep trails has increased, and new roads have been built. Some previous roadless areas along the border have become criss-crossed with jeep trails. Loss of surface cover and disturbance to wildlife result. Fences are cut, new trails are created, trash is deposited, plants are damaged or cut down, wildfires can be started.	
Air to ground bombing (B. M. Goldwater Range)	Potential for direct kill, visual and noise disturbance, disturbance to wildlife behavior, abandonment of suitable habitat by wildlife, disposal of explosive ordnance	Provides conservation of open space and expanses of habitat with limited access for humans.

TABLE 5
EFFECTS OF LAND AND WATER USE ACTIVITIES ON BIOLOGICAL RESOURCES
(continued)

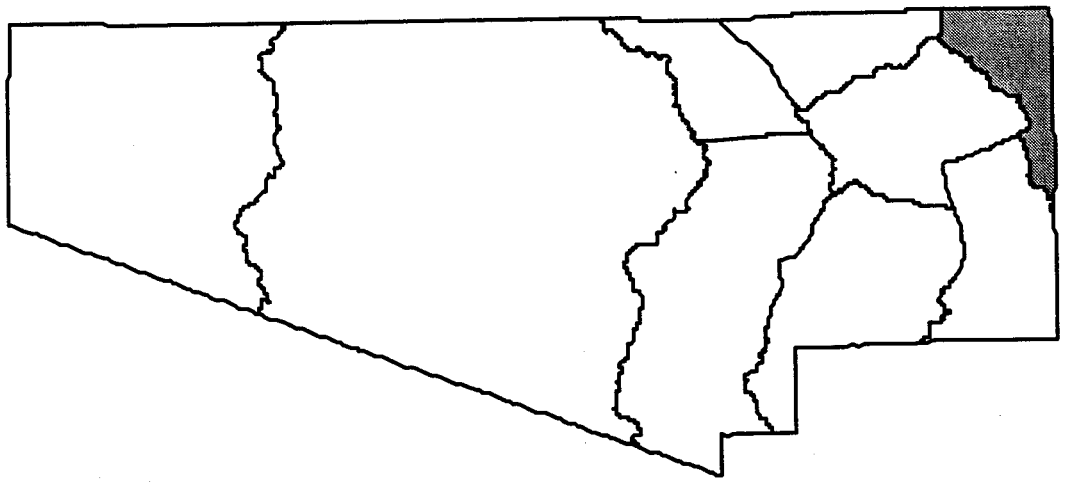
Stress Sources	Potential Negative Impact	Potential Benefit
Low-level overflights (500'-2000') and military training activities	Visual and noise disturbance, disturbance to wildlife behavior, abandonment of suitable habitat by wildlife, shifting of use areas by raptors, aircraft collisions with wildlife, impacts caused by live fire and military debris (e.g., tow darts) including scattering of live ordnance	

San Pedro

Sub Area 1

III. San Pedro (Subarea 1)

The portion of the San Pedro watershed that occurs within Pima County is located at the far northeast corner of the County, east and northeast of the Catalina and Rincon Mountains (Figure 1). The Galiuro Mountains form the eastern side of this valley landscape. The subarea consists mostly of undeveloped land and is characterized by rural homesites and ranches. (Figure 2).

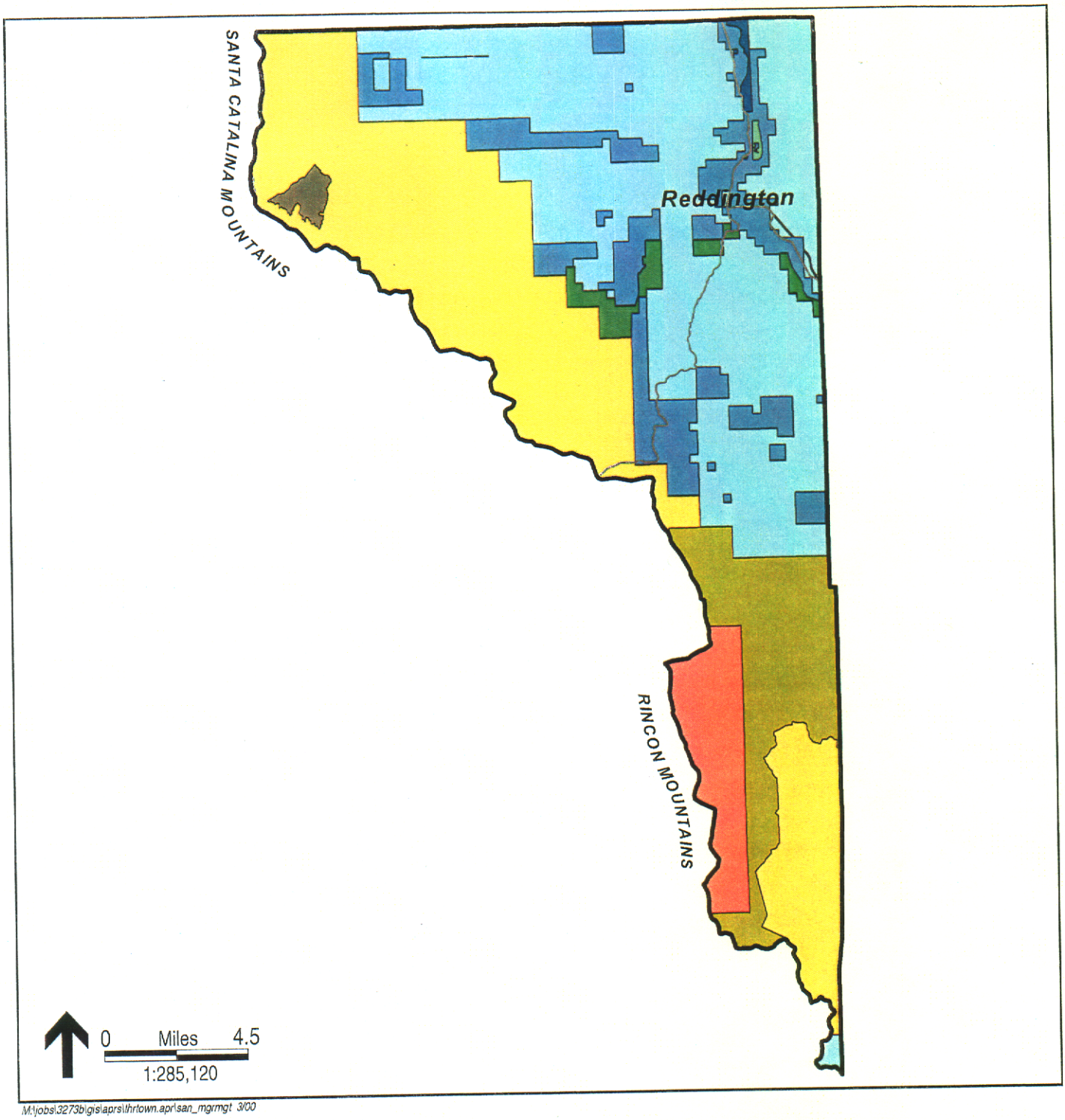


San Pedro Subarea Location in Pima County
Figure 1

A. Potential Threats and Stressors

1. Land Use and Landscape Character

The Conceptual Land Use Element of the Pima County Comprehensive Plan identifies the non-federal portion of the San Pedro valley as a Rural Planning District, with Desert Belt Segments of acquired natural open space linking the San Pedro River to the Coronado National Forest (Pima County 1996). There is a small community, Redington, clustered in the area where Redington Road intersects the Mammoth/Benson Road. Most of the land in the valley area is State Land. However, numerous parcels of private land abut or include the San Pedro River and its associated riparian woodland corridor (Pima County 2000). Therefore, private development must be considered as a possibility for the future. Private development encroaching into riparian areas and a continued increase in ranch conversion, lot splitting, and wildcat subdividing throughout the valley pose distinct conflicts with the preservation of open space and protection of biological resources (TNC 2000). (Conversely, the private land holdings offer some protection to the watercourse from unregulated recreational use.) There has been no development of regulated subdivisions in the subarea. A review of parcel boundaries indicates many individual parcels occur just outside the boundary of Coronado National Forest, in addition to those located along the river.



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Land Ownership and Land Management
in the San Pedro Subarea

- NPS - Saguaro National Park Wilderness Area
- Pima County - Open Space
- Pima County Unreserved - Private Lands
- Pima County Unreserved - State Trust Lands
- TNC - Bingham Cienega Natural Preserve
- TNC - The Nature Conservancy (deeded land)
- USFS - Butterfly Research Natural Area
- USFS - Coronado National Forest (unreserved)
- USFS - Rincon Mountain Wilderness Area
- Major Road or Highway

Figure 2

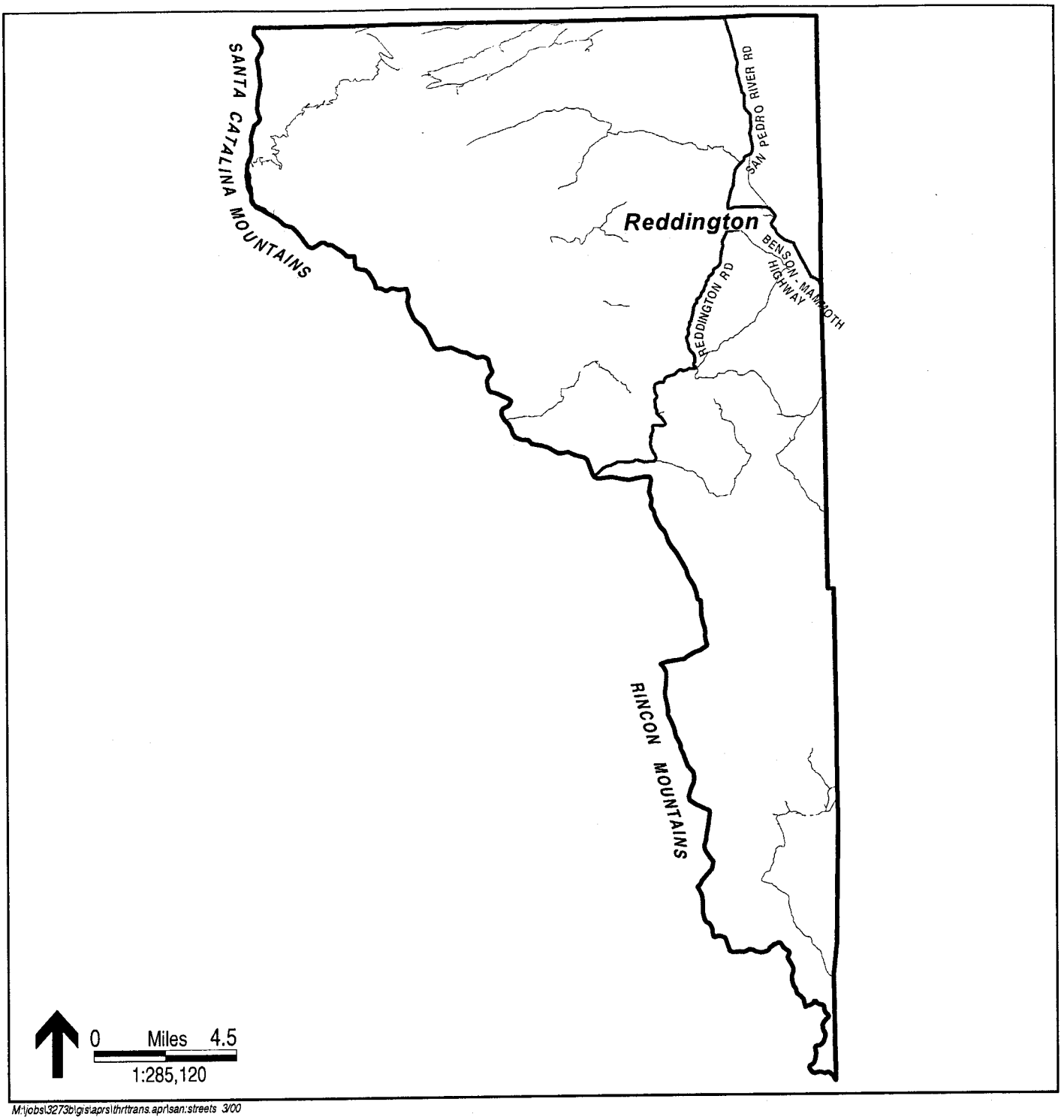
Ranching and farming have a long history in the San Pedro Valley and continue to be an important part of the economy. Grazing allotments cover the subarea, extending into the Coronado National Forest and the Rincon Mountain Wilderness area of the forest and the Saguaro National Park. After the Bellota Ranch (located in the Redington Pass area) was initially sold to private interests in 1988, the City of Tucson and The Nature Conservancy acquired it. The sale raised regionwide concerns about the subdivision and conversion of ranch lands—triggering lot-splitting and residential subdivisions. For the time being it appears that no large-scale development is imminent in the subarea, and that lack of infrastructure and services will continue to be a deterrent at least through the near future (Pima County 2000). Past livestock grazing practices and fire suppression have resulted in loss of perennial grass cover and soil erosion in some areas. This has led to increased surface runoff and sediment erosion from uplands and decreased infiltration of water.

Mining has occurred on public and private lands and has been of particular concern within the Buehman Canyon, a tributary to the San Pedro and a major wildlife corridor and riparian area. Activities associated with the claim on the mineral rights in the Canyon have included road cutting and clearing which may be resumed in the near future (TNC 2000). It is possible that claims to mineral rights can be purchased, or that BLM could review the validity of the claim and make a determination of discontinuance. Areas of medium to high potential for mineral resources occur along the northeast flanks of the Catalina Mountains. If explored and developed, mining in this area could have a negative effect on other tributary canyons of the San Pedro. Effects on biological resources from mining could include large-scale degradation of intact areas, habitat loss and fragmentation, potential for downstream watershed contamination, and intensive groundwater pumping to support mine operations. Habitats affected could represent the full range from heavily forested areas at higher elevations, riparian canyons, oak woodlands, and grasslands.

Since 1879 the area has experienced a change in vegetation communities. The sacaton grassland plant community has been eliminated and has been nearly replaced by mesquite, exotic grasses, and woody riparian plants such as tamarisk and Goodding willow (Pima County 2000). Nevertheless, this portion of the San Pedro Valley encompasses many significant ecological features including intact cottonwood-willow riparian forest, mesquite bosques, a rare desert cienega, several rare or declining plant and wildlife species, and side tributary canyons with perennial flow and mixed broadleaf deciduous riparian forest. The valley itself is a nearly unfragmented landscape connecting the mountain ranges on both sides and functioning as a corridor for wide-ranging large mammals (TNC 2000).

2. Transportation

The San Pedro subarea is the least fragmented by existing highways and roads (Figure 3). Within the San Pedro subarea are three primary road corridors: Redington Road, the San Pedro River Road, and the Benson-Mammoth Highway, all unpaved roads which pass through the Bingham Cienega Preserve area along the San Pedro. Increasing private development and a continued increase in lot-splitting and wildcat subdividing in the valley would bring increased pressure on the County to make roadway improvements such as widening and paving. The roadways are a potential source of stress in their ability to bring people into and through the area in increasing numbers.



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Road Network
in the San Pedro Subarea

Highway or Major Road
Local Road

Figure 3

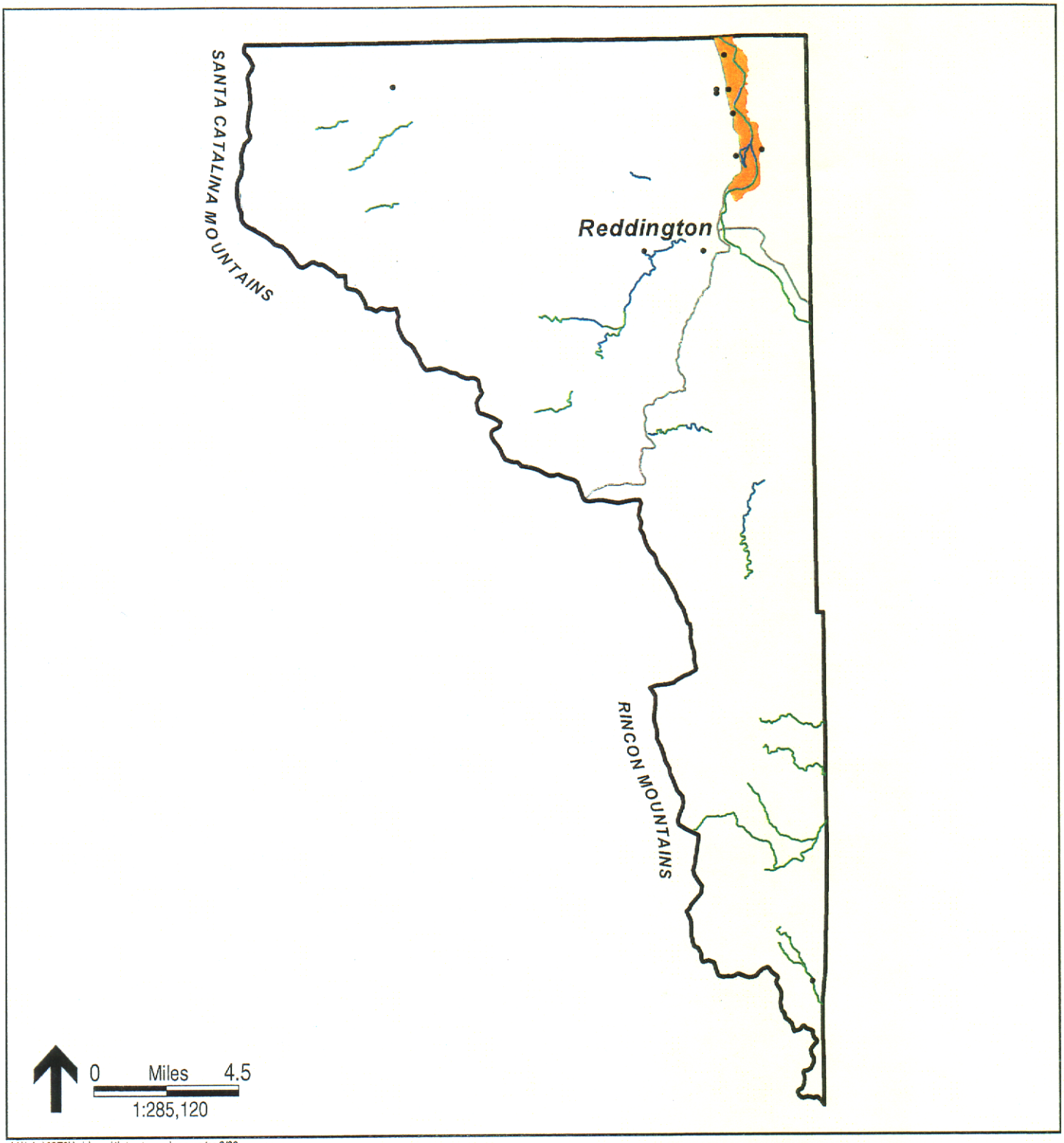
Neither the Long Range Transportation Plan for Unincorporated Pima County (Pima County 1986) nor the Metropolitan Transportation Plan (Pima Association of Governments [PAG] 1998) includes plans for paving or widening Redington Road, a County-maintained roadway. Numerous other unpaved roads and access easements are found throughout the area, often outside of their easement or right-of-way area (Pima County-Goff 2000). As in most rural areas roads are created when old ones become rutted, washed out, or otherwise unpassable. When viewed over time, and on a broad scale, this results in a general degradation of the landscape, habitat fragmentation, and can greatly reduce biological resource value.

3. Water Uses

One of few areas of shallow groundwater in Pima County occurs along the San Pedro, which also has perennial and intermittent flows (PAG 2000). Several of its tributaries within the subarea also have perennial flows (Figure 4 and Table 6). Since the area residents are dependent upon private wells, an increase in homesites, agricultural uses, and other private development would consequently increase the groundwater pumping of the area. Portions of the river have already ceased to flow reliably. Increased pumping could easily and fairly rapidly further decrease the amount of shallow groundwater and surface streamflow supporting the riparian woodland and wetlands along the San Pedro and its tributaries. Upstream of the subarea, in the vicinity of Sierra Vista, the river has been designated a Riparian National Conservation Area due to its significance to wildlife (Pima County-Water Resources 1999). Beaver were once abundant in the river, and have recently been reintroduced within the national conservation area (NCA). San Pedro is considered the best example of a desert riparian system remaining in the southwest and serves as a major migratory pathway for neotropical migratory birds. Populations of numerous species of bats are thought to occur along the river valley due to the elevational gradient, presence of limestone terrain, and diversity of riparian and xeroriparian communities (TNC 2000). Since the area residents are dependent upon private wells, an increase in homesites, agricultural uses, and other private development would consequently increase the groundwater pumping of the area. Portions of the river have already ceased to flow reliably (Pima County-Water Resources 1999). Increased pumping could easily and fairly rapidly further decrease the amount of shallow groundwater and surface streamflow supporting the riparian woodland and wetlands along the San Pedro River and its tributaries.

4. Recreation

The increasing pressure that the Redington Pass area of the Coronado National Forest has been experiencing from recreationists, particularly from off-road vehicles (ORV) and trespass camping, is also a potential stress to the subarea and its unique habitats (U.S. Forest Service, Senn, 2000). Numerous designated and non-designated trails provide access to increasing numbers of hikers, equestrians, mountain bicyclists, and off-road vehicles. Direct effects of these activities and overuse include loss of surface vegetative cover, erosion, habitat fragmentation, and disturbance of wildlife. Damage to riparian vegetation also results. It is realistic to expect that the use of the Redington Pass area and much of the land between the mountains and the San Pedro River will continue to increase as the population of the Tucson basin increases and as the maximum carrying capacity of the Mt. Lemon recreation areas is quickly reached.



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Surface Groundwater and Streams
in the San Pedro Subarea

Suspected Shallow Groundwater Areas (based on well data and aerial imagery)

Well with Depth to Water less than 50 feet (ADWR Well 55-Registry and GWSI databases)

Perennial Reach

Intermittent Reach

Major Street or Highway

Figure 4

TABLE 6
STREAM CHARACTERISTICS IN THE SAN PEDRO SUBAREA

Stream Name	Miles of Perennial Flow	Miles of Intermittent Flow	Acres of Hydro-mesoriparian Habitat	Acres of Class A Riparian Habitat	Acres of Shallow Groundwater	Pygmy-Owl Habitat	Fish Species	Leopard Frogs
Alder Canyon	0	1.2	0	17	N/A	No	N/A	N/A
Geesaman Wash	0	1.2	N/A	N/A	N/A	No	N/A	N/A
Stratton Canyon	0	0	0	50	N/A	No	0	N/A
Atchley Canyon	0	1.8	N/A	N/A	N/A	No	N/A	N/A
Peck Basin	0	1.2	N/A	N/A	N/A	No	N/A	N/A
Edgar Canyon	0.7	0	93.4	71	N/A	No	1	Y
San Pedro River	1.3	10.6	2306	0	2102	Yes	6a	N/A
Bingham Cienega	1.9	0	0	0	N/A	Yes	N/A	N/A
Sycamore Canyon	0	1.1	N/A	N/A	N/A	No	N/A	N/A
Buehman Canyon	5.2	2.5	0	228	N/A	No	3a	Yes
Bullock Canyon	0.7	3.1	N/A	N/A	N/A	No	1	Yes
Espiritu Canyon	2.2	2.4	0	0	N/A	No	N/A	N/A
Youtcy Canyon	1.2	1.6	0	0	N/A	No	N/A	Yes
Deer Creek	0	2.5	N/A	N/A	N/A	No	N/A	N/A
Miller Creek	0	4.1	N/A	N/A	N/A	No	N/A	N/A
Ash Creek	0	3.1	N/A	N/A	N/A	No	N/A	N/A

N/A = not applicable.

B. Biological Resources

1. Vegetation and Land Cover

The San Pedro Subarea abuts the Santa Catalina and Rincon Mountains on the west (Figure 5). At higher elevations habitats include douglas-fir-mixed-conifer, pine, oak, and oak-pine forests and areas of manzanita habitat. At lower elevations to the east habitats include mixed grass scrub, palo verde-mixed cacti, and creosote bursage. Stands of mixed evergreen sclerophyll are interspersed with mixed scrub, cottonwood-willow and limited agricultural development in the northeast corner of the subarea.

2. Critical Habitat

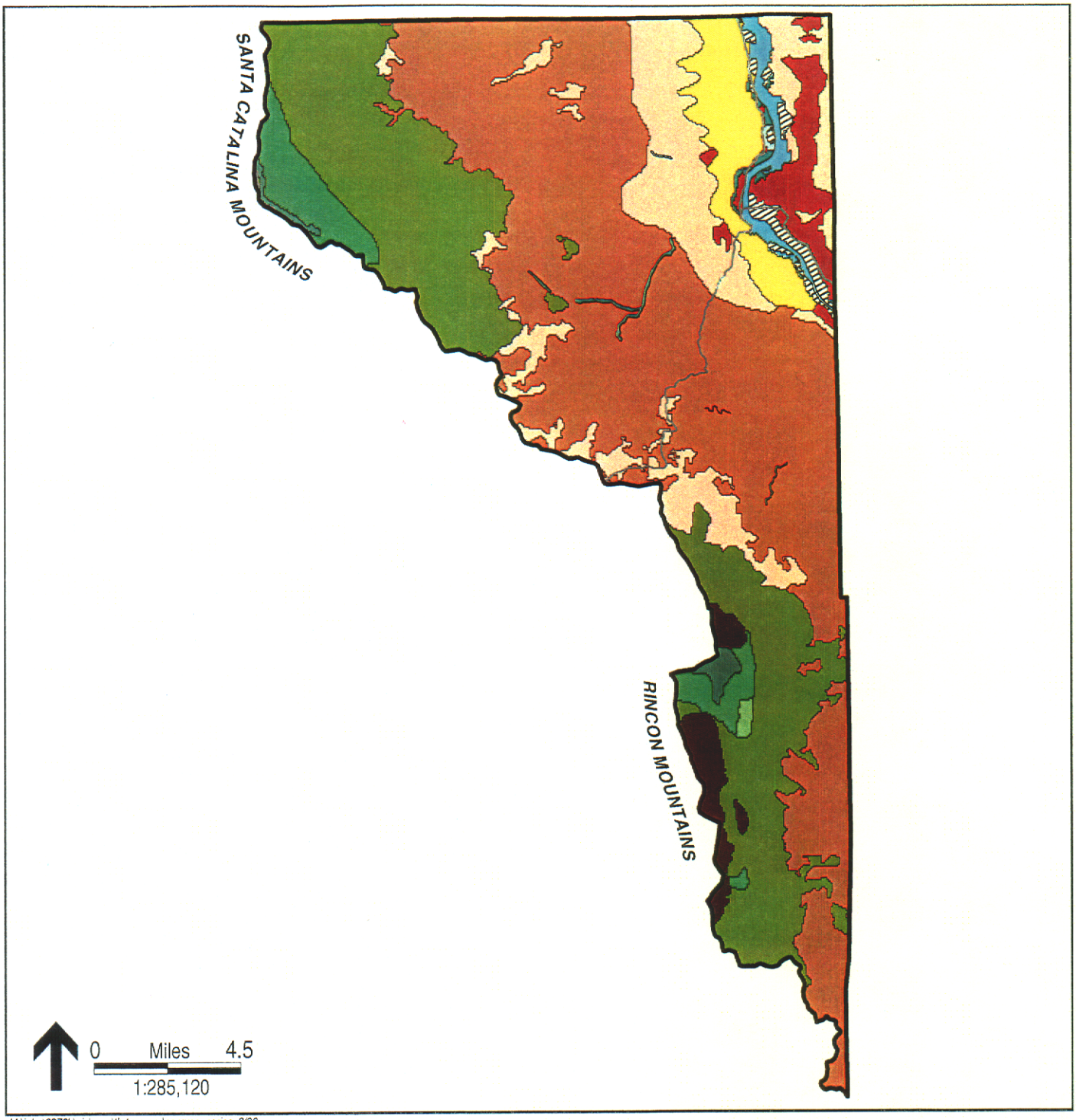
Both the current 289 acres of TNC preserve and the proposed additional 400 acres are within Critical Habitat for the cactus ferruginous pygmy owl (CFPO), Map Unit 6. It includes the riparian woodlands of the lower San Pedro River woodlands. Four pygmy-owls were documented in the mid-1980s. Activities that pose a threat to the Critical Habitat for the CFPO include removing or destroying vegetation; water diversion, impoundment or groundwater pumping that alters water quality or quantity to an extent that riparian vegetation is significantly affected; and recreational activities that appreciably degrade vegetation (U.S. Department of Interior-U.S. Fish and Wildlife Service [USDI-USFWS] 1999).

In December 1999 the USFWS proposed a Critical Habitat designation for the Spikedace and Loach minnow along a 46-mile segment of the San Pedro and 14 miles of Redfield Canyon, a tributary of the San Pedro that extends to the east. Approximately 15 miles of that proposed Critical Habitat lie within the county. None of the habitat is currently occupied by these fish but it is considered to be the type locality and contains important restoration areas (i.e., they have the potential for developing the necessary requirements for survival, growth, and reproduction of the fish). Activities that contribute to habitat destruction; alter natural flow regimes, watershed characteristics, channel morphology, or water chemistry; and/or introduce, spread, or augment nonnative aquatic species could destroy or adversely modify the critical habitat of these fish species (USDI-USFWS 1999).

In February 2000, the USFWS gave notice of a petition to consider listing the yellow-billed cuckoo as endangered. If the listing is determined to be warranted, the USFWS may designate critical habitat. This species prefers dense riparian thickets. Habitat for this bird exists in this reach of the San Pedro River valley and at least one nesting occurrence has been documented (TNC 2000).

3. Species at Risk

A total of 16 Status 1 and 2 Vulnerable Species occur within the subarea (Table 7). The subarea does contain suitable habitat for beaver and so there is a possibility of reintroducing the species. There is also the possibility of natural reestablishment of beaver to the area since they exist both in upstream and downstream locations. One consideration, in addition to public concerns about beaver restoration, are the potential increases in bullfrogs and non-native fishes associated with increased amounts of pool habitats behind beaver dams.



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Vegetation and Land Cover
in the San Pedro Subarea

Vegetation Communities (BLP Classification)

- 122.61 Douglas-Fir-Mixed-Conifer
- 122.62 Pine
- 123.31 Encinal (Oak)
- 123.32 Oak-Pine
- 133.32 Manzanita
- 133.36 Mixed-Evergreen Sclerophyll
- 143.15 Mixed Grass-Scrub
- 154.11 Creosote-Bursage
- 154.12 Paloverde-Mixed Cacti
- 223.22 Mixed Broadleaf
- 224.53 Cottonwood-Willow
- 234.71 Mixed Scrub
- 244.71 Cattail

Other Land Cover Types

- 999.1 Agriculture
- 999.2 Urban
- Major Road or Highway

Figure 5

TABLE 7
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE SAN PEDRO SUBAREA

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Muhlenbergia xerophila Weeping muhly	1	S1	-	Very narrow distribution.	Mica Mountain quad 1978 NPS	Along Rincon Creek in Saguaro NP. May not be in this watershed planning unit, but adjacent to it.
Gila intermedia Gila chub	1	S2	FC FSS WSC	Non-native species, competition and predation. Habitat loss by groundwater pumping and channelization. Flooding. Drought. Dredging. Poor water quality. Livestock grazing (trampling by cattle, watershed changes).	Redington quad 1990-12-01 Private	Upstream in Redfield Canyon, in Graham County, but may occasionally come downstream into Pima County.
Glaucidium brasilianum cactorum Cactus ferruginous pygmy-owl	1	S1	FE FSS WSC	Habitat destruction and alteration, historic and present. Groundwater pumping, channelization, urbanization, historic livestock grazing? Farming and agricultural uses? Wood cutting. Disturbance by bird watchers. Small population subject to stochastic events. Possibility of disease, including emerging diseases, and loss of viable food supply as a result of drought and/or climate change.	Rincon Peak quad 1999 USFS	Subarea is included in Critical Habitat

TABLE 7
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE SAN PEDRO SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Catostomus clarki Desert sucker	2	S3S4	-	Non-native species, competition and predation. Habitat loss by groundwater pumping and channelization. Flooding. Drought. Dredging. Poor water quality. Livestock grazing (trampling by cattle, watershed changes).	Redington quad 1990-12-02 Private Soza Canyon quad 1989-11-11 Private 1993 BLM	Upstream in Graham County and Cochise County, but may occasionally come downstream into Pima County.
Catostomus insignis Sonora sucker	2	S3S4	-	Non-native species, competition and predation. Habitat loss by groundwater pumping and channelization. Flooding. Drought. Dredging. Poor water quality. Livestock grazing (trampling by cattle, watershed changes).	Redington quad 1990-12-01 Private	Upstream in Redfield Canyon, in Graham County, but may occasionally come downstream into Pima County.
Rhinichthys osculus Speckled dace	2	S3S4	FSC	Non-native species, competition and predation. Habitat loss by groundwater pumping and channelization. Flooding. Drought. Dredging. Poor water quality. Livestock grazing (trampling by cattle, watershed changes).	Redington quad 1990 Private	Upstream in Redfield Canyon, in Graham County, but may occasionally come downstream into Pima County.
Accipiter gentilis apache Apache northern goshawk	2	S3	F-petitioned FSS WSC	Habitat destruction by logging and forest clearing. Possibly consequences of fire suppression leading to major timber fires. Organized recreational	Mt.. Bigelow quad multiple records USFS Mica Mountain quad, one record 1992 NPS	May occur at high elevation areas, barely within this subarea. Petitioned for listing as endangered, 90 day finding

TABLE 7
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE SAN PEDRO SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
				timber fires. Organized recreational and sports use. Global climate change. Disturbance by recreationists, cattle grazing, mining, road building and other forest disturbances are site specific threats alleged by Center for Biodiversity.	record, 1992, NPS	endangered, 90-day finding determined that listing was not warranted 6/29/98. Suit filed 2/25/99 to list as endangered.
Coccyzus americanus occidentalis Western yellow-billed cuckoo	2	S3	F-petitioned FSS WSC	Habitat destruction and alteration, historic and present. Groundwater pumping, channelization, urbanization, historic livestock grazing? Farming and agricultural uses? Wood cutting. Reduction of acreage in pecan farming.	Soza Canyon quad 1994-07-18 BLM (in Cochise Co.)	Positive 90-day finding on petition, 2/17/00
Echinomastus erectocentrus var erectocentrus Needle-spined pineapple cactus	2	S3	SC S SR	Very narrow distribution. Land development and off-road vehicles might impact this species.	Galleta Flat West quad, in Cochise Co. at Kiper Spring. 1981. State. Peppersauce Wash quad 2 sites, Pinal Co. 1980, 1990. State	Records are outside but near Pima Co. in this general area.
Empidonax traillii extimus Southwestern willow flycatcher	2		FE WSC	Habitat destruction and alteration, historic and present. Groundwater pumping, channelization, urbanization, historic livestock grazing? Farming and agricultural uses? Nest parisitism by	Soza Canyon 1993-06-12 State	Upstream from county line, in Cochise Co.,

TABLE 7
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE SAN PEDRO SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
				Brown-headed Cowbird.		
Lasiurus blossevillii (=*borealis*) Western red bat	2	S2	FSS WSC	Habitat loss as a result of groundwater pumping, channelization, wood cutting, leading to loss of riparian areas. Farming and agricultural uses, specifically secondary poisoning and reduction of food supply resulting from insecticide use.	Happy Valley quad Rincon Mts. Happy Valley: Miller Flat. 1994-08-05, USFS.	One record, that may be in this subarea: Needs better resolution of subarea boundaries.
Poeciliopsis occidentalis occidentalis Gila topminnow	1	S2	FE FSS WSC	Non-native species, competition and predation. Habitat loss by groundwater pumping and channelization. Flooding. Drought. Dredging. Poor water quality. Livestock grazing (trampling by cattle, watershed changes).	Piety Hill quad 1983-05-24 USFS Mica Mountain quad, Madrona Canyon 1987, NPS	Population in this subarea was apparently extirpated in the 1980's.
Rana yavapaiensis Lowland leopard frog	2	S4	SC FSS WSC	Groundwater pumping, disease, water pollution, invasive non-native species, ozone loss, unknown causes of population declines	Buehman Canyon quad 1995 TNC Buehman Canyon Preserve Soza Canyon quad 1989 Private, 1994 BLM Redington quad 1990 private Piety Hill quad 1993, 1979 USFS	Soza Canyon site is upstream, in Cochise Co.

TABLE 7
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE SAN PEDRO SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Strix occidentalis lucida Mexican spotted owl	2	S3S4	FT WSC FSS	Habitat destruction by logging. Possibly consequences of fire suppression leading to major timber fires. Organized recreational and sports use and recreational development. Global climate change.	Mt. Bigelow quad multiple records USFS Mica Mountain quad, 4 locations in 1997, all NPS	May occur at high elevation areas, barely within this subarea. Critical Habitat for this species had been designated in 1995, but rescinded in 1998. It may have just barely touched portions of this subarea, but was mostly (if not entirely) within subarea 4. On 3/14/00 a federal judge ordered FWS to determine critical habitat by 1/15/01.

NOTE: Records are from Heritage Data Management System (HDMS), Arizona Game and Fish Department.

Quads: Campo Bonito, Peppersauce Wash, Kielberg Canyon, Mt. Bigelow, Buehman Canyon, Redington, Piety Hill, Soza Canyon, Mica Mountain, Happy Valley, Rincon Peak, Galleta Flat West

C. Existing and Proposed Preserve Areas

The Bingham Cienega Preserve, owned by Pima County and managed by The Nature Conservancy for wildlife habitat, is located along the San Pedro River just north of Redington. The Preserve includes a very rare spring-fed cienega, mesquite bosques, a deciduous broadleaf riparian forest, and an area previously cleared for agriculture (TNC 1992). Unusually dry conditions over the last few months contributed to a recent wildfire that completely removed dry cattails in the wettest areas of the cienega, north of Redington Road (Redington Natural Resource Conservation District [RNRCD] 2000). None of the sacaton and deciduous tree areas of restoration, east of the cienega burned. Wild fires pose a threat to this area, as does the invasion by non-native grasses and tamarisk. Domestic livestock grazing is allowed within a 19-acre inholding of the preserve and could be a potential stressor to riparian habitat; incomplete perimeter fencing and resultant trespass livestock grazing is also a potential threat. The presence of the exotic mosquitofish poses a threat to the management goals of reestablishing the Gila topminnow and desert pupfish. The presence of feral hogs all along the San Pedro River is an ongoing management concern within the preserve. The hogs uproot native vegetation in cienega, riparian, and mesquite bosque habitats; compete with native wildlife for food, water, and cover; and can transmit diseases that infect predators and other wildlife (TNC 2000).

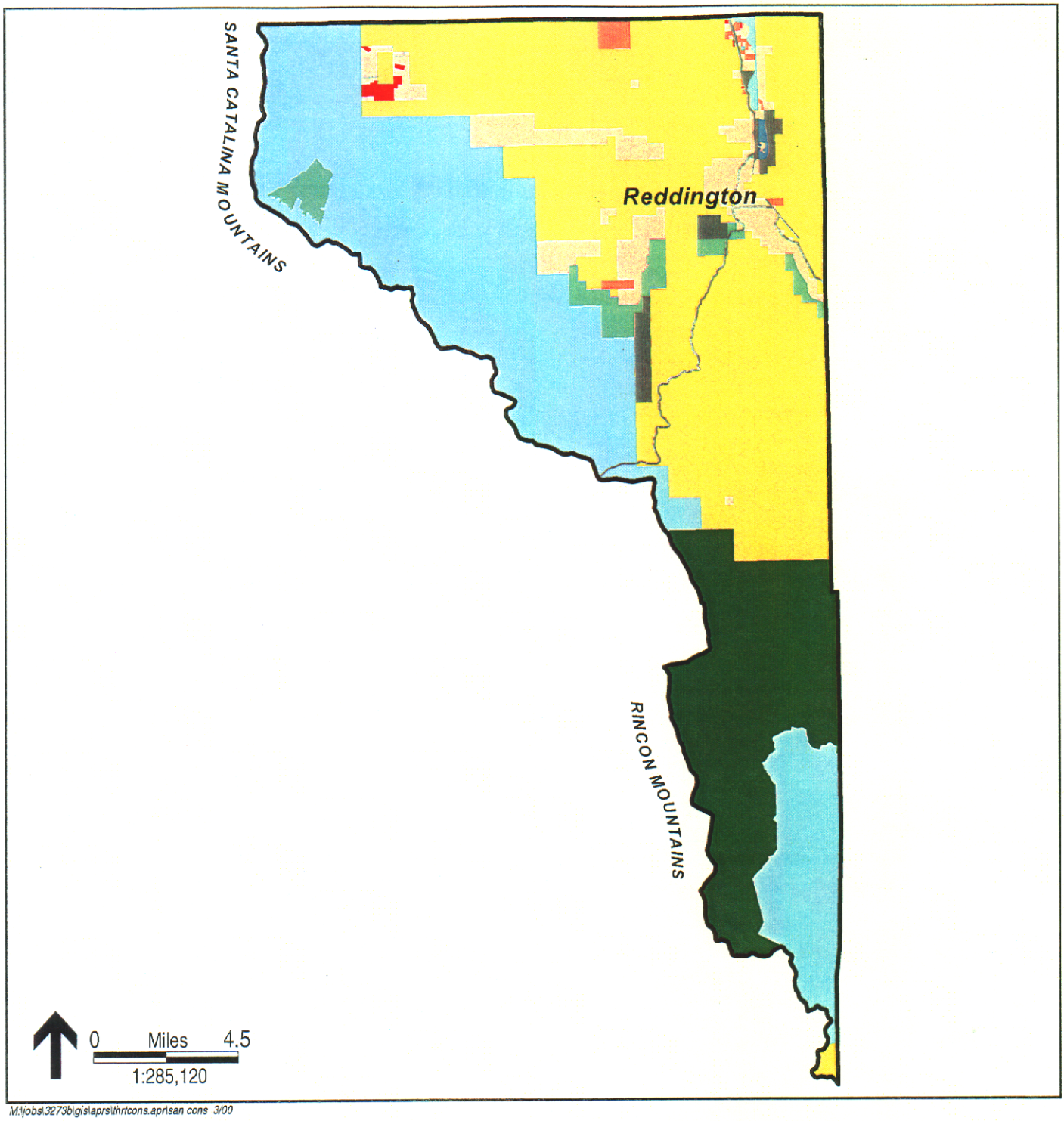
Additional properties totaling 400 acres along the San Pedro, north of the existing preserve area have been identified for future acquisition by the Open Space Acquisition Master Plan to increase the preserve size. Some of the parcels are State Land but the river floodway and adjacent land is mostly privately held ranch land.

The Mountain Parks and the Sonoran Desert Conservation Plan report (Pima County 1999) proposes the establishment of the Buehman-Bingham Natural Preserve. Encompassing 7,489 acres, this preserve would include both the existing Bingham Cienega Preserve and the 1,080 acres held by The Nature Conservancy adjacent to the Coronado National Forest in the Buehman Canyon area. It would form an important wildlife and riparian corridor between the San Pedro River and the Rincon Mountains. Buehman Canyon is one of the most significant tributary canyons to the San Pedro River and provides habitat to endangered aquatic species (i.e., desert pupfish, Gila topminnow, and leopard frogs).

D. Summary of Potential Stressors to Biological Resources

The primary biological stressors of the San Pedro Subarea are habitat alteration, conversion of vegetative cover, human use and overuse, conversion of ranches and other large agricultural properties, disease, and competition by non-native species. Habitats most at risk include areas of shallow groundwater, streams segments with perennial flows, cienegas, riparian woodlands, native grasslands, and areas of Critical Habitat for the CFPO.

While the Bingham Cienega Preserve is a significant portion of the subarea, the majority of the San Pedro Subarea is in land status categories 3b and 4a (Figure 6). These categories indicate both the lack of permanent protection from conversion to more intensive uses and the limited level existing stressors.



Level of Threat Represented by Conservation Status

in the San Pedro Subarea

Level of Threat — Low

Conservation Status — Most Protected

- 1a
- 2
- 3a
- 3b
- 4a

(For status definitions, see GAP Status Categorization Table in Methods section.)

Level of Threat — High

Conservation Status — Least Protected

- 4b
- 4c
- 4e
- 4f
- 4x

Figure 6

Activities that are contributing or have contributed to biological stress include increased residential development, clearing agricultural fields, groundwater pumping, diversion of stream flows, mining, livestock overgrazing, fire suppression, and off-road-vehicle use and indiscriminate recreation uses (Table 8).

Of primary concern in this watershed is the continued presence of surface water in perennial flow areas and cienega marshlands along the San Pedro River, and Buehman and Redfield Canyons. This could be jeopardized by increasing water pumping for residents and for agricultural fields (e.g., alfalfa). The large ranch operations maintain irrigated terraces in the summer months and allow the upland perennial grasses to recover. Mesquite bosques or riparian grasslands are or have been converted to pastures and the pastures must be supported by groundwater pumping. This raises concerns for the perennial flow and riparian habitat that is highly sensitive to drops in the water table and for increased nitrogen levels due to irrigation runoff.

The conversion of ranches and large agricultural properties to smaller lots is a concern not only because of habitat alteration, loss, and fragmentation issues but also because of the potential for increased groundwater pumping.

The potential for mining exists in the side canyons of the San Pedro River. While this has been an immediate concern in Buehman Canyon, it is also a potential for other areas of medium to high potential for mineral resources along the northeast flank of the Catalina Mountains. Landscape and water quality degradation are potential effects of mining.

The presence of feral hogs, non-native fish, and frogs are a concern. They compete with native wildlife for food and can introduce disease. Invasive and exotic plant species change the composition and structure of the native riparian communities, increase potential for wildfires, reduce habitat diversity, reduce water availability for native species, and can increase the salinity of floodplain soils (saltcedar).

TABLE 8
LAND USE ACTIVITIES WITHIN LAND OWNERSHIP/MANAGEMENT CATEGORIES OF THE SAN PEDRO SUBAREA

Ownership or Management Category	Land Uses and Activities									
	Conversion of Ranches	Lot-Splitting	Cultivated Land	Groundwater Pumping	Water Diversion & Impoundments	Recreational Uses	Mining	Roadways	Livestock Grazing	Removal of Plants
Coronado National Forest (56,542 acres)	x	-	-	*	x	x	x	x	x	x
Saguaro National Park East (8,950 acres)	-	-	-	*	x	x	-	x	✪	✪
Bingham Cienega Preserve (180 acres)	-	-	✪	x	x	x	-	x	✪	*
Buehman Canyon Preserve#	*	*	-	x	x	x	x	x	-	*
State Land (66,826 acres)	*	*	*	x	x	x	x	x	x	X
USFS Rincon Mountain Wilderness Area (17,252 acres)										
USFS Butterfly Research Natural Area (1,129 acres)										
TNC (deeded land) (2,793 acres)										
Pima County Open Space (474 acres)										
Private Lands (20,112 acres)	x	x	x	x	x	x	x	x	x	X

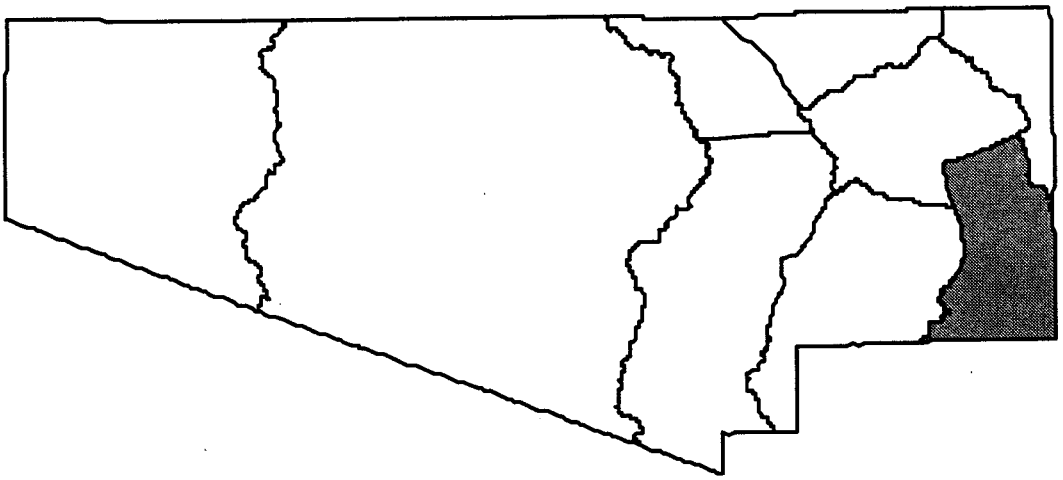
x = occurs
- = does not occur
* = potential to occur
✪ = historic but not present occurrence
= does not appear in GPS data

Cienega-Rincon

Sub Area 2

IV. Cienega-Rincon (Subarea 2)

This subarea is at the eastern edge of Pima County, extending north from the Pima County/Santa Cruz County line to the confluence of the Pantano Wash and Rincon Creek (Figure 7). Landforms defining the subarea include the Rincon Mountains at the north end, the Rincon and Cienega Creek valleys, the Santa Rita Mountains on the west, and the Whetstone Mountains on the east. The communities of Vail and Rocking K are within the subarea.



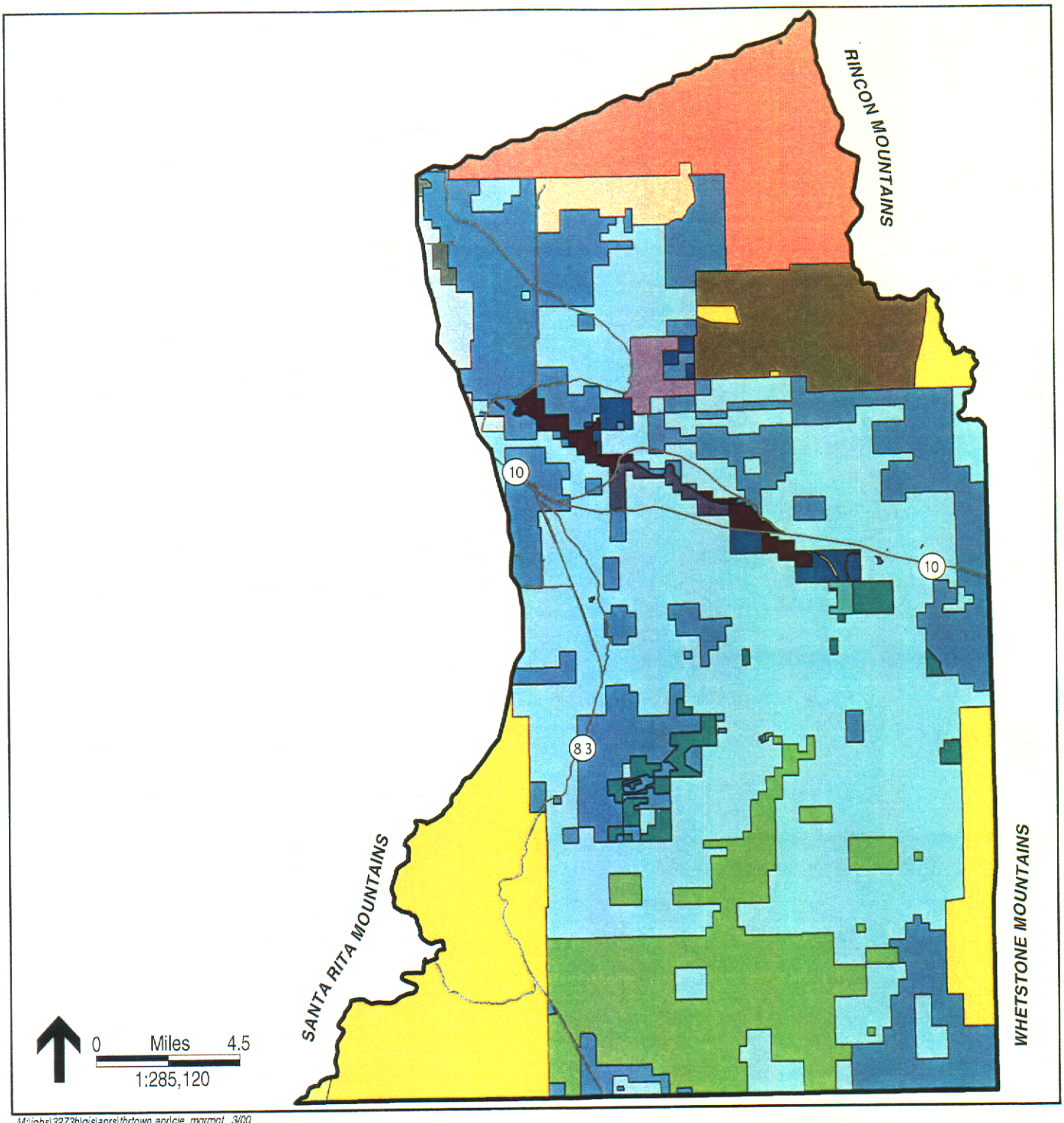
Cienega-Rincon Subarea Location in Pima County
Figure 7

A. Potential Threats and Stressors

1. Land Use and Landscape Character

Historically ranchland, the land use character of this area has been mostly rural, with relatively undeveloped open valleys surrounded by foothills and mountains. With increased population growth throughout southeastern Arizona, the character has been changing (Figure 8). The limits of the city of Tucson now extend to the west side of the Pantano Wash. With increased development pressure, ranches have been subdivided and split into smaller parcels. Lot splitting and wildcat subdividing have become prevalent means of residential development, particularly in the areas of Vail, Garigan's Gulch, Pistol Hill, elsewhere in the Rincon Valley, and in Davidson Canyon, south of Interstate 10 (I-10).

Pistol Hill is west of Colossal Cave Mountain Park, on the south side of Colossal Cave Road. The limestone soils around Colossal Cave support needlespine pineapple cactus as well as *Agave palmeri* and shindagger, two limestone-loving agaves that are critical food sources for the endangered lesser long-nosed bat and other nectar-feeding bats (USDI-BLM 1999). Increased lot-splitting and unregulated subdividing in the Pistol Hill



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Land Ownership and Land Management
in the Cienega-Rincon Subarea

- BLM - Empire-Cienega Resource Conservation Area
- BLM - Unreserved
- NPS - Saguaro National Park East
- NPS - Saguaro National Park Wilderness Area
- Pima County - Cienega Creek Natural Preserve
- Pima County - Cienega Creek Natural Preserve (CC&R)
- Pima County - Colossal Cave Mountain Park
- Pima County - Empirita Ranch
- Pima County - Open Space
- Pima County Unreserved - Private Lands
- Pima County Unreserved - State Trust Lands
- Tucson Unreserved - Private Lands
- Tucson Unreserved - State Trust Lands
- USFS - Coronado National Forest (unreserved)
- USFS - Mt. Wrightson Wilderness Area
- USFS - Rincon Mountain Wilderness Area
- Major Road or Highway

Figure 8

area poses particular concern here due to these unique conditions. Some of the land is State Land and could potentially be released for private development.

The Davidson Canyon area is south of I-10 and east of State Route (SR-83). Increasing lot splitting occurs here, particularly in areas where terrain is not a limiting constraint. Significant areas of State Land, which could be released for private development, surround the private land.

Although not illegal, the effects of lot-splitting throughout the subarea are frequently counter-productive to the intent of the "Resource Conservation," "Resource Transition," and "Low Intensity Rural" designations shown for most of these areas by the County's Comprehensive Land Use Plan. Habitat loss, alteration, degradation, and fragmentation frequently result, floodplains are encroached upon, and the increased number of private wells contributes to the decline in groundwater levels.

Rocking K and Vail Valley are large-acreage Specific Plans approved in the last 15 years for the Rincon Valley. The County's Comprehensive Land Use Plan and the Subregion Plan reflect these plans (Pima County 1997). The Specific Plans are planned communities with mixed uses and golf courses. Both plans have open space areas set aside and provisions for preservation and salvage of native vegetation. When built these communities will significantly increase the population in the Rincon Valley.

The Subregion Plan indicates "Rural Transition" and "Low Intensity Rural" for the lands north and south of Cienega Creek, but a zoning plan approved in 1959 reflects much higher intensity uses. The Vail-Posta Quemada Area Master Plan shows industrial, high density residential and medium density residential land uses in the area along the north side of the Cienega Creek (Pima County 1959). Further north into the foothill areas abutting Saguaro National Park, medium to low density residential is noted. Because this is an approved zoning plan, land developers would only have to go through the subdivision platting process to bring this plan into reality. A portion of the Plan area is within the Cienega Creek Preserve, now owned by Pima County, but much of it is private land or State Land, which could potentially be released for private development. Intensive development of this area would be a serious stressor to biological resources, not only in habitat loss and fragmentation, but in its potential effect of declining groundwater levels in the vicinity of Cienega Creek.

One of the conditions of the Rocking K Specific Plan requires the restoration of the two-mile reach of Rincon Creek that is within the Plan boundaries. The goal is to re-establish a riparian woodland dominated by mesquite, Arizona walnut, sycamore, and cottonwood trees. Restoration efforts will focus on heavily disturbed lands along the Creek. Abandoned agricultural fields dominated by invasive species are located along the floodplain. These fields were originally developed in the 1930s for the production of alfalfa and barley. By the 1950s most of the riparian plant community no longer existed in this area. The removal of vegetation, groundwater pumping for irrigation, channelization, and the impoundment of lower Rincon Creek's tributaries are thought to be the principal reasons (U.S. Geological Survey [USGS] 1997).

Two large subdivisions are planned for the area near I-10 and SR-83. One would be located east of SR-83 on both sides of I-10; the other would be on the west side of SR-83, south of I-10. Both projects are indicative of the development pressure in this

subarea. Proximity to Davidson Canyon is of concern, particularly if bank protection and/or other improvements would be required downstream at the I-10 overpass. (See discussion under Davidson Canyon Preserve.)

Ranching and grazing continues in the upper Rincon Creek area. Here, understory vegetation is absent or sparse and cattle crossings at the Creek have caused bank erosion and undercutting of riparian vegetation. Even in areas that are no longer grazed the impacts from past grazing remain, and invasive shrubs such as burrow weed are prevalent. Increased development and poorly managed grazing could result in upstream continuation of channel erosion such as has occurred on the Pantano Wash (Tellman 2000). This would have a negative effect on the remaining riparian habitat and the wildlife it supports.

Ranching and grazing continue to be an important part of the economy and landscape management in the southern portion of the Cienega-Rincon Subarea. Privately owned ranches and grazing allotments on public land comprise large tracts of open grasslands—both Sacaton grassland bottomlands and highland grasslands. Many ranches in the Cienega-Rincon Subarea provide good examples of how carefully managed ranch operation are compatible with conservation values. Grazing does not presently pose a significant stress to Forest lands in the Santa Ritas (U.S. Forest Service [USFS], Graves, 2000). Ranch conversions, lot-splitting and wildcat subdividing, inappropriate grazing, invasive species, and brush encroachment due to fire suppression are sources of stress to grassland communities (USDI-BLM 1999).

Sand and gravel mining along the Pantano Wash has been extensive and ongoing. The extraction of so much aggregate material is considered to be one reason that the channel bed has lowered as much as 14 feet (Tellman 2000). Implications to biological resources would be the continued upstream channel cutting, erosion, and the subsequent loss of adjacent xeroriparian and riparian vegetation.

The mineral resources of the Santa Rita Mountains have been explored and mined for many years. Continued interest in the area exists and is activated when copper prices are high. The historic mining complex of Helvetia is located on the western side of the Santa Ritas, at the northern end. Southeast of Helvetia, and within this subarea, is the Rosemont area—both are within the Helvetia-Rosemont Mining District. ASARCO holds mining claims covering over 2,000 acres at the company's Rosemont Ranch, located approximately one mile west of SR-83 in the headwaters of Davidson Canyon. In 1996 ASARCO sought a land exchange to add to its existing Rosemont holdings for mining and a buffer. The proposition drew heavy opposition. In 1998 the Forest supervisor for Coronado National Forest suspended an agreement to explore the possibilities because the company had not submitted a mining plan for consideration. ASARCO has put off pursuing the plan, and the necessary environmental impact statement, due to depressed copper prices (*Arizona Daily Star* 1998). Interest in the ore body at Rosemont remains, and mining could be an issue at any time in the future.

South of the Helvetia-Rosemont Mining District is the Greaterville Mining District. Both have areas of high to medium mineral resource potential, as do other isolated areas at the north end of the Santa Ritas and on the west side of the Whetstone Mountains (USDI-USFS 1996). Copper is the primary commodity produced from these deposits; gold, silver, tungsten, zinc, and molybdenum are possible byproducts. The Helvetia-

Rosemont District also contains enormous reserves of limestone and marble. The mineral resources are subject to exploration, development, and production under the federal General Mining Law of 1872. Any mining activities within the boundaries of Coronado National Forest, or otherwise having a federal nexus, would be required to develop a mining plan and an Environmental Assessment or Environmental Impact Statement.

Effects on biological resources from mining could include large-scale degradation of intact areas, habitat loss and fragmentation, potential for downstream watershed contamination, and intensive groundwater pumping to support mine operations. Habitats affected could represent the full range from heavily forested areas at higher elevations, riparian canyons, oak woodlands, and grasslands.

2. Transportation

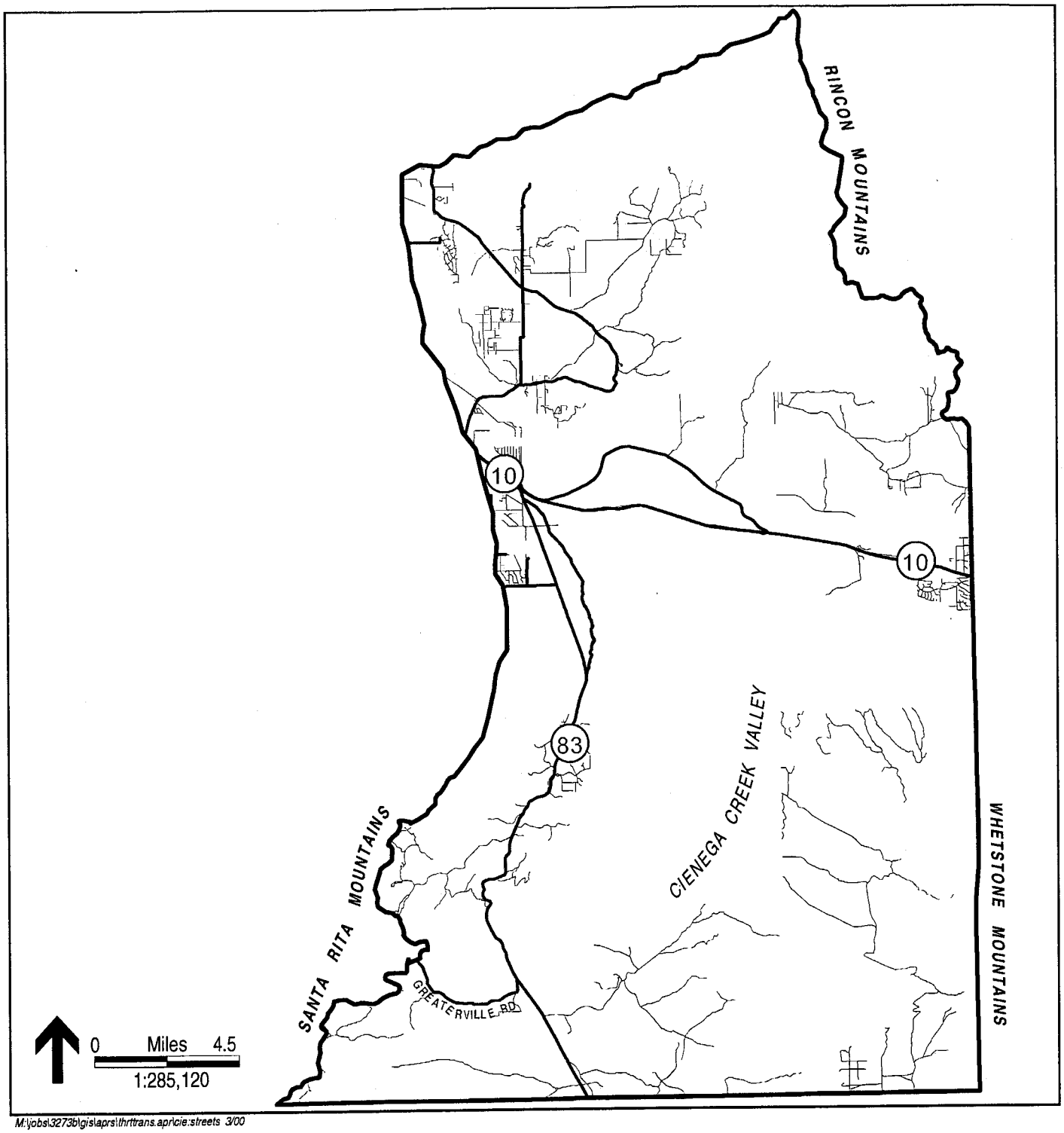
Interstate 10 and SR-83 are the major transportation corridors in the subarea, with limited and dispersed roads, primarily on the western side of the subarea (Figure 9). Colossal Cave Road and Old Spanish Trail are the main roadways in the Rincon Valley. Other paved roads and numerous unpaved roads are found throughout. The Greaterville Road provides east-west access between the Cienega Creek valley and the Upper San Pedro valley, passing through the Greaterville Mining District. If mining in the Rosemont or Greaterville areas becomes active, roads would likely be built and/or improved to provide access. That would serve to further fragment the habitat that the Forest lands provide and could result in habitat loss, particularly of riparian growth in the canyons that existing roads are located.

SR-83 provides access between Nogales, Patagonia, and Sonoita to I-10. Traffic has been increasing along this roadway, in part due to North American Free Trade Agreemtn (NAFTA). Trucks that are heading from Nogales to eastbound I-10 use SR-83 as a shorter route than driving north to Tucson. With increased trucking activity from Nogales, and increasing populations in the vicinities of Patagonia and Sonoita, there is potential for a continued increase in truck and other traffic. If SR-83 was widened and improved in order to accommodate this traffic, it would be more of a barrier to wildlife movement between the valley grassland habitats along Cienega Creek and the Santa Rita Mountains and foothills. Other effects would be direct habitat loss, alteration, fragmentation, and increased roadkill. This would come in part from drainage crossing improvements that would be required for a wider roadway.

Two tracks of the Southern Pacific railroad are within the subarea, following the general alignment of the Cienega Creek and I-10.

3. Water Uses

Private water companies and individual private wells serve most of the water needs of the Cienega-Rincon Subarea. There are a number of watercourses with perennial flows, mostly along the Cienega Creek and on the western side of the Whetstone Mountains (Figure 10 and Table 9). Areas of shallow groundwater are found in association with the perennial reaches, but also occur along the Rincon Creek, Agua Verde Creek, and along Davidson Canyon. Not only do the perennial flows and associated wetlands provide



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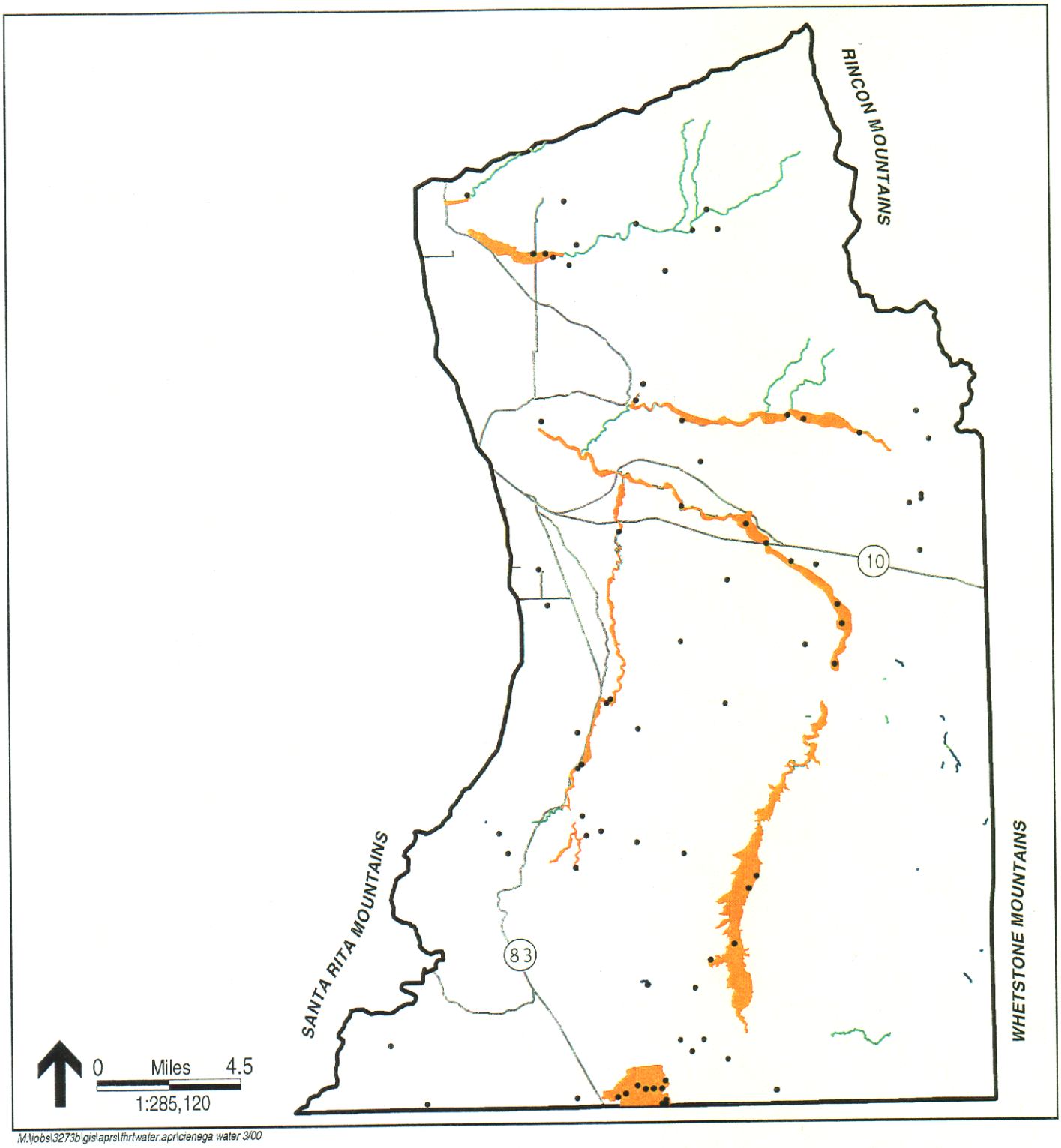
Road Network
in the Cienega-Rincon Subarea

Highway or Major Road
Local Road

Figure 9



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Surface Groundwater and Streams
in the Cienega-Rincon Subarea

Suspected Shallow Groundwater Areas (based on well data and aerial imagery)

Well with Depth to Water less than 50 feet (ADWR Well 55-Registry and GWSI databases)

Perennial Reach

Intermittent Reach

Major Street or Highway

Figure 10

TABLE 9
STREAM CHARACTERISTICS IN THE CIENEGA-RINCON SUBAREA

Stream Name	Miles of Perennial Flow	Miles of Intermittent Flow	Acres of Hydro-mesoriparian Habitat	Acres of Class A Riparian Habitat	Acres of Shallow Groundwater	Pygmy-Owl Habitat	Fish Species	Leopard Frogs
Madrona Canyon	0	3.4	N/A	N/A	N/A	No	N/A	Yes
Turkey Creek	0	3.2	N/A	N/A	N/A	No	N/A	N/A
Rincon Creek	0	11.3	563	0	568	No	1	Yes
Paige Creek	0	3	N/A	N/A	N/A	No	N/A	N/A
Unnamed tributary to Ash Creek	0	1.2	N/A	N/A	N/A	No	N/A	N/A
Cienega Creek (lower)	2.7	4.8	577	56	1651	No	1	Yes
Chimney Canyon	0	3.3	N/A	N/A	N/A	No	N/A	N/A
Davidson Canyon	0.7	1.3	0	27	907	No	2	?
Posta Quemada Canyon	0.3	0	N/A	N/A	21	No	1	N/A
Agua Verde Creek	0	15	N/A	291	1057	No	N/A	N/A
Cumaro Canyon	0	0	0	26	N/A	No	0	N/A
Distillery Canyon	0	3.3	N/A	N/A	N/A	No	N/A	N/A
Mescal Arroyo	0	0	0	218	N/A	No	0	N/A
Smitty Spring	0	0.1	0	0	N/A	No	N/A	N/A
Bootlegger Spring	0	0.1	0	0	N/A	No	N/A	N/A
Unnamed Spring	0	0.2	0	0	N/A	No	N/A	N/A
Wakefield Canyon	1.4	0.3	0	37	N/A	No	1	Yes
Barrel Canyon	0	1.3	0	0	N/A	No	N/A	N/A
Scholefield Spring	0.035	0	N/A	N/A	N/A	No	N/A	N/A
Cienega Creek (upper)	7.7	4.6	897	160	2911	No	3	Yes
Mattie Canyon	1.3	0.4	N/A	N/A	N/A	N	3a	N/A
Little Nogales Spring	0.2	0	0	0	N/A	No	1	Yes
Nogales Spring	0.3	0	0	0	N/A	No	1	Yes
Montosa Canyon	0.2	0	N/A	N/A	N/A	N	N/A	N/A
Apache Spring	0.0276	0	N/A	N/A	N/A	No	N/A	N/A

TABLE 9
STREAM CHARACTERISTICS IN THE CIENEGA-RINCON SUBAREA
(continued)

Stream Name	Miles of Perennial Flow	Miles of Intermittent Flow	Acres of Hydro-mesoriparian Habitat	Acres of Class A Riparian Habitat	Acres of Shallow Groundwater	Pygmy-Owl Habitat	Fish Species	Leopard Frogs
Gardner Canyon	0	0.5	N/A	N/A	1210	No	N/A	N/A
Cinco Canyon	0.7	0	N/A	N/A	N/A	No	N/A	N/A
Empire Gulch	1.4	0	N/A	N/A	N/A	No	N/A	N/A
Wild Cow Spring	0.049	0	N/A	N/A	N/A	No	N/A	N/A
Simpson spring	0.4	0	N/A	N/A	N/A	No	N/A	N/A
Mud Spring Canyon	0	2.6	N/A	N/A	N/A	No	N/A	N/A

N/A = not applicable.

aquatic habitat for species which are endangered or rare, they provide a potential site for reintroduction of native fish.

Within the Cienega Creek Preserve surface flows are perennial and Pima County has an instream flow permit, but at the west end of the Preserve the water is diverted and piped to the Vail Valley Ranch development. Perennial flows, and associated riparian habitat, stop just downstream of a subgrade dam and diversion. The water rights are held by the Vail Valley Ranch developers who will use the water for golf course and landscape irrigation (Pima County 2000).

Within the southeast end of the Preserve is the Empirita Ranch area. According to the Cienega Creek Natural Preserve Management Plan (Pima County-Cienega 1994) Pima County's agreement with the prior owner, the Empirita Ranch Limited Partnership, allows the Partnership to construct and operate up to 16 wells within the ranch area. The water can be used to support off-site uses and private development. This presents the possibility of groundwater pumping in this area negatively affecting not only this area's stream flows and the vegetation it supports, but also the downstream perennial flows through the Preserve. The Management Plan identifies maintenance of the perennial stream flow as the most important of the management objectives. It further acknowledges that off-site activities, particularly ground water pumping, will ultimately determine the future of perennial stream flow within the Preserve. Without the stream flow, the associated riparian woodland vegetation would be lost and the habitat values of the preserve would be greatly diminished.

Other concerns with regard to water use are tied to the development potential of private and State Lands, increased lot-splitting, and increased ground water pumping to provide for the water needs of a growing population within the subarea.

4. Recreation

Opportunities for recreation are abundant within the Cienega-Rincon Subarea as provided by the surrounding preserves. Coronado National Forest unreserved areas and Wilderness areas (Rincon Mountain and Mt. Wrightson), Saguaro National Park, Colossal Cave Mountain Park, Cienega Creek Natural Preserve, and BLM's Empire-Cienega Resource Conservation Area (RCA). Additionally, there are State Lands and other BLM lands that receive recreational use. Recreational activities include wilderness experience and backcountry use, bird and wildlife observation, hiking, picnicking and camping, hunting, off-road-vehicle use, cave exploring (in Gardner Canyon area), horseback riding, and mountain biking.

Recreation use within the Cienega Creek Natural Preserve is by permit only, and is limited to a maximum of 50 persons a day (Pima County-Cienega 1994). Presently about 10 people per weekday visit the Preserve (Pima County-Mt. Parks 1999). The Empire-Cienega RCA has no campgrounds or developed facilities, but hiking, camping, bicycling, and hunting are allowed. Its 45,000 acres are under the administration of the BLM.

Recreation use is increasing on Forest lands, particularly in the area of Gardner Canyon and north to the Rosemont area. Irresponsible off-road-vehicle use here has resulted in

habitat loss and degradation, erosion, gullying and disturbance of wildlife. The Forest Service is initiating a program of public education and adding fencing and cattle guards to stabilize the high-use areas.

Sources of biological stress associated with the increasing recreational use of the area include damage to or removal of vegetative communities due to off-road-vehicle use, creation of wildcat trails and roads, primitive camping and vandalism; disturbance of wildlife; and increased potential for wildfires. Caves are being damaged in some areas by theft vandalism and over use (Sonoran Institute 1999).

B. Biological Resources

1. Vegetation and Land Cover

Habitat within the Cienega-Rincon Subarea consists primarily of mixed grass scrub (Figure 11). Areas of higher elevation support stands of pine, oak, oak-pine, and manzanita on the southwestern, western, and northern edges of the subarea. Other habitat types contained within the subarea include palo verde-mixed cacti, creosote-tarbush, creosote-bursage, and mixed scrub communities. Drainages in the south-central and northwest portions of the subarea support sacaton scrub vegetation, cordgrass, and stands of cottonwood willow. Limited agricultural development has taken place in the central drainage of the subarea. Urban development occupies a portion of the eastern edge of the subarea.

2. Critical Habitat

No areas of Critical Habitat have been designated within the Cienega-Rincon Subarea.

3. Species at Risk

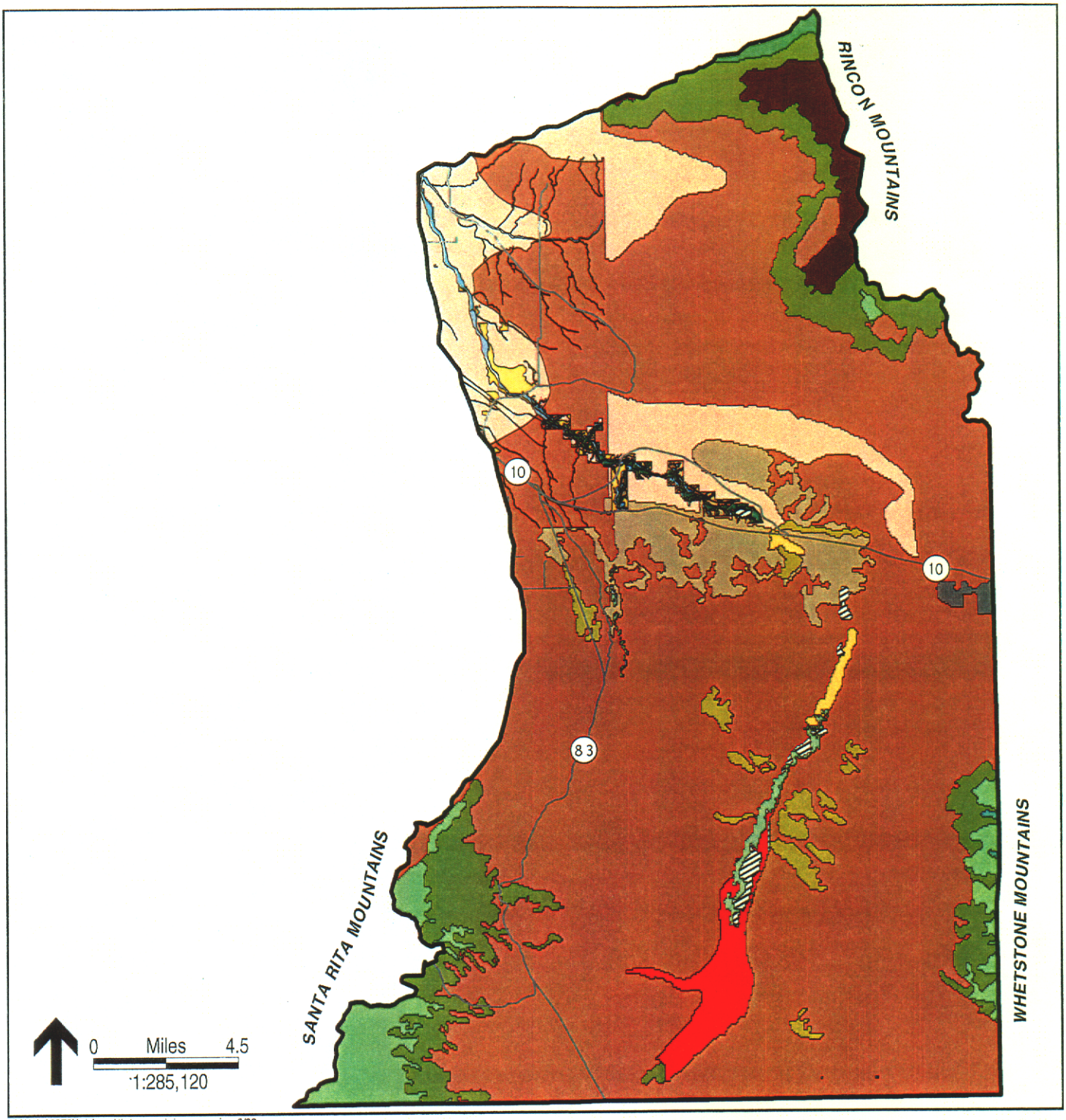
A total of 19 Status 1 and 2 Vulnerable Species occur within the Cienega-Rincon Subarea (Table 10).

C. Existing and Proposed Preserve Areas

There are several proposals, one of great regional and national significance, to expand existing preserve areas and create new ones.

1. Las Cienegas National Conservation Area (NCA)

The creation of Las Cienegas NCA has been proposed by a bill introduced to Congress in September 1999. It would total over 200,000 acres of land and would include the Empire-Cienega RCA, Cienega Creek Natural Preserve, Colossal Cave Mountain Park, State Lands, other BLM land, and private lands (*Arizona Daily Star* 2000). As proposed, the NCA would provide a connecting corridor of land between the Catalina and Rincon mountains, the Cienega and Rincon Creek watersheds, the Santa Rita Mountains, and Forest lands in southeastern Arizona. The NCA would not transfer land out of private ownership or restrict private property rights. It would allow grazing and recreation activities to continue in appropriate areas (Sonoran Institute 2000).



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Vegetation and Land Cover
in the Cienega-Rincon Subarea

Vegetation Communities (BLP Classification)

- 122.62 Pine
- 123.31 Encinal (Oak)
- 123.32 Oak-Pine
- 133.32 Manzanita
- 143.14 Sacaton Scrub
- 143.15 Mixed Grass-Scrub
- 143.16 Shrub-Scrub Disclimax
- 153.21 Creosote-Tarbush
- 153.26 Mixed Scrub
- 154.11 Creosote-Bursage
- 154.12 Paloverde-Mixed Cacti
- 223.21 Cottonwood-Willow
- 223.22 Mixed Broadleaf
- 224.52 Mesquite
- 224.53 Cottonwood-Willow
- 234.71 Mixed Scrub
- 243.53 Cordgrass

Other Land Cover Types

- 999.1 Agriculture
- 999.2 Urban
- 999.3 Water
- Major Road or Highway

Figure 11

TABLE 10
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE CIENEGA-RINCON SUBAREA

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Amoreuxia gonzalezii Saiya	1	S1	FSC FSS SR	Very narrow distribution and small number of individuals. Grazing (plant is palatable to cattle). Degradation of habitat due to livestock grazing. Competition by introduced invasive plants. Javelina consume roots.	Empire Ranch quad 1976. USFS	Limestone endemic.
Gila intermedia Gila Chub	1	S2	FC FSS WSC	Non-native species, competition and predation. Habitat loss by groundwater pumping and channelization. Flooding. Drought. Dredging. Poor water quality. Livestock grazing (trampling by cattle, watershed changes).	Spring Water Canyon quad, Cienega Creek, BLM many records	Probably a viable population in Cienega Creek.
Glaucidium brasilianum cactorum Cactus Ferruginous Pygmy-owl	1	S1	FE FSS WSC	Habitat destruction and alteration, historic and present. Groundwater pumping, channelization, urbanization, historic livestock grazing? Farming and agricultural uses? Wood cutting. Disturbance by bird watchers. Small population subject to stochastic events. Possibility of disease, including emerging diseases, and loss of viable food supply as a result of drought and/or climate change.	Tanque Verde Peak quad 1994 private; 1975 private; 1995 NPS Rincon Peak quad 1999 USFS	Subarea is not included in Critical Habitat

TABLE 10
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE CIENEGA-RINCON SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Accipiter gentilis apache Apache northern goshawk	2	S3	F-petitioned, FSS WSC	Habitat destruction by logging and forest clearing. Possibly consequences of fire suppression leading to major timber fires. Organized recreational and sports use. Global climate change. Disturbance by recreationists, cattle grazing, mining, road building and other forest disturbances are site specific threats alleged by Center for Biodiversity.	Mica Mountain quad, 1992, NPS Mt. Wrightson quad, 1991, 1994, 1997 USFS	May occur at high elevation areas, barely within this subarea. Petitioned for listing as endangered, 90-day finding determined that listing was not warranted 6/29/98. Suit filed 2/25/99 to list as endangered.
Coccyzus americanus occidentalis Western yellow-billed cuckoo	2	S3	F-petitioned FSS WSC	Habitat destruction and alteration, historic and present. Groundwater pumping, channelization, urbanization, historic livestock grazing? Farming and agricultural uses? Wood cutting. Reduction of acreage in pecan farming.	Tanque Verde Peak quad, Tanque Verde Wash, 1985 Private The Narrows quad, Cienega Creek 1998 BLM Helvetia quad, Florida Canyon, 1925 USFS Empire Ranch W of Cienega Creek 1998 BLM Spring Water Canyon, several records, Cienega Creek, 1998 BLM Mt. Wrightson quad 1923, 1927 USFS	Positive 90-day finding on petition, 2/17/00

TABLE 10
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE CIENEGA-RINCON SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Coryphantha scheeri var. *robustispina* Pima pineapple cactus	1	S2	FE HS	Narrow distribution, much of which is on private and Indian lands and much of which has been developed. Development, off-road vehicle traffic.	60 records for Pima Co. 15 for this subarea. Vail: 6: 2 private, 3 BOR, 1 State Mount Fagan: 7: 4 BOR, 3 State Helvetia: 2, USFS	May not be a valid variety using today's standards.
Echinomastus erectocentrus var. *erectocentrus* Needle-spined pineapple cactus	2	S3	SC S SR	Very narrow distribution. Land development and off-road vehicles might impact this species.	Tanque Verde Peak quad Rocking K, 1994 Private Vail quad, 1966, 1981 Private Galleta Flat West quad, Kiper Spring 1981 State Mount Fagan quad, Davidson Canyon, 1990 State The Narrows quad, Pantano, 1941 Private, Cienega Creek drainage, 1990 State	
Lasiurus blossevillii (=*borealis*) Western red bat	2	S2	FSS WSC	Habitat loss as a result of groundwater pumping, channelization, wood cutting, leading to loss of riparian areas. Farming and agricultural uses, specifically secondary poisoning and reduction of food supply resulting from insecticide use.	Empire Ranch quad, Empire Gulch, 1989 BLM.	This probably is more common on Empire Ranch than the records indicate. Also reported confirmed from Colossal Cave Mountain Park, roosting in trees on Posta Quemada Ranch.

TABLE 10
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE CIENEGA-RINCON SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Leptonycteris curasoae yerbabuenae Lesser long-nosed bat	2	S2	FE WSC	Alleged to be related to reduction of numbers of maternity colonies and decline in size of remaining maternity colonies in Arizona and Sonora due to exclusion and disturbance. Additionally, thought to be negatively affected by large reductions in acreage of native agaves over large areas of northern Mexico due to excessive harvesting for local manufacture of mescal and tequila. Excessive browsing by livestock on newly emergent flower stalks of *Agaves* has also been suggested as possibly decreasing foraging opportunities and thus contributing to declines among these bats.	Tanque Verde Peak quad, Box Canyon Crevice 1993 NPS Vail quad. Rincon Mountains 1968, 1988 Private Helvetia quad 2 mi E of Helvetia 1976 USFS Empire Ranch quad, Empire Ranch 1989 BLM Spring Water Canyon quad, Cienega Canal, 1989 BLM Mt. Wrightson quad, Sawmill Canyon (Santa Cruz Co.) 1988 USFS	There was formerly a maternity roost in Colossal Cave. With much effort, bats were excluded and driven away. They may return if the cave is managed properly for them. The Colossal Cave Mountain Park website lists this species as present, not in the cave but roosting in cliffs.
Lilaeopsis schaffneriana recurvata Huachuca Water Umbel	1	S2	FE HS	Groundwater pumping. Habitat loss. Historic channel cutting. Floods. Competition from introduced species. Watershed degradation.	Spring Water Canyon quad. Empire Gulch 1996 BLM	Critical Habitat has been designated, and does not include Pima County
Muhlenbergia dubioides Box Canyon Muhly	1	S1	FSS	Very narrow distribution.	Helvetia 1986 USFS	
Muhlenbergia xerophila	1	S1	FSS	Very narrow distribution.	Mica Mountain quad 1978	

TABLE 10
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE CIENEGA-RINCON SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Weeping Muhly					NPS Helvetia 1990, 1940 USFS	
Plecotus townsendii pallescens Pale Townsend's big-eared bat	2	S3S4	FSC	Disturbance of roosts by recreationists and renewed mining.	Vail quad, Rincon Valley, 1986 Private. Mt. Wrightson quad, Santa Cruz Co. Cave Creek 1986 USFS	This species is probably more common in Pima Co. than records indicate. Reported from Colossal Cave, which it uses as a maternity roost.
Poeciliopsis occidentalis occidentalis Gila Topminnow	1	S2	FE FSS WSC	Non-native species, competition and predation. Habitat loss by groundwater pumping and channelization. Flooding. Drought. Dredging. Poor water quality. Livestock grazing (trampling by cattle, watershed changes).	Tanque Verde Peak quad, Tanque Verde Ridge Rincon Site. 1989 NPS Mica Mountain quad, Madrona Canyon 1987, NPS The Narrows quad, Cienega Creek, 1998, BLM Mescal quad, Wakefield Canyon 1989 BLM Spring Water Canyon quad, Cienega Creek, many records, BLM	After 1989, none were found in 3 surveys of pools at Rincon Site. No records for Madrona Canyon site after 1987.or Wakefield Canyon after 1989 Cienega Creek population is probably viable.
Rana chicahuensis Chiricahua Leopard Frog	1	S3	FC FSS WSC	Disease. Introduced predators/competitors. Loss of habitat, groundwater pumping, water diversions. Center for Biological Diversity alleges threats are:	Helvetia quad, Santa Rita Mts. West Sawmill Canyon 1995 USFS; Box Canyon 1979 USFS. Spring Water Canyon	CBD sued to list as endangered 8/27/99

TABLE 10
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE CIENEGA-RINCON SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
				"continued degradation and destruction of Southwest riparian areas by livestock grazing, groundwater pumping, water diversion, and dams. They are also threatened by exotic species, such as the bull frog and the large-mouth bass, which compete with and prey on the frog"	quad. Cienega Creek. 1989, 1986 BLM. Mt. Wrightson quad, in Santa Cruz Co. several records. In Pima Co., Fish Canyon 1995 USFS Elgin quad. 1 record in Santa Cruz Co., Babocomari River.	
Rana yavapaiensis Lowland Leopard Frog	2	S4	SC FSS WSC	Groundwater pumping, disease, water pollution, invasive non-native species, ozone loss, unknown causes of population declines	The Narrows quad, Cienega Creek, 1990 BLM 1995 Private Mescal quad, Wakefield Canyon 1998 BLM Helvetia quad, Box Canyon 1979 USFS Empire Ranch quad, Empire Spring 1990 BLM Spring Water Canyon quad, Cienega Creek, several records 1990-1991 BLM Mt. Wrightson Quad, several records in Santa Cruz Co. 1979-1989 USFS	

TABLE 10
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE CIENEGA-RINCON SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Sorex arizonae Arizona Shrew	2	S2S3	FSC FSS WSC	Limited distribution, poorly known. Fires and floods. Recreational development and camping.	Mt. Wrightson quad, Santa Cruz Co. Stone Cabin Canyon 1923 USFS	Appropriate habitat has not been surveyed using the best available techniques. This species may or may not be present in montane areas in Pima Co.
Strix occidentalis lucida Mexican Spotted Owl	2	S3S4	FT WSC FSS	Habitat destruction by logging. Possibly consequences of fire suppression leading to major timber fires. Organized recreational and sports use and recreational development. Global climate change.	Mica Mountain quad, 4 locations in 1997, all NPS Rincon Peak quad, 1997 NPS Mt. Wrightson quad, several locations all in Santa Cruz Co. 1994 USFS	May occur at high elevation areas, barely within this subarea. Critical Habitat for this species had been designated in 1995, but rescinded in 1998. It may have just barely touched portions of this subarea, but was mostly (if not entirely) within subarea 4. On 3/14/00 a federal judge ordered FWS to determine critical habitat by 1/15/01.
Thamnophis eques megalops Mexican Garter Snake	2	S2S3	FSC FSS WSC	Predation by bullfrogs. Aquatic and riparian habitat degradation and destruction.	Spring Water Canyon quad, Cienega Creek 1986, 1994 BLM Elgin quad, Santa Cru Co. near Elgin Private	

NOTE: Records are from Heritage Data Management System (HDMS), Arizona Game and Fish Department

Quads: Tanque Verde Peak, Mica Mountain, Vail, Rincon Peak, Galleta Flat West, Mount Fagan,The Narrows, Mescal, Helvetia, Empire Ranch, Spring Water Canyon, Apache Peak, Mt. Wrightson, Sonoita, Elgin, Mustang Mountains

Habitats protected by the NCA would include cienega marshlands, cottonwood-willow riparian woodlands, juniper-oak woodlands, sacaton grasslands, mesquite bosques, and semi-desert highland grasslands. Wildlife species protected include native fish, including the endangered Gila topminnow, endangered lesser long-nosed bat and other bats species, southwestern willow flycatcher, yellow-billed cuckoo, Chiricahua leopard frog, and many other important wildlife species (Sonoran Institute 2000). Underlying this is the overall protection of the watershed, groundwater reserve, and perennial and intermittent flows. Water resources would primarily be protected by limited groundwater pumping, limits on activities at areas of surface flows, minimized impervious road surfaces, and minimized drainageway alterations. A well-functioning watershed is promoted by fewer impervious roadways, and limiting access to many parts of the watershed reduces the likelihood that intact wildlife habitat will be affected by incompatible activities.

One of the driving forces behind the proposal is the desire to prevent the urbanization of the Cienega Creek watershed. Since over half of the proposed NCA area is State Land that is susceptible to lease or sale and development, this is a distinct possibility, especially in light of the increasing growth and pressure as the urbanized area of the Tucson basin continues to expand. The biological stressors associated with urbanization are habitat removal, alteration and fragmentation, increased groundwater pumping and depleted water resources, competition by invasive species, human use, and overuse.

2. Empire-Cienega Resource Conservation Area

This RCA would be fully incorporated into the proposed NCA. Its 45,000 acres have been under the administration of BLM since 1988. Prior to BLM's acquisition the 10 miles of surface flows, riparian woodlands, oak woodlands, and native grasslands were facing biological stress associated with the real possibility of housing and commercial development (USDI-BLM 2000). Presently, grazing with appropriate limitations continues in the RCA. It is an area of few roads (none paved) and little habitat alteration providing habitat to a highly diverse wildlife population. Finding protection here are three native fish (endangered Gila topminnow, Gila chub, and longfin dace), lowland leopard frog, canyon tree frog, numerous reptiles, over 170 species of birds (including the yellow-billed cuckoo), and game and non-game mammals (USDI-BLM 2000).

3. Empire Mountain Park

This park was identified for inclusion as a part of the Sonoran Desert Conservation Concept Plan. The BLM is committed to acquiring additional land in this area. Over 16 sections of State Land have been identified for consideration. The area, south of the Empirita Ranch, is being analyzed and planned for in the content of the Resource Management Plan for the Empire-Cienega Resource Conservation Area.

4. Colossal Cave Mountain Park

The Sonoran Desert Conservation Plan Concept Plan proposes to expand the existing 2,038-acre Park to over 21,000 acres, based on recommendation by County staff and the Rincon Institute. This expansion would include large parcels of State Lands as well as private land. It would provide a direct link between the existing Park and Saguaro National Park to the north, protect two important segments of Rincon and Agua Verde

Creeks, habitats of both the Sonoran and the Chihuahuan Desert, and protect significant areas of unique limestone geology and the species it supports (Pima County-Mt. Parks 1999).

As discussed under Land Use, private and State Lands in the vicinity of the park are being rapidly developed by lot-splitting. This puts at risk "limy" areas containing the needlespine pineapple cactus and two limestone-loving agaves that are critical food sources for the endangered lesser long-nosed bat and other nectar-feeding bats. The increased population also brings with it increased groundwater pumping. The expansion would protect some of the tributary flows of the Rincon Creek as well as segments of Rincon and Agua Verde Creeks.

5. Cienega Creek Natural Preserve

The Sonoran Desert Conservation Concept Plan proposed the Preserve be expanded by approximately 9,000 acres. Representing one of few remaining desert riparian areas with perennial flows, Cienega Creek and the Preserve have extremely high resource and habitat values. A segment of the creek has been designated as a "Unique Water of Arizona" by the Arizona Department of Environmental Quality (ADEQ) due to its significance. The Preserve also includes the portion of Davidson Canyon north of I-10. This canyon extends south and southwest into the Santa Rita Mountains and is an important tributary to Cienega Creek.

The proposed expansion would protect gaps that presently exist within the Preserve, widen the corridor of protection, add assurance that perennial stream flows will continue, and protect additional riparian habitat and adjacent upland habitat. It would also provide an important corridor and link to adjacent open space and preserve areas such as Colossal Cave Mountain Park and the Empire-Cienega RCA. As part of the proposal 1,856 acres of State Land surrounding the Mescal Arroyo to the east would be added to the Preserve and the narrow corridor along Davidson Canyon would be widened to approximately one mile.

6. Davidson Canyon Natural Preserve

Approximately 6,191 acres of State Land and private land would encompass a preserve along 11 miles of Davidson Canyon upstream from I-10. This would provide a critically important link between the Cienega Creek Natural Preserve and the Santa Rita Mountains by protecting a significant riparian corridor. Mining interest in the canyon is of concern, as expressed by ASARCO's plans to develop their Rosemont Ranch area along the canyon. Although those plans have been halted, mineral resources remain and could be developed at some time in the future. That would likely result in habitat destruction and fragmentation of a unique canyon habitat. Several proposals for large subdivisions in close proximity, and a pattern of increasing lot-splitting of private properties in the Davidson Canyon area are indications of the growing development pressure (Pima County-Mt. Parks 1999).

Not protecting this area would result in the loss or degradation of a regionally significant biological corridor and hydrological component. The existing I-10 overpass of the canyon is a good height above the riverbed and thereby provides for wildlife crossing with

adequate distance to mitigate the noise, vibration, and other impacts of the highway. Development impacts to the private land that is located immediately south of I-10 could impair this location as a viable corridor connection, and would be incompatible with the preserve status of the watercourse on the north side of I-10.

7. Santa Rita Mountain Park

This is a 10,703-acre area at the northeast corner of the Santa Rita Mountains. It would be comprised almost entirely of State Land and private lands. The same development pressures that exist for the Davidson Canyon and the intersection of I-10 and SR-83 exist here. Numerous homes have been built on the 1,826 acres of private land within the boundaries of the proposed Park and others are expected to follow. A wildcat subdivision area exists to the west. This Park would flank the west side of Davidson Canyon and would abut the Forest boundary. The biological value of this land is in the dense vegetation along drainages tributary to Davidson Canyon and the open space linkage to that watercourse, Cienega Creek, and the Santa Ritas. The area is known for a large population of bats, large mammals, and a tremendous diversity of plant and other wildlife species. Not protecting this area would bring the edge of the urbanized area in closer proximity to the Cienega Creek watershed and result in habitat loss, alteration, fragmentation, and increased groundwater pumping.

8. Saguaro National Park

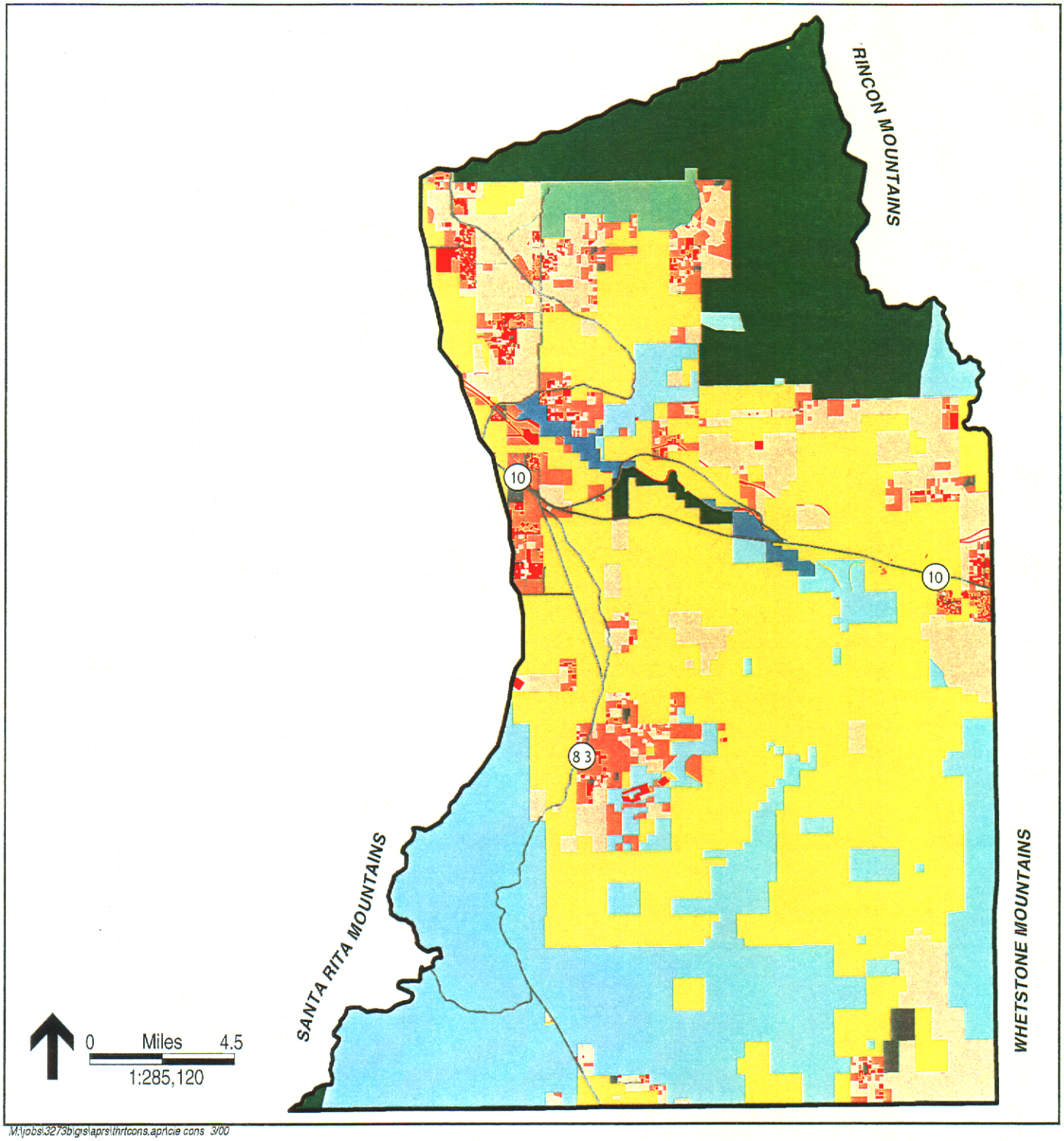
In 1991 legislation was enacted to expand the boundaries of the Rincon Mountain District by acquiring over 4,000 additional acres along the southern edge of the district. The expansion area gives protection to a portion of Rincon Creek and an important tributary, Chimenea Creek. Protection of Chimenea Creek is expected to have a positive effect on the hydrologic and habitat function of its riparian zone and floodplain. Additional trails are proposed but patrols in the creek area are planned to ensure that adverse impacts to riparian vegetation are minor. All existing roads and social trails that are not adopted as trails will be revegetated (USDI-National Park Service [NPS] 1999).

D. Summary of Potential Stressors to Biological Resources

Primary stressors to biological resources within the Cienega-Rincon Subarea include habitat loss, alteration and degradation; habitat fragmentation, human use and overuse, conversion of ranch lands, and a decline in stream surface flows and competition by invasive species. Lower elevation palo verde-cacti communities with invasive non-native grasses are at risk of wildfires. The current ownership and management pattern within the Cienega-Rincon Subarea provides significant conservation protection in the north and along a limited portion of Cienega Creek (Figure 12). The majority of the subarea is status 4a and 3b, with significant areas of higher intensity of use.

Habitats most at risk include cienega marshlands, riparian gallery forests, crinkle-awn grasslands, southwest oak savanna, giant Sacaton grassland bottomlands, healthy highland grassland, cave habitats, and limestone dependent plant communities.

Activities contributing to biological stress are shown on Table 11. These include ground water pumping, diversion of stream flows, mining, historic overgrazing, increasing



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Level of Threat Represented by Conservation Status
in the Cienega-Rincon Subarea

Level of Threat: Low → High

Conservation Status: Most Protected → Least Protected

1a	4b
2	4c
3a	4e
3b	4f
4a	4x

(For status definitions, see GAP Status Categorization Table in Methods section.)

Figure 12

TABLE 11
LAND USE ACTIVITIES WITHIN LAND OWNERSHIP/MANAGEMENT CATEGORIES OF THE CIENEGA-RINCON SUBAREA

Ownership or Management Category	Land Uses and Activities									
	Conversion of Vegetative Cover	Competition/Predation by Invasive Species	Lot-Splitting & Urbanization	Groundwater Pumping	Water Diversion & Impoundments	Recreational Uses	Mining	Roadways	Livestock Grazing	Removal of Plants
Saguaro National Park East (4,246 acres)	-	x	-	x	x	x	✪	x	✪	✪
Saguaro National Park East Wilderness Area (27,526 acres)	-	x	-	x	x	x	x	x	x	x
Coronado National Forest-unreserved (41,674 acres)										
USFS Rincon Mountain Wilderness Area (14,726 acres)										
USFS Mt. Wrightson Wilderness Area (283 acres)										
Coronado National Forest-Wilderness (41,674 acres)	-	x	-	-	*	x	✪	x	x	✪
Colossal Cave Mountain Park (1,896 acres)	-	x	-	x	*	x	-	x	-	-
Cienega Creek Natural Preserve (2,643 acres)	-	x	-	-	x	x	-	x	✪	x
Cienega Creek Natural Preserve CC&R (1,244 acres)										
Empire-Cienega RCA (31,892 acres)	-	x	-	-	x	x	-	x	x	-
Other BLM Lands (4,188 acres)	-	x	-	x	x	x	x	x	x	x
Pima County Empirita Ranch (366 acres)										
Pima County Open Space (2,553 acres)										
Pima County Unreserved – State Trust Lands (119,873)										
State Land Tucson Unreserved (2,649 acres)	x	x	*	x	x	x	x	x	x	x
Pima County Unreserved – Private Lands (62,158 acres)										
Private Lands Tucson Unreserved (572 acres)	x	x	x	x	x	x	x	x	x	x

x = occurs
- = does not occur
* = potential to occur
✪ = historic but not present occurrence

urbanization (both regulated and unregulated subdivision), off-road-vehicle use, recreational activities, fire suppression and fuel build up, removal of plants, and the introduction and spread of exotic species.

Of primary concern in this watershed is the continued presence of surface water in perennial flow areas and cienega marshlands along the Cienega Creek. This is a priority within existing preserve areas, but could be jeopardized by water rights held by non-preserve entities. The possibility of groundwater pumping from wells at the Empirita Ranch, at the southeast end of Cienega Creek Natural Preserve, exists due to the water rights being held by the previous owner. If pumping was maximized here it could easily have a negative effect on the perennial surface flows downstream. The greatest stressor to perennial streams, cienega marshlands, and springs in the subarea is ground water pumping. Acquiring water rights to protect the perennial flows in the subarea would greatly reduce the potential future stress to biological resources.

Increased lot-splitting in the Pistol Hill area of Rincon valley and in Davidson Canyon continue to displace and fragment habitat. The groundwater pumping associated with numerous private wells depletes the aquifer and may affect the surface flows and vegetation of nearby Cienega Creek. The presence of private land and large tracts of State Land adjacent to existing preserves raises the possibility of increased development in areas where biological resource values are high and preserves are proposed for expansion. This is a particular concern in the areas around Colossal Cave Mountain Park and in Davidson Canyon south of I-10. The establishment of Las Cienegas NCA would resolve many of these concerns related to encroaching urbanization.

According to the Sonoran Institute, the Cienega Creek watershed is the only large basin in southern Arizona surrounded by mountains containing extensive amounts of carbonate rock exposures, predominantly limestone (Sonoran Institute 1999). This unusual geology results in caves as well as unique soil and habitat conditions. Two species of limestone-loving agaves that provide forage for nectar-feeding bats, the needlespine pineapple cactus, the rare crinkle-awn grassland, and rock-banded rattlesnake are supported by limy conditions (Sonoran Institute 1999). Caves are always at risk of being degraded due to vandalism and human overuse, but at this time access to caves in Gardner Canyon is by permit only, through the Coronado National Forest (USFS, Graves, 2000).

There are a number of areas with high to medium potential for mineral resources in the Santa Rita Mountains. The potential for future development of mining activity exists, particularly at the north end in Davidson Canyon where interest has been recently expressed. Increasing copper prices will increase the risk of habitat loss and degradation resulting from mining activity.

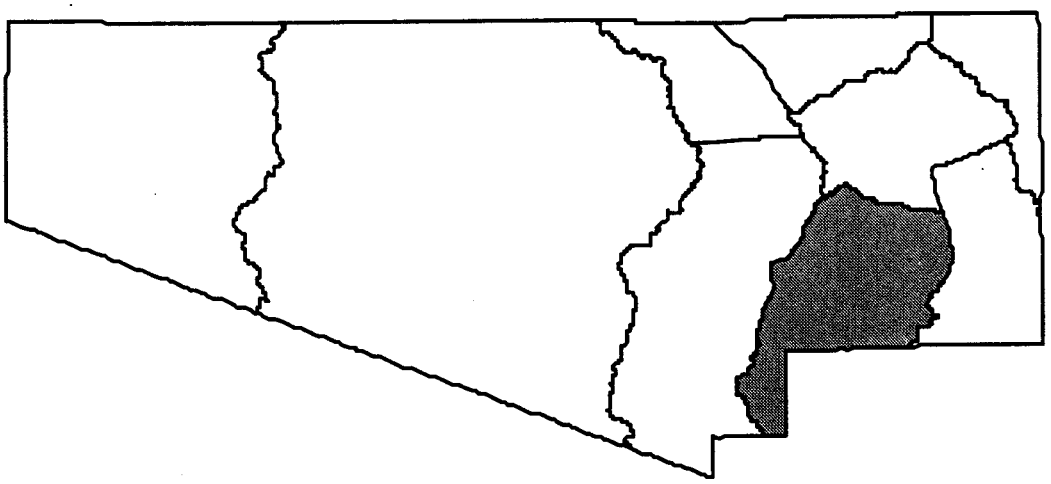
Increased recreation use of the east flank of the Santa Ritas is of concern, particularly in the area of Gardner Canyon and north to the Rosemont area. Irresponsible off-road-vehicle use has resulted in habitat loss and degradation, erosion, gullying, creation of new roads and trails, and disturbance of wildlife. The Forest Service is initiating a program of public education and adding fencing and cattle guards to stabilize the high use areas.

Upper Santa Cruz

Sub Area 3

V. Upper Santa Cruz (Subarea 3)

This subarea extends north from the Pima County/Santa Cruz County line to Martinez Hill, near the northern boundary of the San Xavier District of the Tohono O'odham Nation (Figure 13). It consists of the valley formed by the Santa Cruz River, the Santa Rita mountains on the east, and the Sierrita Mountains on the west. The communities of Green Valley, Continental, and the Town of Sahuarita are within the subarea.



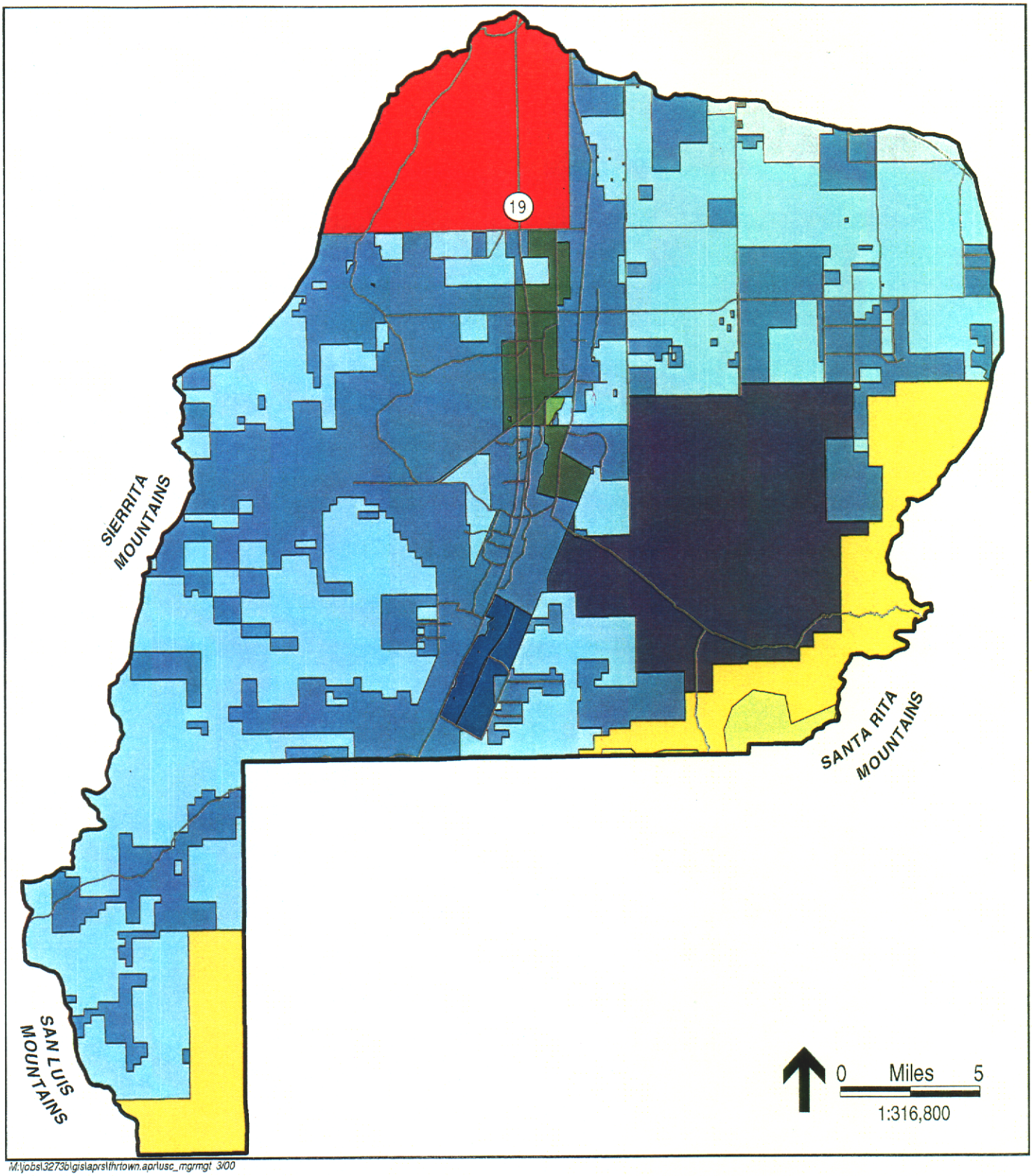
Upper Santa Cruz Subarea Location in Pima County
Figure 13

A. Potential Threats and Stressors

1. Land Use and Landscape Character

Historically, the area has been used for ranching, farming, and mining. Residential growth and commercial development in Green Valley and other communities during the last 50 years has changed the rural character to one more urbanized The general distribution of land ownership and management status is depicted in Figure 14. This is mostly evident along the I-10 corridor. Cultivated fields have given way to pecan orchards, and some of the pecan orchards are now being developed for residential uses. This has displaced many of the mature pecan trees, which provide habitat for the yellow-billed cuckoo and numerous other birds (Kingsley 1989).

The County's Comprehensive Plan reflects this corridor of urbanization in the Upper Santa Cruz Valley Subregion Plan (Pima County 1997). The Plan shows medium and high intensity urban uses along both sides of I-19 up to the Town of Sahuarita boundaries. Lower intensity rural is shown as distance from I-19 increases. Significant blocks of land on the west side of I-19 are identified as "Resource Productive." These are where the large open pit mines and tailing ponds are located.



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Land Ownership and Land Management
in the Upper Santa Cruz Subarea

- BLM Unreserved
- Pima County Open Space
- Pima County Unreserved - Private Lands
- Pima County Unreserved - State Trust Lands
- Sahuarita Unreserved - Private Lands
- Sahuarita Unreserved - State Trust Lands
- Tohono O'Odham Nation Unreserved
- Tucson Unreserved - Private Lands
- Tucson Unreserved - State Trust Lands
- USFS Coronado National Forest (unreserved)
- USFS Mt. Wrightson Wilderness Area
- UofA Santa Rita Experimental Range
- Major Road or Highway

Figure 14

Residential growth by lot splitting has been prevalent in some areas, such as east of the San Xavier District and along Sahuarita Road, near Corona de Tucson, and in the Arivaca area (Pima County 1998). Otherwise the growth has been accommodated by regulated specific plans, subdivisions, and developments. Green Valley started out as a retirement community but is seeing a wider diversity as growth continues to increase in the area. Newer subdivisions and master-planned communities such as Madera Reserve, Madera Estates, and Quail Creek are located on the east side of I-19 and the Santa Cruz River. There is currently a proposal to build 5,000 retirement homes on 2,106 acres in Quail Creek, a Specific Plan area (*Arizona Daily Star* 2000). Quail Creek may become annexed into the Town of Sahuarita.

Within Sahuarita's boundaries are two master planned projects now in the process of being built that will take up the northern one-third of the town's 14 square miles. One is Rancho Sahuarita, a 2,800-acre community. The other is Madera Highlands, a 920-acre community. Both of these will have mixed uses and golf courses. The developers of Rancho Sahuarita will build a wastewater treatment plant and a lake as part of the project and turn them over to the town when completed. They will also give the town a water well and water rights for the purposes of supplying the lake. Eventually the lake will be fed by treated wastewater. The remaining pockets of private land within the town will likely be built out in the near future (Town of Sahuarita-Staley 2000). Over half of the Madera Highlands community is on land that was previously pecan groves. To the east of Sahuarita are many more acres of pecan groves. With mounting development pressure, there is the possibility that these groves could be converted to residential uses. They are owned by the Farmers Investment Company (FICO), a privately held company. These trees provide habitat for numerous species of birds.

Last year a major rezoning for the Canoa Ranch Specific Plan, in the southern part of the subarea, was denied. Subsequently, the Board of Supervisors revised the Comprehensive Plan to designate this area as "Resource Conservation." Although the project may be redesigned and resubmitted for consideration at some time in the future, any development proposal for over one residence per three acres would require an amendment to the Comprehensive Plan. The County is considering the purchase of the property, or a portion of the property, for the purposes of establishing a cultural and natural resources preserve. At this time, no actions have been taken towards that end.

The Tohono O'odham Nation has plans for building a large casino on 55 acres at the south end of the San Xavier District, at I-19 and Pima Mine Road. The facility will include retail shops, a concert venue, restaurants, and a bingo hall in addition to the casino and is expected to generate 500 new jobs. Future plans may include a hotel on an adjacent 80 acres. The presence of the casino will increase the potential for the interchange location to become a major commercial center.

At the current and projected rate of growth in this area and further south in Rio Rico, it is possible that the entire I-19 corridor between Tucson and the County line will become urbanized within the future. Although the land along the corridor that is within the San Xavier District now exists as mostly undeveloped open space, that is subject to change as is evidenced by the planned new casino. Stressors to biological resources resulting from the urbanization of the corridor have included and will continue to include habitat loss and degradation, habitat fragmentation, conversion of vegetative cover, decline in groundwater levels, and competition by invasive species. As new impervious surfaces

are constructed drainages are frequently altered or channelized, resulting in the removal of wash-associated xeroriparian vegetation, and the wildlife it supports is displaced. This has been the case in much of Green Valley. Development has led to the channelization of most of the washes which drain the Sierrita Mountains and foothills. Other significant drainage improvements, expansion of culverts, construction of earthen and concrete dikes, bank stabilization, rip-rapping, and erosion control projects are either underway or planned in the Green Valley to protect homes from flooding and erosion. (See report under separate cover, "Watershed and Watercourse Considerations.") The Santa Cruz River has experienced dramatic changes over the last 100 years. Human uses in the floodplain, urbanization, diversion, channelization, and livestock over-grazing have all contributed. Once broad and shallow, the channel has widened and is estimated to have deepened 20-30 feet in places. This eliminated significant amounts of vegetation once associated with the river channel and banks. Continued channel cutting and erosion would be made worse by increased urbanization adjacent to the river channel, which could eventually require continuous bank protection.

Although much of the valley along the Santa Cruz River is taken up with a growing urbanized corridor, ranching continues to be an important part of the economy and landscape management in the areas closer to the mountains. There are many acres of private ranch land and many acres of State Land and forest land with grazing allotments. (The BLM has a relatively small amount of land in the subarea.) The Santa Rita Experimental Range is a 53,159-acre area abutting the northwest flank of the Santa Rita Mountains. The land is owned by the state and administered by the University of Arizona, College of Agriculture for the purpose of studying range ecology and management techniques. The range is grazed under careful management. The vegetation has changed since the 1900s. Where shrub-free grassland once dominated half of the range, velvet mesquite is now a dominant overstory species. Other species such as burroweed, cholla, and prickly pear are now prevalent. Lehmann lovegrass, a non-native invasive grass, now dominates nearly 40 percent of the range (USDI-Medina 1996).

The pressure on ranchers to sell off all or portions of their private holdings is as much a concern in this subarea as it is in other subareas. The conversion of ranches to subdivisions and/or lot-split areas poses concern for biological resources. Habitat loss, alteration, and fragmentation can result, along with increased groundwater pumping. Further, the opportunity to manage the land's biological resources on a landscape level is lost.

Mining has had a significant impact on the landscape within this subarea. ASARCO's open pit copper mines at the Mission Complex consisting of six mines situated on 20,000 acres (ASARCO 2000). Cyprus Climax has three open pit mines at its Sierrita facility. These mines are all on the west side of I-19. Although copper mining had been projected to diminish, new extractive techniques have extended the viability of the mines. Even if closed out, the long-term impacts of the mines and tailings ponds on the landscape and watershed will remain. The tailing ponds trap much of the runoff from the west, keeping it from ever entering the Santa Cruz River. The USGS is currently studying water quality issues associated with mining operations in this subarea.

The mineral resources of the Santa Rita Mountains have been explored and mined for many years. There are several areas of medium to high potential for mineral resources

in these mountains, the largest of these is the Helvetia-Rosemont mining district (USDI-USGS 1996). A proposal by ASARCO to develop a mine on the east side of the Santa Ritas, in the Rosemont area, was put on hold in 1998. Interest in the ore body at Rosemont remains, and mining could be an issue at any time in the future (*Arizona Daily Star* 1998). There is currently one active aggregate limestone operation in the Helvetia Mining District where there are enormous reserves of recrystallized limestone. An aggregate product and landscaping rock is produced here. According to a report produced for the Coronado National Forest, the potential for development of collection and quarry sites for riprap and aggregate is high, particularly in areas easily reached from developed areas adjacent to the forest boundary (USDI-USGS 1996).

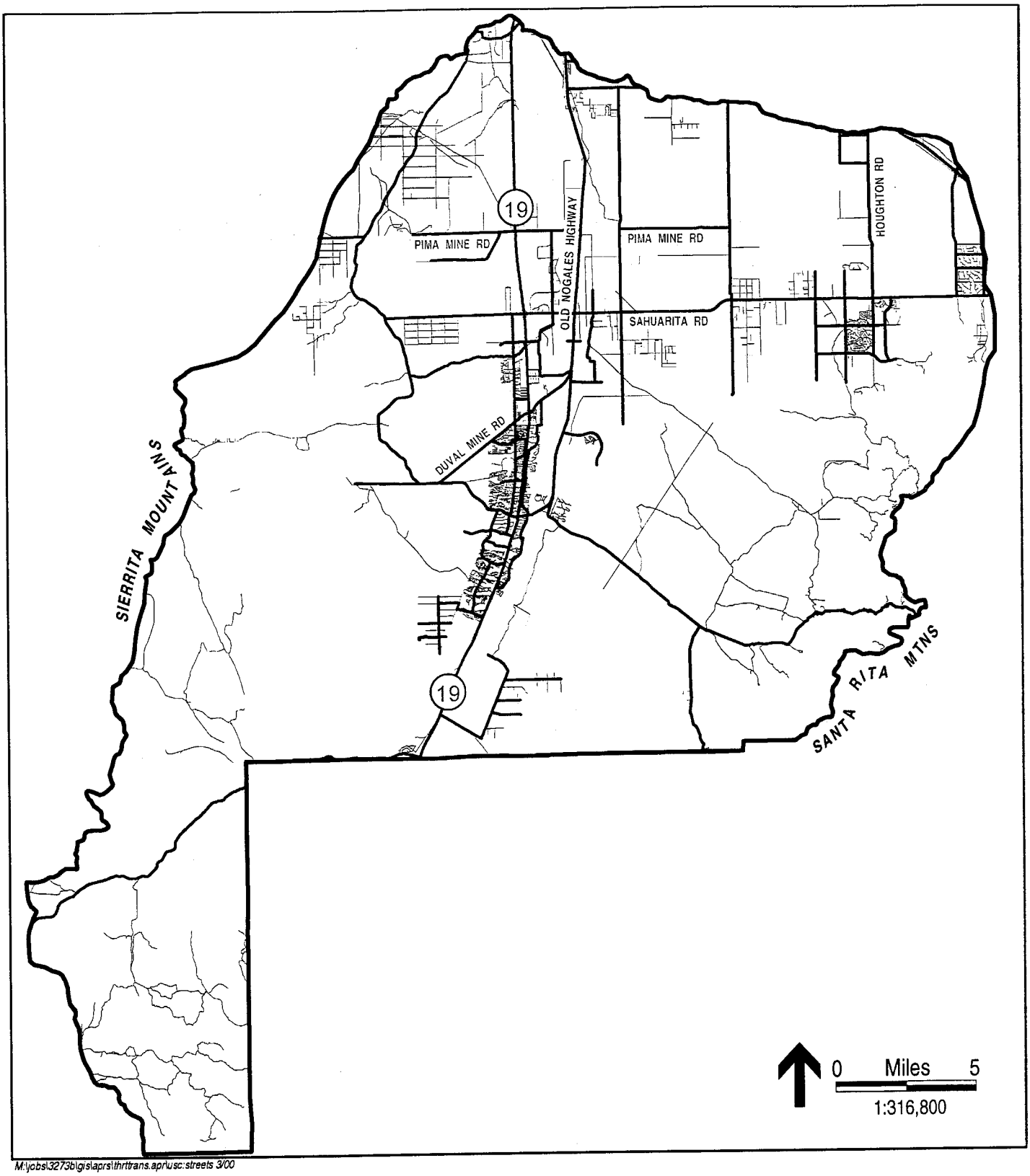
Effects on biological resources from mining can include large-scale degradation of intact areas, habitat loss and fragmentation, potential for downstream watershed contamination, and intensive groundwater pumping to support mine operations. Habitats affected could represent the full range from heavily forested areas at higher elevations, riparian canyons, oak woodlands, and grasslands.

2. Transportation

The existing network of highways and roads fragments much of the remaining natural landscape in the Upper Santa Cruz Subarea (Figure 15). I-19 is the primary north-south roadway, generally bisecting the subarea. It generally parallels the Santa Cruz River. The Old Nogales Highway extends south and connects with Duval Mine Road. The Southern Pacific Railroad follows the east side of Old Nogales Highway and the Santa Cruz River down to Nogales. These elements, in combination with the frontage roads, other smaller roadways, and the commercial and residential development along the corridor from a major barrier to east-west movement of wildlife across the valley.

The Long Range Transportation Plan (Pima County 1986) shows Sahuarita Road (I-19 to SR-83), Kolb Road (Sahuarita Road to I-10), and Houghton Road (Sahuarita Road to I-10) as Key Features within the subarea. This designates a controlled access roadway with a 300-foot-wide right-of-way. Sahuarita Road would be realigned in the vicinity of SR-83 and I-10 and would accommodate significant truck traffic by reducing travel time by bypassing the Tucson area. The Tucson Airport Authority, City of Tucson, Town of Sahuarita, Pima County, and ADOT are all interested in the improvement of Sahuarita Road as a commercial traffic bypass. For the Tucson Airport Authority (TAA), the roadway would provide better access to their freight center on the east side of the airport. Sahuarita Road has been placed on the state highway system as a joint-funded State Route. Additional planning studies focusing on the roadway will be undertaken this year (Pima County-Goff 2000). Kolb and Houghton Roads are planned to ultimately become the principal north-south roadways connecting to I-10 (Pima County 1986).

Although these roadway improvements are not on the PAG Metropolitan Transportation Plan, they are still on record as part of Pima County's long-term plans and there is interest in moving them forward. If built as controlled access roadways, they would displace significant amounts of vegetation and habitat and serve as barriers to wildlife movement. This area, along with the southeastern portion of the Tucson basin in general, has seen increased growth, both regulated and unregulated. It has recently begun to have more appeal to developers because it does not have the constraint of the CFPO Critical Habitat designation that the Tortolita Subarea has. A floodplain study for



Road Network

in the Upper Santa Cruz Subarea

Highway or Major Road
Local Road

Figure 15

this area north of the Santa Rita Experimental Range described the area as consisting of a tributary network of poorly defined watercourses within an alluvial fan (DeGrood and Fuller 1988). If development continues to increase in this area and the poorly defined washes are channelized, downstream flooding and upstream erosion and channel cutting will likely result, as they have in other areas under these circumstances. Direct modification of the watercourse, downcutting, and loss of xeroriparian and upland vegetation can essentially transform an area of rich biodiversity into one low biological resource value. This is a serious concern for this area and elsewhere in other subareas (e.g., Tortolita Fan area). This potential for erosion and watershed degradation will compound the impacts of habitat loss and fragmentation that is associated with development and urbanization of a rural area that is expected to experience rapid growth in the future.

3. Water Use

Private water companies serve the communities of Green Valley, Continental, and Sahuarita. Additionally, there are numerous private wells. The mines and the pecan growers (FICO) have private wells. There is a proposal by the Upper Santa Cruz Water Users Group (USCWUG) to extend the Central Arizona Project (CAP) line south from Pima Farms Road to water users in the Green Valley Sahuarita area, including the mines and the pecan groves. At this time the biggest constraint is the lack of water delivery infrastructure. ASARCO and FICO are considering participating in the Groundwater Savings Facility Program by using CAP water in lieu of groundwater if the technical and economic issues can be resolved (Arizona Department of Water Resources [ADWR] 1998).

Recharge basins for CAP water are located at Pima Mine Road, and plans for instream recharge from there north to Valencia Road are being developed. The full-scale capacity of the project is expected to reach 30,000 acre-feet per year. The San Xavier Arroyos project uses CAP water by recharging into arroyos west of I-19 and the main channel of the Santa Cruz River (ADWR 1998). This project has potential for recreating and enhancing riparian and xeroriparian habitats. The Bureau of Reclamation (BOR) and the Nation constructed an erosion control project on the west bank of the Santa Cruz River near the bridge at the Mission. It includes an area for riparian habitat restoration using CAP water. The Nation is also considering using CAP water to reconstruct the mesquite bosque that once grew south of San Xavier Mission.

Directly affecting the potential future use of CAP water, the USFWS issued a jeopardy decision in their recent draft Biological Opinion of the impacts of Santa Cruz River Basin recharge projects on the endangered Gila topminnow. The BOR and the USFWS are continuing to work through the Section 7 Consultation process. As part of their Biological Assessment the BOR will be constructing two fish barriers along the Santa Cruz River near Pima Mine Road and will implement other measures to offset potential impacts to the endangered fish which exists upstream between Tubac and Nogales (USDI-BOR 2000). These fish barriers would have no effect on any CAP water entering the watershed upstream of Pima Mine Road.

It is unclear to what extent the ongoing Section 7 consultation will impact CAP delivery and recharge projects within the Upper Santa Cruz Subarea and elsewhere throughout the Santa Cruz basin.

Shallow groundwater exists in the area along the Sopori Wash, which extends west from the Santa Cruz River near the Arivaca Junction (PAG 2000). Most of the land on both sides of the wash is privately owned, surrounded by State Land. The pattern of land development here is by lot splitting, and there are numerous private wells. If residential density and ground water pumping continues to increase in this area the water table may decline and vegetation that the shallow ground water supports could be lost over time. The Sopori Wash is the largest tributary to the Santa Cruz within this subarea and has significant biological resource values due to the dense vegetation and proximity to the undeveloped open space areas of the Coronado National Forest and State Lands.

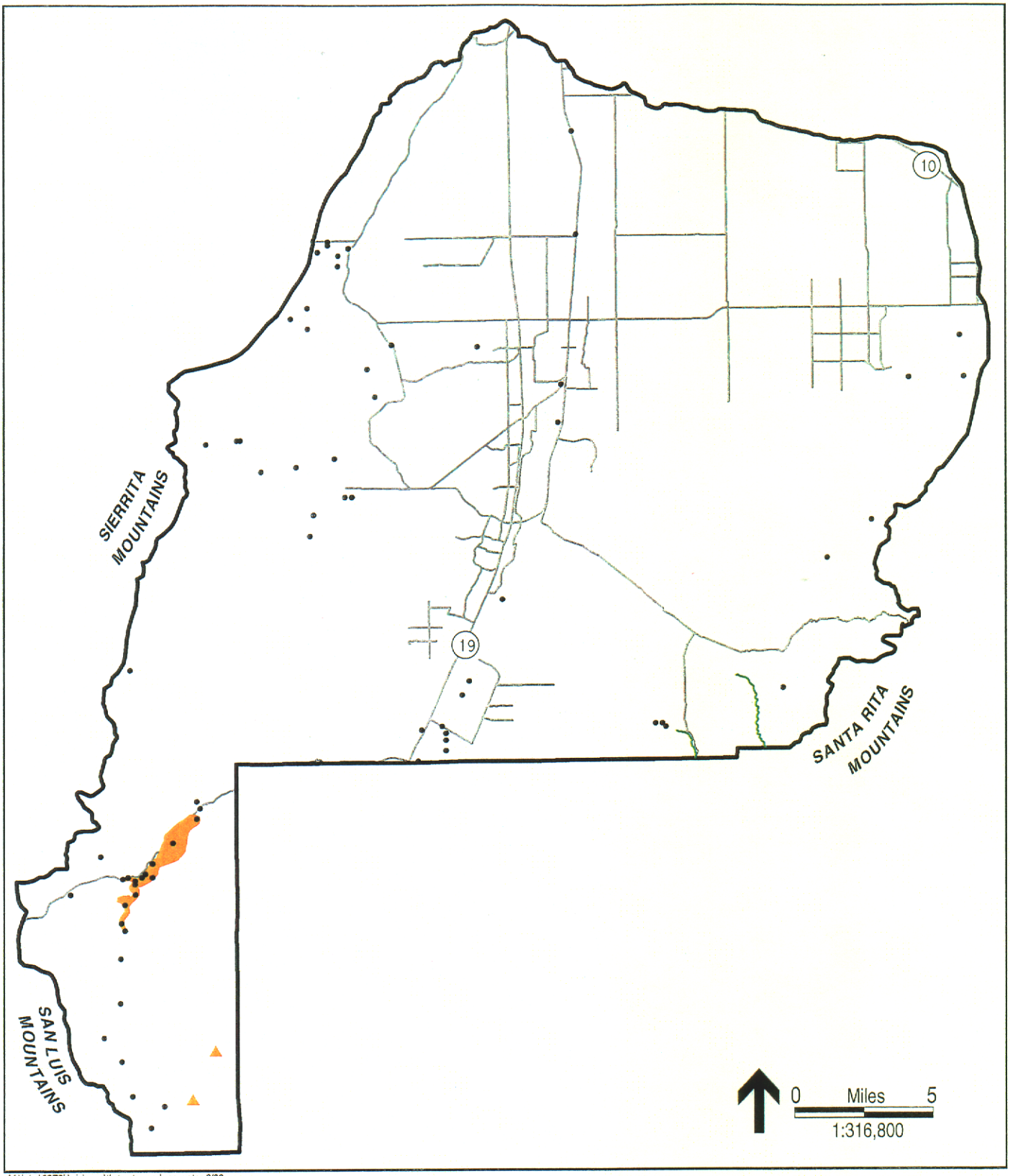
The depth to groundwater has declined between 50 and 100 feet since 1940 throughout much of the Green Valley area and other portions of the subarea in the valley area. Immediately north of the subarea the groundwater has declined 100-150 feet. This forms a cone of depression that has been linked to the decline and demise of a large mesquite bosque and cottonwood gallery south of the San Xavier Mission. Springs that once flowed near San Xavier no longer flow because of this decline in the water table. The decline has been attributed to groundwater pumping for the mines, agriculture, and urban use. One of the City of Tucson's most productive well fields is near here.

This example of the direct effect of groundwater overdraft on biological resources and habitats of concern presents possibilities of similar scenarios taking place in the future further upstream along the Santa Cruz River. As groundwater pumping continues to increase and the groundwater table continues to decline, riparian and xeroriparian vegetation communities associated with the river and its tributaries are put at greater and greater risk of dying out (Figure 16 and Table 12).

4. Recreation

Coronado National Forest provides the largest area for recreation within the Upper Santa Cruz Subarea. Madera Canyon has developed facilities such as the Bog Springs campground, picnic areas, parking, and trails. There are also private homes within the canyon and a private concession, the Santa Rita Lodge. Most of the developed facilities are within Santa Cruz County. Much of the recreation use of the Canyon is geared to bird watching, other wildlife viewing, and hiking, but a full range of uses are allowed within Forest lands. Numerous bird species, including the elegant trogon and many hummingbird species, bats, deer, black bear, and other wildlife species inhabit this canyon which has ephemeral stream flows. Bird species diversity is especially high here because the Santa Rita Mountains are the northern limit of the range of many of the bird species. Florida Canyon Wash is also a well known birding and wildlife viewing area due to its well-developed xeroriparian vegetation.

Biological stressors associated with recreational uses in the Santa Ritas are primarily tied to human use and overuse. Increasing growth in Green Valley and Sahuarita, and further south in Santa Cruz County, results in increased use of Forest lands for recreation. The limited facilities at Madera Canyon are well-used and primitive camping and use of other areas of the Forest is increasing. The Greaterville Road provides east-west access to I-19 and SR-83. The more traveled this road becomes for recreational uses, the greater chance there is for roadkill, habitat degradation, introduction and spread of exotic species, and wildfires.



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Surface Groundwater and Streams
in the Upper Santa Cruz Subarea

Suspected Shallow Groundwater Areas (based on well data and aerial imagery)

Possible Shallow Groundwater Area (based on vegetation assemblages)

Well with Depth to Water less than 50 feet (ADWR Well 55-Registry and GWSI databases)

Intermittent Reach

Major Street or Highway

Figure 16

TABLE 12
STREAM CHARACTERISTICS IN THE UPPER SANTA CRUZ SUBAREA

Stream Name	Miles of Perennial Flow	Miles of Intermittent Flow	Acres of Hydro-mesoriparian Habitat	Acres of Class A Riparian Habitat	Acres of Shallow Groundwater	Pygmy-Owl Habitat	Fish Species	Leopard Frogs
Franco Wash	0	0	0	67	N/A	No	0	N/A
Madera Canyon	0	1.5	N/A	105	N/A	No	N/A	N/A
Florida Canyon	0	3.4	N/A	N/A	N/A	No	N/A	N/A

N/A = not applicable.

B. Biological Resources

1. Vegetation and Land Cover

Habitat within the Upper Santa Cruz Subarea consists primarily of mixed grass scrub giving way to palo verde-mixed cacti towards the north (Figure 17). Much of the central portion of the subarea is urbanized and has drainages running through that support mixed scrub and cordgrass habitats. To the west, south, and east limited areas of encinal oak forest habitat grow at higher elevations. Limited agricultural land occupies the south-central portion of the subarea.

2. Critical Habitat

No areas of Critical Habitat have been designated within the Upper Santa Cruz Subarea.

3. Species at Risk

A total of 18 Status 1 and Status 2 Vulnerable Species occur within the Upper Santa Cruz Subarea (Table 13).

C. Existing and Proposed Preserve Areas

1. Canoa Ranch

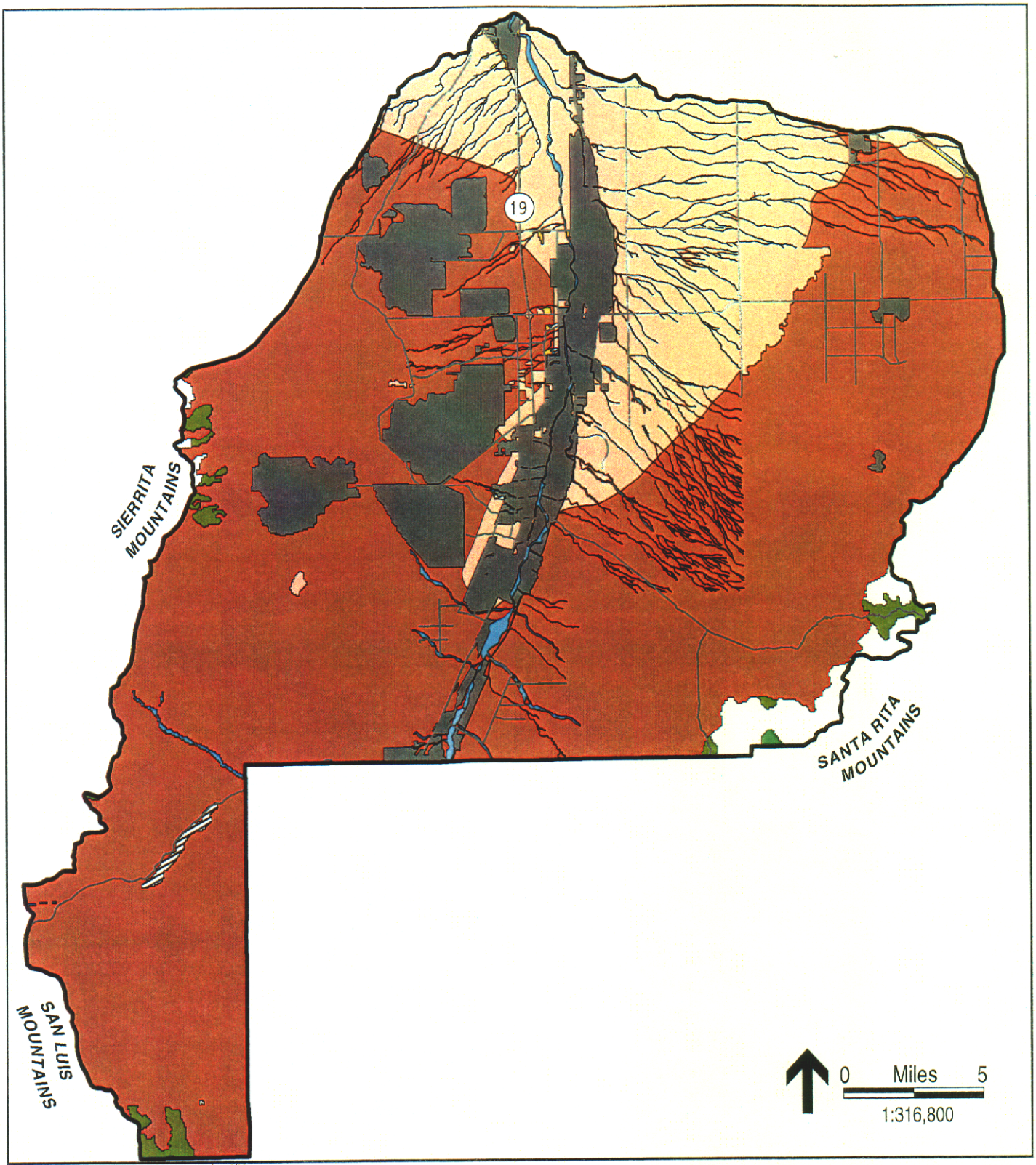
The County's Open Space Acquisition Master Plan identifies this for acquisition (Pima County 2000). The 1997 Open Space Bond Program provided two million dollars to acquire approximately 500 acres of the original Spanish Land Grant of 1821. This amount is less than the current estimated acquisition costs. The area identified for acquisition is located at the south end of the Canoa Ranch, on both sides of the Santa Cruz River and I-19. It would include the confluence of the Madera Canyon Wash and other tributary washes, and a small pond associated with the historic ranch house. If this area is not purchased and managed as preserved open space, the land will likely be developed at intensities found elsewhere along the I-19 corridor. Stressors to biological resources would then include those associated with urbanization such as habitat loss and degradation, habitat fragmentation, groundwater pumping and decline in groundwater levels, and competition by invasive species. The likelihood of removal of xeroriparian vegetation for wash channelization and bank protection would increase.

2. Sierrita Ranch Conservation Area

Incorporating State Land, BLM land, and private land, this conservation area would serve to protect much of the Sierrita Mountains while allowing ranches to continue their operations, including grazing cattle. Without some level of protection the mountains and foothill areas would be subject to increasing development pressures, as evidenced by the subdivisions and lot-splitting that have taken place immediately to the northwest.

D. Summary of Potential Stressors to Biological Resources

Primary stressors to biological resources within the Upper Santa Cruz Subarea include habitat loss, alteration, and degradation; habitat fragmentation; human use and overuse;



Vegetation and Land Cover
in the Upper Santa Cruz Subarea

Vegetation Communities (BLP Classification)

- 122.61 Douglas-Fir-Mixed-Conifer
- 122.62 Pine
- 123.31 Encinal (Oak)
- 133.32 Manzanita
- 133.36 Mixed-Evergreen Sclerophyll
- 143.15 Mixed Grass-Scrub
- 154.11 Creosote-Bursage
- 154.12 Paloverde-Mixed Cacti
- 223.22 Mixed Broadleaf
- 234.71 Mixed Scrub
- 243.53 Cordgrass

Other Land Cover Types

- 999.1 Agriculture
- 999.2 Urban
- Major Road or Highway

Figure 17

TABLE 13
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE UPPER SANTA CRUZ SUBAREA

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Accipiter gentilis apache Apache northern goshawk	2	S3	F-petitioned, FSS WSC	Habitat destruction by logging and forest clearing. Possibly consequences of fire suppression leading to major timber fires. Organized recreational and sports use. Global climate change. Disturbance by recreationists, cattle grazing, mining, road building and other forest disturbances are site specific threats alleged by Center for Biodiversity.	Mt. Hopkins quad. Santa Cruz Co. 1990 USFS Mt. Wrightson quad, 1991, 1994, 1997 USFS	May occur at high elevation areas within this subarea. Petitioned for listing as endangered, 90-day finding determined that listing was not warranted 6/29/98. Suit filed 2/25/99 to list as endangered.
Amoreuxia gonzalezii Saiya	1	S1	FSC FSS SR	Very narrow distribution and small number of individuals. Grazing (plant is palatable to cattle). Degradation of habitat due to livestock grazing. Competition by introduced invasive plants. Javelina consume roots.	Empire Ranch quad 1976. USFS Mt. Hopkins quad, Santa Cruz Co. northeast of Agua Caliente Caves, 1991 USFS	Limestone endemic.

TABLE 13
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE UPPER SANTA CRUZ SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Coccyzus americanus occidentalis Western yellow-billed cuckoo	2	S3	F-petitioned FSS WSC	Habitat destruction and alteration, historic and present. Groundwater pumping, channelization, urbanization, historic livestock grazing? Farming and agricultural uses? Wood cutting. Reduction of acreage in pecan farming.	Helvetia quad, Florida Canyon, 1925 USFS Empire Ranch W of Cienega Creek 1998 BLM Saucito Mtn. quad, Santa Cruz Co. Sopori Wash 1980 Private Mt. Hopkins quad, Santa Cruz Co., Chino Canyon, 1981 USFS Mt. Wrightson quad 1923, 1927 USFS Arivaca quad. Wilbur Wash 1994 private Arivaca Creek 1994 FWS	Positive 90-day finding on petition, 2/17/00
Coryphantha scheeri var. *robustispina* Pima pineapple cactus	1	S2	FE HS	Narrow distribution, much of which is on private and Indian lands and much of which has been developed. Development, off-road vehicle traffic.	60 records for Pima Co. 41 for this subarea. San Xavier Mission, 1, 1993 private; Tucson SW, 2, 1992 private; Tucson SE, 2, 1998, 1999 private and State; Vail: 6: 2 private, 3 BOR, 1 State Twin Buttes, 2, 1981, 1982 private; Sahuarita, 3, 1989, 1998 State; Corona de Tucson, 2, 1989, 1999 State; Mount Fagan: 7: 4	May not be a valid variety using today's standards. There are many more unreported locations in this subarea.

TABLE 13
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE UPPER SANTA CRUZ SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
					BOR, 3 State; Esperanza Mill, Sierrita Mountains, 2, 1987, 1988 private; Green Valley, 6, State, BLM, USFS, Helvetia: 2, USFS; Amado 4, 1982-1996 State; Mt. Hopkins Santa Cruz Co. 1994 private	
Echinomastus erectocentrus var. *erectocentrus* Needle-spined pineapple cactus	2	S3	SC S SR	Very narrow distribution. Land development and off-road vehicles might impact this species.	Vail quad, 1966, 1981 Private Mount Fagan quad, Davidson Canyon, 1990 State	
Lasiurus blossevillii (=*borealis*) Western red bat	2	S2	FSS WSC	Habitat loss as a result of ground-water pumping, channelization, wood cutting, leading to loss of riparian areas. Farming and agricultural uses, specifically secondary poisoning and reduction of food supply resulting from insecticide use.	Green Valley quad, Santa Rita Experimental Range, 1991 State. Empire Ranch quad, Empire Gulch, 1989 BLM.	This probably is more common on Empire Ranch than the records indicate. Also reported confirmed from Colossal Cave Mountain Park, roosting in trees on Posta Quemada Ranch.
Leptonycteris curasoae yerbabuenae Lesser long-nosed bat	2	S2	FE WSC	Alleged to be related to reduction of numbers of maternity colonies and decline in size of remaining maternity colonies in Arizona and Sonora due to exclusion and disturbance. Addi-	Vail quad. Rincon Mountains 1968, 1988 Private Helvetia quad 2 mi E of Helvetia 1976 USFS	There was formerly a maternity roost in Colossal Cave. With much effort, bats were excluded and driven away. They may return if the cave is managed

TABLE 13
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE UPPER SANTA CRUZ SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
				tionally, thought to be negatively affected by large reductions in acreage of native agaves over large areas of northern Mexico due to excessive harvesting for local manufacture of mescal and tequila. Excessive browsing by livestock on newly emergent flower stalks of *Agaves* has also been suggested as possibly decreasing foraging opportunities and thus contributing to declines among these bats.	Empire Ranch quad, Empire Ranch 1989 BLM Mt. Hopkins quad, Santa Cruz Co. Madera Canyon Lodge 1988 Private Mt. Wrightson quad, Sawmill Canyon (Santa Cruz Co.) 1988 USFS	properly for them. The Colossal Cave Mountain Park website lists this species as present, not in the cave but roosting in cliffs.
Muhlenbergia dubioides Box canyon muhly	1	S1	FSS	Very narrow distribution.	Helvetia 1986 USFS	
Muhlenbergia xerophila Weeping muhly	1	S1	FSS	Very narrow distribution.	Helvetia 1990, 1940 USFS	
Plecotus townsendii pallescens Pale Townsend's big-eared bat	2	S3S4	FSC	Disturbance of roosts by recreationists and renewed mining.	Vail quad, Rincon Valley, 1986 Private. Samaniego Peak quad, Sierrarita Mtns, Tascuela Canyon 1996 BLM. Cerro Colorado quad, Las Guijas Mtns. 1996 BLM Mt. Hopkins quad, Santa Cruz Co. Devils Cash Box 1993 State	This species is probably more common in Pima Co. than records indicate. Reported from Colossal Cave, which it uses as a maternity roost.

TABLE 13
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE UPPER SANTA CRUZ SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
					Mt. Wrightson quad, Santa Cruz Co. Cave Creek 1986 USFS Arivaca quad, Fraguita Wash 1991 USFS, Fraguita Spring 1986 USFS	
Poeciliopsis occidentalis occidentalis Gila topminnow	1	S2	FE FSS WSC	Non-native species, competition and predation. Habitat loss by ground-water pumping and channelization. Flooding. Drought. Dredging. Poor water quality. Livestock grazing (trampling by cattle, watershed changes).	Arivaca quad. Altar Valley, Arivaca Creek drainage, 1989, private	
Rana chicahuensis Chiricahua leopard frog	1	S3	FC FSS WSC	Disease. Introduced predators/ competitors. Loss of habitat, groundwater pumping, water diversions. Center for Biological Diversity alleges threats are: "continued degradation and destruction of Southwest riparian areas by livestock grazing, ground-water pumping, water diversion, and dams. They are also threatened by exotic species, such as the bull frog and the large-mouth bass, which compete with and prey on the frog."	Helvetia quad, Santa Rita Mts. West Sawmill Canyon 1995 USFS; Box Canyon 1979 USFS. Mt. Wrightson quad, in Santa Cruz Co. several records. In Pima Co., Fish Canyon 1995 USFS Arivaca quad, Arivaca Creek, 1992 private. Murphy Peak quad, Tumacacori Mtns. 2 sites. 1989 USFS	CBD sued to list as endangered 8/27/99

TABLE 13
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE UPPER SANTA CRUZ SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Sonorella eremita San Xavier talussnail	1	S1	-	Protected by Conservation Agreement. Limited distribution. Agreement challenged by CBD, who threatened a lawsuit. Alleged threats are: vandalism, collection, herbicide poisoning, habitat disturbance, siltation from runoff.	Twin Buttes quad., near San Xavier, NW shoulder of white hill, 1990 private.	lawsuit apparently not filed
Rana yavapaiensis Lowland leopard frog	2	S4	SC FSS WSC	Groundwater pumping, disease, water pollution, invasive non-native species, ozone loss, unknown causes of population declines.	Helvetia quad, Box Canyon 1979 USFS Empire Ranch quad, Empire Spring 1990 BLM Mt. Wrightson Quad, several records in Santa Cruz Co. 1979-1989 USFS Arivaca quad, Arivaca Creek 1981 private.	
Sorex arizonae Arizona shrew	2	S2S3	FSC FSS WSC	Limited distribution, poorly known. Fires and floods. Recreational development and camping.	Mt. Wrightson quad, Santa Cruz Co. Stone Cabin Canyon 1923 USFS	Appropriate habitat has not been surveyed using the best available techniques. This species may or may not be present in montane areas in Pima Co.

TABLE 13
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE UPPER SANTA CRUZ SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Strix occidentalis lucida Mexican Spotted Owl	2	S3S4	FT WSC FSS	Habitat destruction by logging. Possibly consequences of fire suppression leading to major timber fires. Organized recreational and sports use and recreational development. Global climate change.	Mt. Hopkins quad, several records in Santa Cruz Co. 1994 USFS Mt. Wrightson quad, several locations all in Santa Cruz Co. 1994 USFS	May occur at high elevation areas, barely within this subarea. Critical Habitat for this species had been designated in 1995, but rescinded in 1998. It may have just barely touched portions of this subarea, but was mostly (if not entirely) within subarea 4. On 3/14/00 a federal judge ordered FWS to determine critical habitat by 1/15/01.
Thamnophis eques megalops Mexican garter snake	2	S2S3	FSC FSS WSC	Predation by bullfrogs. Aquatic and riparian habitat degradation and destruction.	Arivaca quad, Arivaca Creek, 1981 private	
Tumamoca macdougalii Tumamoc globeberry	2	S3	FSS SR	Threats include urbanization, farming, overgrazing, recreation, habitat conversion, javelina (eating tubers), off-road vehicle use, pesticides.	San Xavier Mission quad, 2 sites, 1988 private Sahuarita quad, Sahuarita vicinity 1988 State Green Valley quad, Sahuarita vicinity 1988 USFS	This species was formerly listed as endangered, but was delisted because it was found to be more common than thought at the time of listing.

NOTE: Records are from Heritage Data Management System (HDMS), Arizona Game and Fish Department.
Quads: San Xavier Mission, Tucson SW, Tucson SE, Vail, Samaniego Peak, Twin Buttes, Sahuarita, Corona de Tucson, Mount Fagan, Batamote Hills, Esperanza Mill, Green Valley, Helvetia, Empire Ranch, Cerro Colorado, Saucito Mtn, Amado, Mt. Hopkins, Mt. Wrightson, Arivaca, Murphy Peak

a decline in ground water levels; and competition by invasive species. Very little of the Upper Santa Cruz Subarea is currently under management for conservation of biological resources (Figure 18). The majority of the subarea is land status 4a and 3b, with substantial areas urban and other intensive uses.

Habitats most at risk include the mixed riparian and xeroriparian woodlands associated with the Santa Cruz River and its tributaries, palo verde mixed scrub associations in uplands, and areas of semi-desert grasslands. Habitats supporting the Pima pineapple cactus and the western yellow-billed cuckoo are at risk from urbanization.

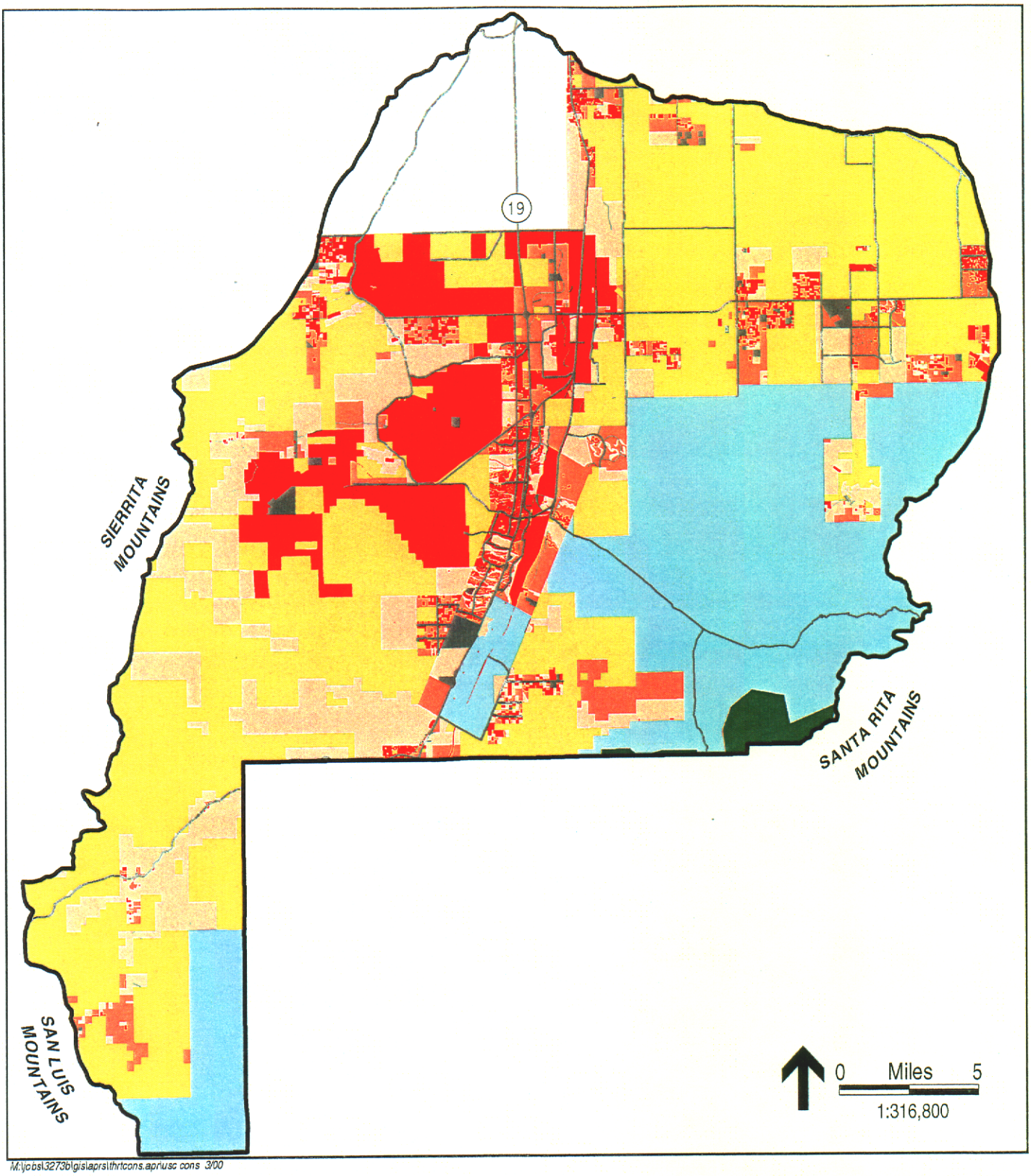
Activities contributing to biological stress are shown on Table 14. These include ground water pumping for mines, agriculture, and urban uses; mining; historic overgrazing; loss of native vegetation to agriculture; conversion of agricultural lands to urbanized uses; rapid urbanization of the I-19 corridor; and lot splitting in rural areas along the Sahuarita Road corridor and in the Arivaca area.

The conversion of some of the pecan groves to residential subdivisions raises concerns because of the presence of numerous bird species, including the yellow-billed cuckoo. The USFWS is currently reviewing a petition to list this bird as endangered (USDI-USFWS 2000). Some of the groves have already been sold for development. Increasing development pressures in the future could trigger further conversion.

The continued urbanization of the I-19 corridor is of concern in part because of its proximity to the Santa Cruz River. A combination of factors has dramatically altered the river channel and floodplain and it has experienced significant widening and deepening, coupled with the loss of channel and bank vegetation. Channelization and bank protection of tributary washes throughout the Green Valley area continues to result in the loss of wash-associated xeroriparian vegetation.

Although the proposed Canoa Ranch Specific Plan was denied, the owners may submit a revised plan for consideration. The area has now been designated as "Resource Conservation" by the Comprehensive Land Use Plan, but unless it is acquired for preservation it will continue to be susceptible to development.

Growth in rural areas by lot splitting has become prevalent along Sahuarita Road and along the Arivaca Road. Arivaca Road closely parallels the Sopori Wash and areas of shallow groundwater. If residential growth and groundwater pumping continues to increase in this area the water table may decline and vegetation that the shallow groundwater supports could be lost. The watershed along the Sahuarita Road consists of numerous poorly defined washes. If development continues to increase in this area and the poorly defined washes are channelized, downstream flooding and upstream erosion and channel cutting will likely result, as they have in other areas under these circumstances. The resulting loss of xeroriparian and upland vegetation can essentially transform an area of rich biodiversity into one low biological resource value. This is a serious concern for this area and elsewhere in other subareas (e.g., Tortolita Fan area). This potential for erosion and watershed degradation will compound the impacts of habitat loss and fragmentation that is associated with development and urbanization of a rural area that is expected to experience rapid growth in the future.



Level of Threat Represented by Conservation Status

in the Upper Santa Cruz Subarea

Level of Threat
Low

Conservation Status
Most Protected

1a
3b
4a
4b

(For status definitions, see GAP Status Categorization Table in Methods section.)

Level of Threat
High

Conservation Status
Least Protected

4c
4e
4f
4x

Figure 18

TABLE 14
LAND USE ACTIVITIES WITHIN LAND OWNERSHIP/MANAGEMENT CATEGORIES OF THE UPPER SANTA CRUZ SUBAREA

Ownership or Management Category	Land Uses and Activities											
	Conversion of Vegetative Cover	Conversion of Ranches	Conversion of Ag.ricultural Lands	Competition/Predation by Invasive Species	Lot-Splitting & Urbanization	Groundwater Pumping	Water Diversion & Impoundments	Recreational Uses	Mining	Roadways	Livestock Grazing	Removal of Plants
Coronado National Forest- unreserved (38,370 acres)	x	-	-	x	-	x	x	x	x	x	x	x
Mt. Wrightson – Wilderness (3,677 acres)	-	-	-	x	-	-	*	x	✪	x	x	✪
Pima County Open Space (4,563 acres)	-	-	-	x	-	x	x	x	x	x	x	x
Sahuarita Unreserved – State Lands (303 acres)												
Sucosn Unreserved – State Trust Lands (5,251 acres)												
Pima County Unreserved –State Land (156,494 acres)	x	x	x	x	*	x	x	x	x	x	x	x
Sahuarita Unreserved – Private Lands (8,904 acrres)												
Tucson Unreserved – Private Lands (105 acres)												
Pima County Unreserved –Private Lands (148,274 acres)	x	x	x	x	x	x	x	x	x	x	x	x
Tohono O'Odham Nation Unreserved (31,689 acres)												
U of A Santa Rita Exper. Range (51,978 acres)												

x = occurs
- = does not occur
* = potential to occur
✪ = historic but not present occurrence

The pressure on ranchers to sell all or portions of their private holdings is as much a concern in this subarea as it is in other subareas. The conversion of ranches to subdivisions and/or lot-split areas poses concern for biological resources. Habitat loss, alteration, and fragmentation can result, along with increased groundwater pumping. Further, the opportunity to manage the land's biological resources on a landscape level is lost.

The casino planned for the intersection of I-19 and Pima Farms Road has the potential to turn this interchange into a major commercial center. This would be increased greatly if this interchange is used for the future connection of the Sahuarita Road corridor (a possible alternative).

The presence of several areas of medium to high potential for mineral resources in the Santa Rita Mountains establishes the potential for continued and possibly expanded mining activities, particularly at the northern end and in the Greaterville area. Effects on biological resources from mining could include large-scale degradation of intact areas, habitat, and fragmentation; potential for downstream watershed contamination; and intensive groundwater pumping to support mine operations. Habitats affected could represent the full range from heavily forested areas at higher elevations, riparian canyons, oak woodlands, and grasslands.

Groundwater pumping to support the mines, agriculture, and urban uses have contributed greatly to the decline in groundwater levels. The proposal to extend the CAP line further south to serve these water users would significantly reduce dependence on groundwater pumping and provide new opportunities for recharge and riparian restoration projects. The draft jeopardy opinion by the USFWS regarding the effect of CAP water on the Gila topminnow within the Santa Cruz River basin raises serious concerns about the viability of CAP use here as well as in other subareas. It may be an even bigger concern in this area simply because of proximity to the upstream effluent-dominated reach of the Santa Cruz that does support the topminnow.

The development of a lake in Sahuarita poses additional concern for groundwater overdraft. Although it is planned to eventually be fed by effluent, until that time it will be filled with groundwater, further adding to the overdraft of the area.

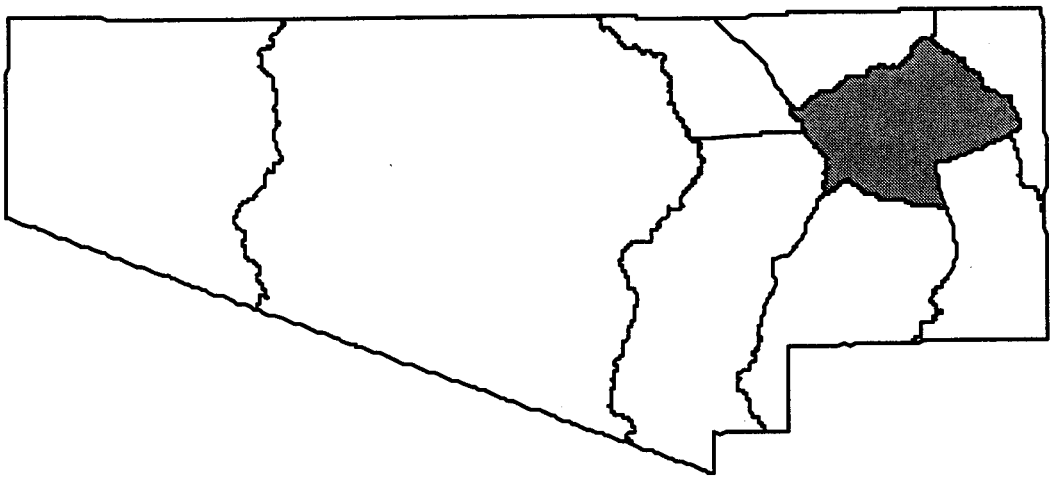
Without some level of protection, such as the Sierrita Ranch Conservation Area could provide, the areas around the Sierrita Mountains will be subject to increasing development pressures, as evidenced by the subdivisions and lot-splitting that have taken place immediately to the northwest. This would be facilitated if State Lands and/or BLM lands are released for private development. Similar concerns exist for the Santa Rita Experimental Range. Although it is administered by the University of Arizona for research and utilized for grazing, it is State Land and as such brings with it a level of uncertainty as to its future. Research and present uses continue at the discretion of the State Legislature. Competition by invasive species, particularly non-native grasses, is a problem for the Experimental Range and ranchers in this subarea.

Middle Santa Cruz

Sub Area 4

VI. Middle Santa Cruz (Subarea 4)

The Middle Santa Cruz Subarea encompasses the Santa Cruz River watershed from Martinez Hill, near the northern boundary of the San Xavier District of the Tohono O'odham Nation, north to the confluence of the Canada del Oro Wash (Figure 19). It is bounded by the Tucson Mountains on the west, the Catalina Mountains on the north, and the Rincon Mountains on the east, and contains the Tucson Basin, the Rillito River, Pantano Wash, Tanque Verde Creek, and many smaller tributaries.

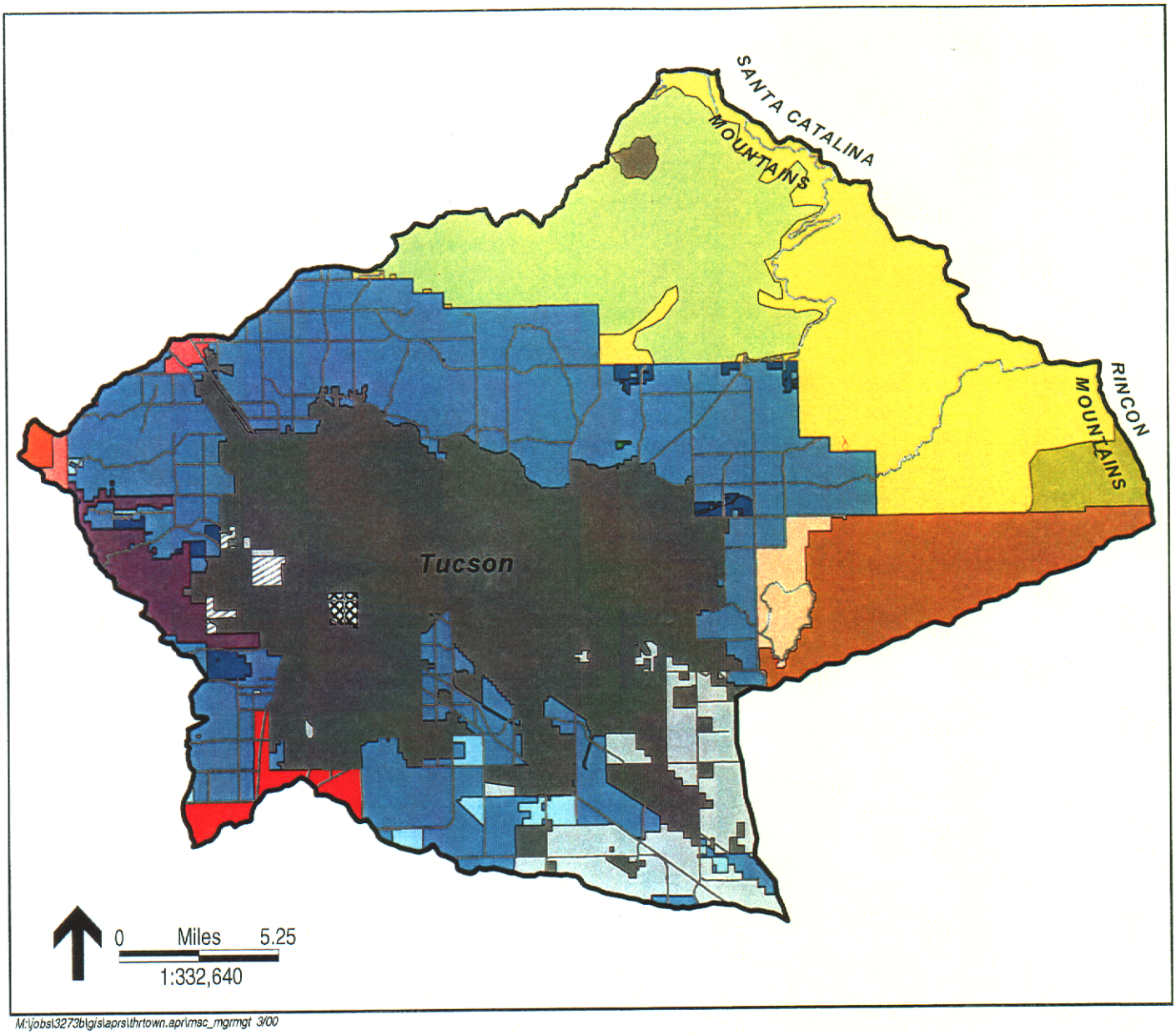


Middle Santa Cruz Subarea Location in Pima County
Figure 19

A. Potential Threats and Stressors

1. Land Use and Landscape Character

Although the landscape character varies throughout the subarea, the dominant character is defined by urbanized land uses (Figure 20). The population of the Tucson area has grown significantly during the last 100 years, from an estimated 10,500 in 1900 to over 778,000 in 1998 (Pima County-History 2000). Most of this growth occurred after World War II and it continues today, extending the urban boundary outward into previously undeveloped desert lands. Urbanization has resulted in the removal of much of the native vegetative cover and wildlife habitat, including extensive areas of Sonoran desert scrub and riparian and xeroriparian habitats. However, a previous study (Pima County Habitat Inventory, by Dr. Wm. Shaw and others) found that more than half of their Tucson study area was natural open space (Pima County-Land 2000). There still remain washes and other areas with native vegetation within the urban core, but this is more common in the outlying areas, and channelized watercourses and washes with bank protection are the norm. Many of the areas with native vegetation within the urban core exist as ecologically isolated islands that are not connected with other natural areas and are not part of an interconnected open space system.



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Land Ownership and Land Management
in the Middle Santa Cruz Subarea

- Marana Unreserved - Private Lands
- NPS - Saguaro National Park East
- NPS - Saguaro National Park West
- NPS - Saguaro National Park West Wilderness Area
- NPS - Saguaro National Park Wilderness Area
- Oro Valley Unreserved - Private Lands
- Pima County - Open Space
- Pima County - Tucson Mountain Park
- Pima County Unreserved - Private Lands
- Pima County Unreserved - State Trust Lands
- TNC - The Nature Conservancy (easements)
- Tohono O'Odham Nation - Unreserved
- South Tucson Unreserved - Private Lands
- Tucson Open - Space
- Tucson Unreserved - Private Lands
- Tucson Unreserved - State Trust Lands
- USFS - Coronado National Forest (unreserved)
- USFS - Pusch Ridge Wilderness Area
- USFS - Rincon Mountain Wilderness Area
- USFS - Santa Catalina Research Natural Area
- Major Road or Highway

Figure 20

Landscaping and replanting associated with growth and development has historically utilized non-native, high water-use plants imported from other parts of the country. This has been due in part to people using plants materials common to their non-desert home states and a local emphasis on tourism and the "palm trees and turf" look that was marketed in the 1940s and 1950s. Many of the introduced non-native plants (e.g., Bermuda grass, fountain grass, African sumac) are invasive and have spread throughout the basin, into washes and other natural areas. Within the last 20 years there has been a growing appreciation for native and other low-water plants, the foundation for "xeri-scaping." Now all jurisdictions within the Tucson Basin have a landscape ordinance requiring this type of landscaping for subdivisions and commercial developments, for the purpose of reducing groundwater use and for aesthetics. All jurisdictions also have an ordinance requiring an evaluation of native vegetation before property development. Consideration must be given to preserving vegetation in place, and/or salvaging and transplanting vegetation that cannot be preserved. Pima County, the City of Tucson, and the Town of Oro Valley also have ordinances that set strict parameters for the protection of watercourses and riparian habitat. These ordinances, along with site-specific rezoning requirements and other ordinances work to define and establish a new aesthetic for the Tucson Basin—one in which native vegetation plays a strong role.

Much of the Tucson Basin has been developed. We are now seeing infill of many remaining vacant parcels within the urban core that have the appeal of fewer constraints on development than lands on the urban fringe, coupled with proximity to existing roads and infrastructure. Developable infill properties with infrastructure and existing zoning will continue to increase in value as their numbers dwindle. Much of the vegetation that remains on these parcels has been stressed due to a reduced water supply resulting from upstream urbanization. Current ordinances require the preservation of vegetation along the more significant watercourses, but many smaller washes are graded to accommodate homes and commercial development.

Growth and planning proposals in the southeastern portion of the valley have increased over the last several years as much of the northwestern area is either built out or tied up by designated Critical Habitat for the CFPO. An example is a recent proposal by a private company for developing 7,700 acres of land east of Davis-Monthan Air Force Base and Rita Ranch, and west of the Pantano Wash. The land, within the Tucson City limits, would first need to be purchased from the State Land Department (*Arizona Daily Star* 1999). City planning staff considers the proposal as a positive step from a planning perspective since it is in an area that has existing utilities and infrastructure. The vegetation in the area is dominated by creosote, but washes support mesquite, acacia, and xeroriparian habitat.

Development in the Catalina foothills continues as vacant lots are sold and large lots are split and built upon. A recent proposal for a shopping mall at the intersection of Campbell Avenue and Sunrise Drive has raised concerns for loss of palo verde-saguaro habitat and traffic congestion (*Arizona Daily Star* 2000). Commercial zoning has existed at this intersection since 1958, leaving the County no option of denying the proposal. The intersection's other three corners are either built or planned for commercial uses. A hotel or resort and other retail businesses are likely at two of the corners. In order to accommodate the associated future traffic, Sunrise Drive would need to be widened between Orange Grove and Swan Roads (over three miles) and nearby intersections

may require improvements as well. Potential sources of stress to biological resources include direct loss of palo verde-saguaro habitat and alteration of washes.

A similar pattern of residential development occurs in the Tucson Mountains. Plans to expand the Starr Pass Resort development, located between Anklam Road and 22nd Street, have included a development agreement between Pima County and the developer to preserve open space. Over 200 acres of land abutting the Tucson Mountain Park, combined with portions of washes that serve as wildlife corridors to the Park, will be conveyed as conditions of developing the project. (See discussion under Preserves.) Other adjacent vacant private lands will likely be developed in the near future, bringing more development to the outside edges of the Park.

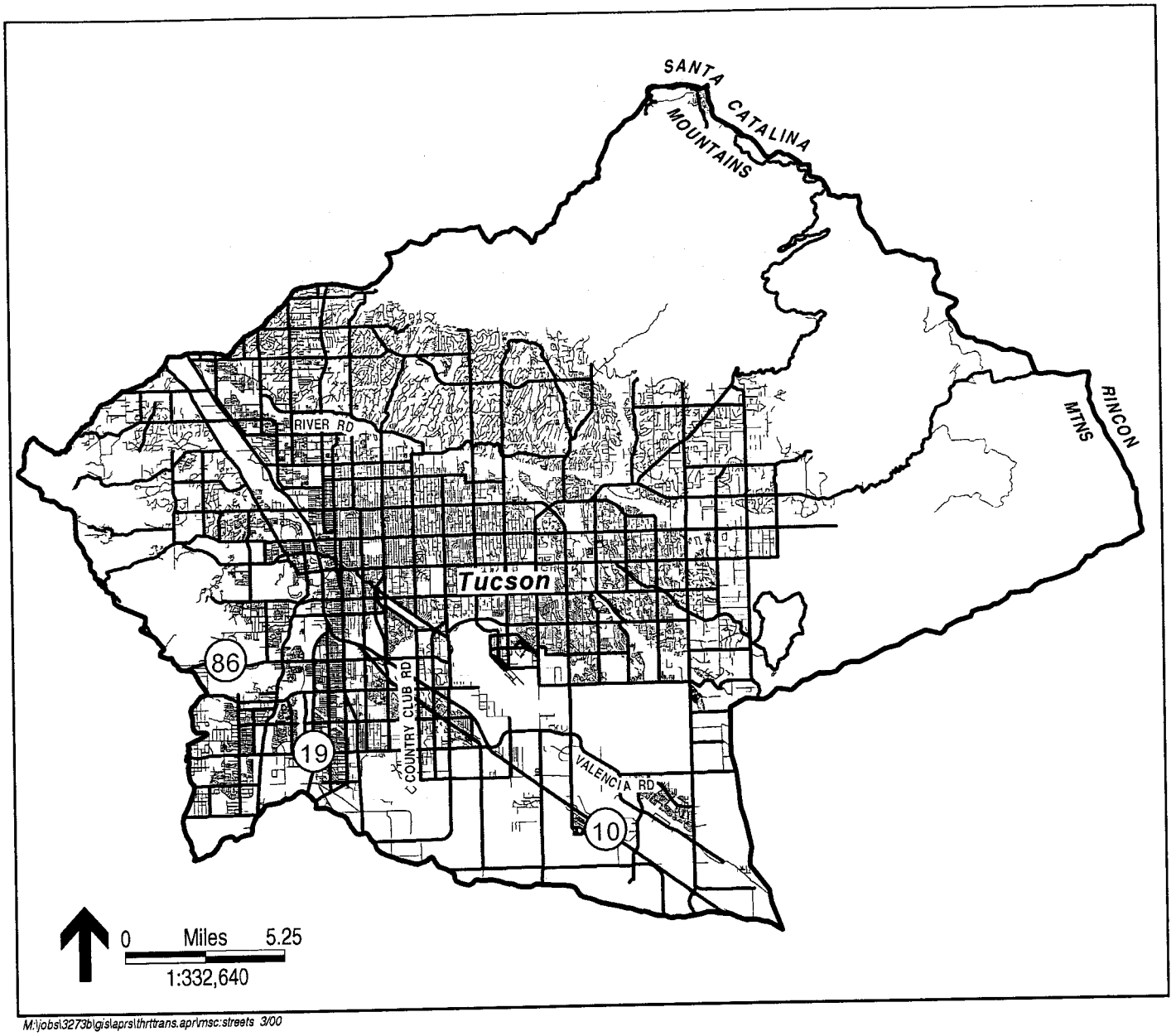
Agriculture has been a part of the Tucson basin for hundreds of years and was practiced by pre-historic people. The floodplains of the Santa Cruz and Rillito Rivers were used for cultivated agriculture in the late 1800s and early 1900s, replacing native plant communities and diverting flows. Channel down-cutting and widening of the Santa Cruz River eliminated flood farming and farmers began to rely on groundwater pumping for irrigation (Pima County-Science 2000). Historical accounts indicate that the River flowed perennially in the reach between the San Xavier Mission and downtown Tucson, and that the area even supported a population of beaver. By the late 1930s and 1940s water no longer flowed in the river, and springs near the Mission dried up. A large mesquite bosque near the Mission died due to a declining water table. Today, commercial agriculture has shifted out of the Tucson Basin, mostly northwest to Marana and Avra Valley, and most lands previously used for agriculture have been developed for urban uses.

Excavation of sand, gravel, and other aggregates is an important commercial use of the major watercourses. This has resulted in the removal of huge quantities of materials from the river floodplains. Some of the resultant pits were used as landfills, which has complicated and/or precluded water recharge opportunities. There are many active commercial excavation sites on the Santa Cruz River (north of the Mission, and at Camino del Cerro and Orange Grove Road), and on the Pantano Wash, south of 22nd Street. The demand for readily available aggregates, for building, paving, and landscape materials, has increased as growth and development have increased. Unlike the County, the City allows mining within the active channel of a watercourse. Potential impacts to biological resources include the removal and/or degradation of wash-associated vegetation, altering hydrological patterns and channel morphology, increased potential for bank collapse, channel erosion, and increased potential for downstream siltation and water quality degradation.

2. Transportation

With urban area of Tucson as the dominant land use, the Middle Santa Cruz Subarea has the highest density of highways and roads in Pima County (Figure 21). Future transportation needs will result in significant additions and modifications to the transportation network in this subarea.

The County's Long Range Transportation Plan shows the extension of Snyder Road across the Sabino Creek as a "Key Linkage." This would connect the Tanque Verde Valley to the Sabino Canyon area and northern portion of the Tucson Basin (Pima



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Road Network
in the Middle Santa Cruz Subarea

Highway or Major Road
Local Road

Figure 21

County 1986). The roadway would have a 200-foot right-of-way. This crossing has been discussed for many years, at least since the early 1960s and has received much opposition. The development of Sabino Springs Specific Plan and other subdivisions on the east side of Sabino Creek, combined with similar increased residential growth on the west side will likely make this crossing necessary in the near future, if only to address public safety and emergency response concerns. Sabino Creek has perennial flows in this area and supports a fully developed riparian gallery of cottonwood and sycamore trees. Sources of stress to biological resources associated with constructing this crossing could include loss and alteration of prime riparian habitat, siltation, interruption/disruption of stream flows, and subsequent traffic noise and vibration. A detailed biological impact mitigation plan would have to be developed before this project could be initiated.

Another feature of the Long Range Transportation Plan that has received much opposition is River Road between Country Club Road and Craycroft. At issue is the current "kinky" alignment through a rural area of local historic significance and crossing the Rillito River. The roadway, like others in the Catalina foothills and elsewhere throughout the subarea, has experienced increased traffic. Additional commercial development at Campbell Avenue, Swan Road, and Craycroft Road is adding to this. Numerous alternatives have been considered. The planned alignment will extend four lanes east of Campbell, bridge the River at Dodge, and connect with Alvernon Road. The river is bank protected in this section and little or no riparian vegetation remains to be disturbed by construction.

ADOT plans to begin construction of a three-tiered interchange at I-19 and I-10 this year. Additionally, they recently announced plans to widen I-19 between Ajo Way and Valencia Road, a three-mile segment (*Arizona Daily Star* 2000). There are no formal plans at this time to widen I-19 further south to Green Valley. However, this is a distinct possibility in the future given the rate of growth in the Upper Santa Cruz Subarea, growth of communities further south in Santa Cruz County, and the increase in commercial truck traffic resulting from NAFTA. Such a widening would require the removal of a significant amount of Sonoran desert scrub vegetation, including saguaros and mesquite. Additional loss of vegetation (wash-associated xeroriparian) would be associated with the drainage crossing improvements that would be part of the widening construction (at Santa Cruz, Airport Wash, Santa Clara Wash, Hughes Wash, and other smaller washes).

TAA has developed a Master Plan for the Tucson International Airport (TIA) that calls for the eventual construction of a third parallel air carrier runway to accommodate long-term future demand at the airport. They are currently in the process of initiating an Environmental Assessment for the acquisition of land for the new runway, planned to be northeast of the existing runway. Some of the expansion area has been previously disturbed for sand and gravel operations, and most of the undisturbed areas are dominated by creosote.

The Coronado National Forest has been working on widening and improving the Mt. Lemon Highway in stages for several years. Eventually, all portions of the roadway will be improved providing safer access to Forest lands. This provides for easier access for larger numbers of visitors every year and facilitates increased use of campgrounds, picnic areas, and other facilities. (See discussion under Preserves). Last year an

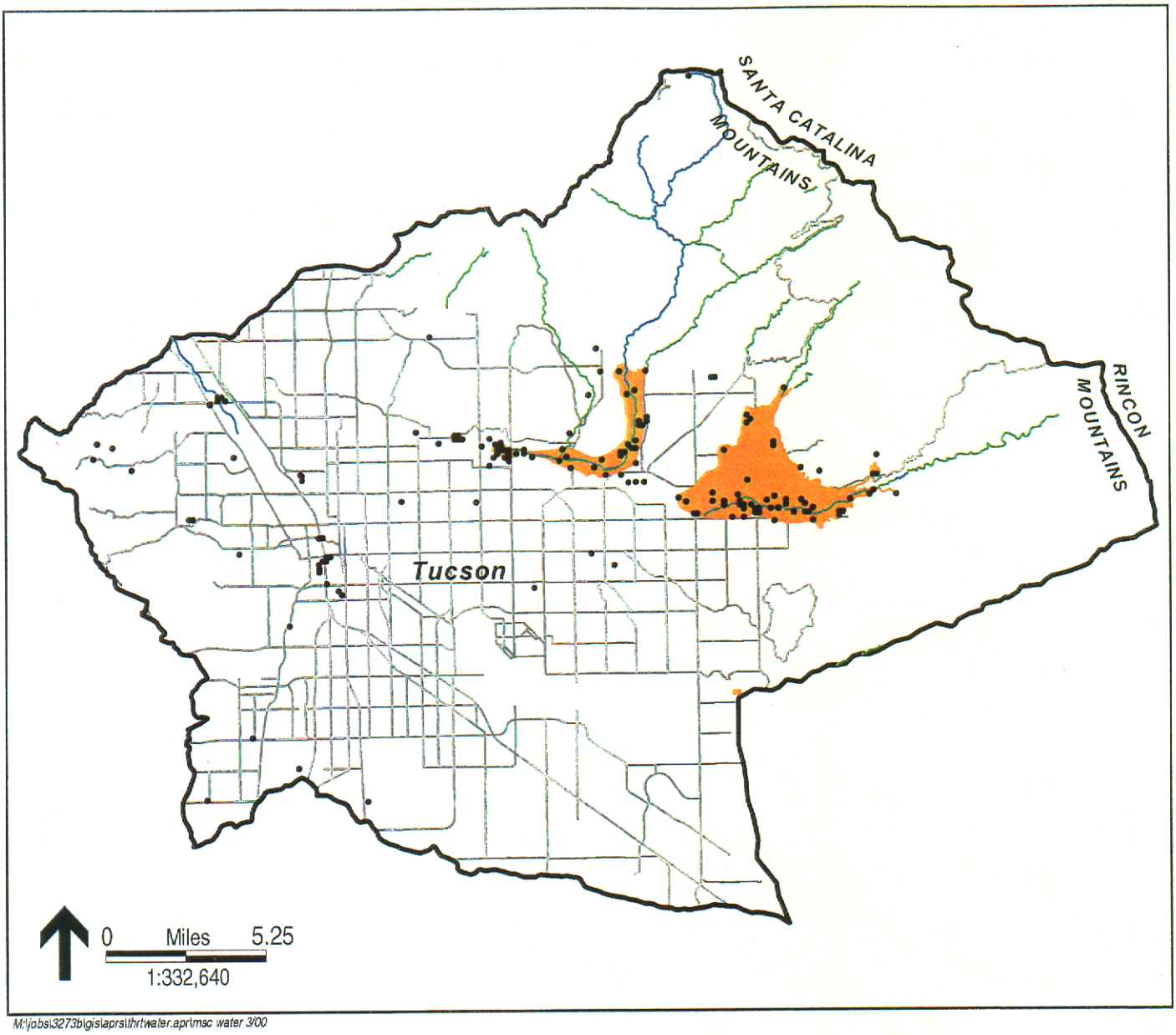
entrance fee collection station was built at Molino Basin. This has had no measurable effect in reducing visitor use volumes (USDA-USFS, McCallister, 2000).

3. Water Use

Historically, ground water from public and private wells has been the source of potable water and water for irrigation and mining. As a result of pumping to meet increasing demands, the water table has declined from 50 feet to over 200 feet within the Tucson basin (Pima County- Environmental 1999). In some central areas the depth to water table is almost 400 feet (Tellman 2000). Areas of shallow groundwater have been reduced to an area in the vicinity of Sabino Creek (including Bear Canyon Wash) downstream to the Rillito River, and an area along the Tanque Verde Wash (including Agua Caliente Wash). Stream reaches with perennial flow, riparian habitat, and wetlands have declined dramatically since the 1890s. Today, perennial stream flow in the Middle Santa Cruz Subarea is limited to upper Sabino Creek (extending up to Mt. Lemmon), Tanque Verde Creek, Romero Canyon, and the effluent-dominated portion of the Santa Cruz River (PAG 2000) (Figure 22 and Table 15).

Up at Mt. Lemmon water is drawn from springs and wells to serve area residents and businesses. The City of Tucson has water rights to 9 million gallons a year from the springs; the USFS has rights to 10 million gallons a year. Currently, annual use averages 5 million gallons. With the population growth that is anticipated in the next 50 years, this is expected to reach 12 million gallons per year (City of Tucson-Jones 2000). Towards this end, a new storage tank has been built along with a pad for a future tank. Due to dry conditions and low water reserves this winter the Mt. Lemmon Cooperative Water Company recently resorted to using a Forest Service well and spring to replenish the dwindling water supply in their storage tank (*Arizona Daily Star* 2000). Although most homes are on septic systems, there is a small wastewater treatment plan that serves some of the cabins and business. Under the requirements of a consent decree with Pima County, effluent is released into the San Pedro watershed. This is due to restrictions on releasing it into the Sabino Creek watershed (Sabino Creek has protective status). The Sierra Club filed an application with ADWR for in-stream flow rights for Sabino Creek, to benefit the plant community and wildlife, but that has not been resolved. At this time, a management plan that balances water use needs has not been developed but water use for humans continues to increase. Stressors to the biological resources of the area include a potentially declining water resource base on which a diverse assembly of mixed-conifer, riparian, and aquatic species depend.

Along with the drop in the ground water table in the Tucson Basin and the near elimination of perennial stream flow have come significant losses of riparian habitat. The once biologically rich and diverse riparian corridors of the Tucson Basin (and elsewhere across the western United States) have been significantly altered or eliminated. As a result, wildlife species have been profoundly affected. It is estimated that 60-75 percent of Arizona's resident wildlife population depends on riparian habitat during all or part of their life cycle. At least four threatened or endangered species in the subarea have been endangered by the depletion of water: desert pupfish, Gila topminnow, Huachuca water umbel, and cactus ferruginous pygmy owl (Pima County-Water 2000). Other Status 1 & 2 species directly affected by the depletion of water include the western yellow-billed cuckoo, lowland leopard frog, and Mexican garter snake. Numerous other obligate



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Surface Groundwater and Streams
in the Middle Santa Cruz Subarea

Suspected Shallow Groundwater Areas (based on well data and aerial imagery)

Well with Depth to Water less than 50 feet (ADWR Well 55-Registry and GWSI databases)

Perennial Reach

Intermittent Reach

Major Street or Highway

Figure 22

TABLE 15
STREAM CHARACTERISTIC OF THE MIDDLE SANTA CRUZ SUBAREA

Stream Name	Miles of Perennial Flow	Miles of Intermittent Flow	Acres of Hydro-mesoriparian Habitat	Acres of Class A Riparian Habitat	Acres of Shallow Groundwater	Pygmy-Owl Habitat	Fish Species	Leopard Frogs
Sabino Canyon	15	3.4	839	N/A	1753	No	3a	N/A
Romero Canyon	0.4	4.8	186	N/A	N/A	No	1c	N/A
Ventana Canyon	0	9.3	N/A	N/A	N/A	No	N/A	N/A
Pima Canyon	0	1.8	N/A	N/A	N/A	No	N/A	N/A
Finger Rock Canyon	0	2.8	N/A	N/A	N/A	No	N/A	N/A
Eash Fork Sabino Canyon	0	1.3	N/A	N/A	N/A	No	N/A	N/A
Bear Canyon	0	12.3	N/A	N/A	N/A	No	N/A	N/A
West Fork Sabino Creek	0	2.4	N/A	N/A	N/A	No	N/A	N/A
Rose Canyon Creek	0	0.4	N/A	N/A	N/A	No	N/A	N/A
Molino Canyon	0	5.2	N/A	N/A	N/A	No	N/A	N/A
Rillito Creek	0	0	177	0	177	No	0	N/A
Tanque Verde Creek	0.5	17.2	1115	N/A	5528	No	1	N/A
Agua Caliente Canyon	0	0	1011		2863	No	1	N/A
Soldier Canyon	0	2.9	N/A	N/A	N/A	No	N/A	N/A
Pantano Wash	0	0	N/A	N/A	30	No	0	N/A
Santa Cruz River	6.8	15.7	3500	N/A	N/A	Yes	N/A	N/A

N/A = not applicable.

riparian and aquatic habitat species are also affected; many, including the beaver, have been extirpated.

After the rejection of Proposition 200 last November, Tucson Water has been given authority once again to include CAP water in the potable water distribution system. This legal change will allow Tucson Water to reduce pumping and eventually close a number of wells in the Tucson Basin. Over-pumping of those central wells has caused subsidence of four inches in the past five years. A new pipeline is being built to carry recharged CAP water from Avra Valley to the Hayden-Udall treatment plant and from there into the potable water distribution system. The alignment will closely parallel the CAP canal but will not cross the CAP Mitigation Corridor (USDI-BOR 2000). This project has been on hold since 1995 (*Inside Tucson Business* 2000).

The City Council and the Board of Supervisors reached an agreement this February that will allow increased use of treated wastewater for recharge and riparian restoration projects throughout the basin (*Arizona Daily Star* 2000). The City will continue to recharge at several locations along the Santa Cruz River, and the County will be able to buy reclaimed water at a reduced rate. The County will also gain control of effluent produced at eight small treatment plants in outlying areas (Green Valley, Mt. Lemon, Rillito, and Marana). Effluent will also be used to water large public turf areas. This agreement will thereby reduce the amount of groundwater currently being pumped to irrigate parks, ball field, and golf courses, by allowing increased use of reclaimed water instead.

Both the City and the County have wetland and/or riparian restoration projects underway or built. The City's constructed Sweetwater Wetlands at the County's Roger Road Wastewater Treatment Plan received much attention last year when two forms of potentially deadly encephalitis virus were found in mosquitoes there. Tucson Water has cleared out cattails and bulrushes from the settling basins and has a regular mosquito abatement program there. Last month they initiated a burning program which will burn almost five acres of mosquito habitat this spring. Two settling ponds had been drained and allowed to dry before the initial burn. This has raised concerns about the design and management of wetlands, not only for human health but for that of wildlife as well. The Sweetwater Wetlands site has become a popular birding spot, attracting numerous species. Encephalitis can be spread among birds, killing out populations.

Downstream from the Roger and Ina Road Treatment Plants, there is effluent-dominated perennial flow in the Santa Cruz. The longitudinal extent of flow varies seasonally but can extend up to 25 miles to the north, beyond the County line. This water source (approximately 50,000 acre-feet per year) supports a variety of plant communities and a diverse population of birds and other wildlife species. A recent vegetation mapping study identified that over half of the total vegetation cover is hydromesic (dependent on above-normal soil conditions). Over 2,000 acres of riparian woodland was mapped. It is represented by Goodding willow, saltcedar, and velvet mesquite (Southwest 2000).

Much of the effluent distribution system has been constructed to deliver effluent to multiple points along the Rillito and Santa Cruz Rivers, and elsewhere within the Tucson Basin (Pima County-Water 1999). Increased utilization of effluent in other areas of the basin, as recently agreed upon for riparian restoration and turf irrigation, could decrease

the amount available for discharging into the Santa Cruz. Reduced flows here could directly impact and reduce the amount of effluent-dependent riparian habitat in this area.

Many CAP recharge sites are proposed for the Middle Santa Cruz Subarea. The presence of landfill sites along or in close proximity of watercourses is a limiting factor. Potential sites have been identified along the Tanque Verde Creek/Pantano Wash/Rillito River confluence, the Pantano Wash, and at the confluence of the Rillito and Santa Cruz Rivers (ADWR 1998). The Tanque Verde area, an area of critical groundwater decline, still has areas where shallow groundwater supports riparian habitat. Recharge here, and reduced groundwater pumping, could maintain and/or restore the cottonwood willow community.

A series of riparian restoration projects are planned by the County. Three of these are pursued in partnership with the U.S. Army Corps of Engineers: Paseo de las Iglesias (seven-mile length along the Santa Cruz), the Rillito River Habitat Restoration, and the Ajo Detention Basin. They combine flood control efforts, environmental enhancement, reuse of existing gravel pits, and recreation. Now that Pima County has a source of renewable water supply, effluent, these projects have a water budget on which to plan. It is estimated that if 2,000 acre-feet of water were available for vegetation, it would support approximately 500 acres of mixed cotton-willow forest and mesquite woodland (Pima County-Environmental 1999). An acreage of this size would represent one of the most significant riparian restorations in the southwest. For comparison, projects that secure endorsement by the USFWS will be eligible for a portion of a 5,000 acre-foot pool for each of the first five years of conservation. Every year after that they may draw from a 10,000 acre-foot pool (*Arizona Daily Star*-City 2000).

At least five threatened or endangered species stand to benefit directly from efforts to restore portions of the Santa Cruz River and tributaries: desert pupfish, Gila topminnow, Huachuca water umbel, cactus ferruginous pygmy owl, and the southwestern willow flycatcher. Other Status 1 & 2 species that would benefit from riparian restoration projects are the western yellow-billed cuckoo, Gila chub, desert sucker, Sonoran sucker, long-fin dace, lowland leopard frog, and Mexican garter snake. Numerous other obligate riparian and aquatic habitat species would also benefit. Opportunities also exist to establish native grasslands and saltbush-wolfberry scrub which were once common along the floodplain prior to agricultural development.

The availability of CAP and effluent water presents opportunities for re-establishing plant communities and wildlife species that were once prevalent along our watercourses. Directly affecting these and other uses of CAP water, and potentially affecting the use of effluent is the USFWS' recently issued jeopardy decision in their recent draft Biological Opinion of the impacts of Santa Cruz River Basin recharge projects on the endangered Gila topminnow. The BOR and the USFWS are continuing to work through the Section 7 consultation process. As part of their Biological Assessment, the BOR will be constructing two fish barriers along the Santa Cruz River and will implement other measures to offset potential impacts to the endangered fish which exists upstream between Tubac and Nogales. It is unclear to what extent the ongoing Section 7 consultation will impact CAP delivery and recharge projects within the Middle Santa Cruz Subarea and elsewhere throughout the Santa Cruz basin.

There are other concerns regarding riparian restoration activities. Because they are conceptually planned to have a recreation element or use, conflicts between human use and environmental restoration are inherent. Impacts associated with water-based recreation can include disturbance of wildlife to the point that areas are no longer viable habitat for some species. The potential for the introduction and invasive species is high, particularly in areas like the Tucson Basin that has a large human population. Any projects that add water to our desert environment open the possibility of the introduction and spread of invasive plants such as saltceder, Russian thistle, Bermuda, and other grasses. Problems with mosquitoes and encephalitis have occurred at the Sweetwater wetlands, as discussed above. Aquatic habitats are degraded by the release of sport fish, live bait, aquarium fish, and other amphibians and reptiles. Competition and predation by non-native species has contributed to the decline of native species such as the Gila topminnow, lowland leopard frog, and Mexican garter snake. Bullfrogs, crayfish, and predatory fish such as bass are a chronic problem to native aquatic species throughout the state. Existing or introduced native aquatic species usually cannot compete with these non-native species. Further, the non-native species eat insects, worms, and other food sources that would otherwise be available to native species. An example of this are crayfish and bullfrogs. An introduced species, crayfish have spread and infested Sabino Creek, affecting four native fish: the Gila chub, the speckled dace, the Sonora sucker, and the desert sucker. New rules proposed by Arizona Game and Fish Department (AG&FD) would ban the sale and transport of crayfish (*Arizona Daily Star* 2000). Bullfrogs in the Creek prey on the Mexican garter snake.

4. Recreation

Recreation opportunities with the Middle Santa Cruz Subarea are met by urban parks as well as by the public lands that surround the basin. The Tucson Mountain Park, Coronado National Forest, and Saguaro National Park East all receive increasing use with some seasonal variability. Hiking trails are found within all these areas and frequently follow watercourses into upper elevations. Certain areas, such as Sabino Canyon, Mt. Lemmon, and Redington Pass are used intensively and have problems with over use and indiscriminate/irresponsible use. The resource base in Sabino Canyon became so degraded that the Forest Service disallowed vehicular access except by the concession tram. Redington Pass is an area of dispersed use that receives intense and indiscriminate use by off-road vehicles. The Forest Service has applied for State grant money to increase patrol and management of this area and close certain roads in more sensitive habitat areas. Funds generated by the recently initiated entrance fees at the Molino Basin area have enabled the Forest Service to improve maintenance and patrolling of the Mt. Lemmon area. This has helped to curtail human use impacts to biological resources.

Besides the impacts of habitat loss and degradation, recreation and human over use frequently results in the introduction and spread of non-native and invasive species- both plant and wildlife. Although not specifically tied to recreation use, non-native grasses are a continuing problem in Saguaro National Park and have altered the fire regime there. Lower elevation habitats of cacti and desert scrub are not fire resistant and are at risk when non-native grasses increase wildfire incidence. The presence of other introduced species, including feral cats, dogs, and other domestic animals, are an ongoing problem that increases as human use increase and as development occurs up to the boundaries of preserves.

The Pusch Ridge Wilderness has been a victim to human overuse. It receives so much use by hikers that it is questionable whether the potential for a "wilderness experience" still exists here (USFS, Senn, 2000). A small number of bighorn sheep occupy the Pusch Ridge Wilderness. Their numbers have declined over the years and wildlife biologists studying the situation believe this may be in part due to increased numbers of people using the wilderness trails (AG&FD 2000).

B. Biological Resources

1. Vegetation and Land Cover

The Middle Santa Cruz Subarea contains the city of Tucson and is heavily urbanized. To the north and east of Tucson lie the Santa Catalina and Rincon Mountains. These areas support pine, oak, and oak-pine forest as well as manzanita and mixed-evergreen sclerophyll habitats. At lower elevations near the city habitats include mixed grass scrub, palo verde-mixed cacti, and creosote-bursage. Drainages descending from the mountains and cutting through the city of Tucson support mixed scrub and cordgrass habitats (Figure 23).

2. Critical Habitat

Critical Habitat, Map Unit 2, for the CFPO has been designated for much of the Tucson Mountains and foothills. This Map Unit connects habitat on the Tohono O'odham Indian Nation, Schuk Toak District, to habitat in Saguaro National Park West and Pima County's Tucson Mountain Park. Ownership in this area is Pima County, State Trust, BLM, BOR, and some private lands. The Unit includes Sonoran desert scrub with high densities of ironwood and saguaro cacti, mesquite bosques interspersed by washes, and some retired agricultural lands in Avra Valley. Activities that pose a threat to Critical Habitat for the CFPO include removing or destroying vegetation; water diversion, impoundment or groundwater pumping that alters water quality or quantity to an extent that riparian vegetation is significantly affected; and recreational activities that appreciably degrade vegetation (USDI-USFWS 1999).

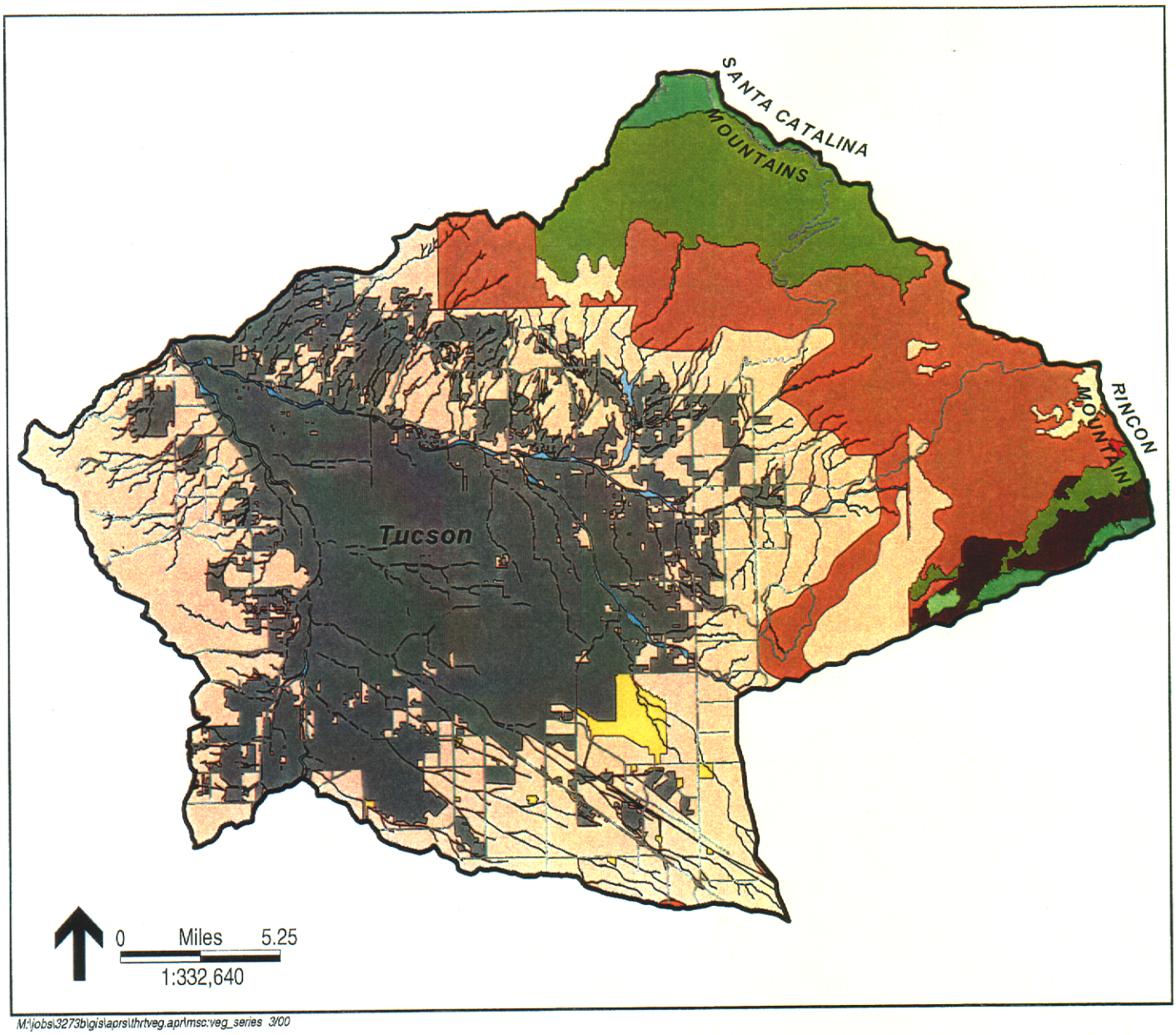
3. Species at Risk

A total of 19 Status 1 and Status 2 Vulnerable Species occur within the Middle Santa Cruz Subarea (Table 16). Many other species not on this list, such as the beaver, have been extirpated, in large part due to the decline of surface water and lowering of the groundwater table.

C. Existing and Proposed Preserve Areas

1. Tucson Mountain Park and Tumamoc Hill

The Open Space Acquisition Master Plan has targeted a number of parcels on the north and east sides of the Park for acquisition. This area is experiencing increased development pressures, and has been developing by lot splitting, regulated subdivisions, and the Star Pass Resort. These parcels are considered to have significant resource values as CFPO habitat and as extensions of the park boundaries and as biological linkages to Tumamoc Hill. As described earlier, over 200 acres were conveyed by the



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Vegetation and Land Cover
in the Middle Santa Cruz Subarea

Vegetation Communities (BLP Classification)

- 122.61 Douglas-Fir-Mixed-Conifer
- 122.62 Pine
- 123.31 Encinal (Oak)
- 123.32 Oak-Pine
- 133.32 Manzanita
- 133.36 Mixed-Evergreen Sclerophyll
- 143.15 Mixed Grass-Scrub
- 154.11 Creosote-Bursage
- 154.12 Paloverde-Mixed Cacti
- 223.22 Mixed Broadleaf
- 224.53 Cottonwood-Willow
- 234.71 Mixed Scrub
- 243.53 Cordgrass

Other Land Cover Types

- 999.1 Agriculture
- 999.2 Urban
- Major Road or Highway

Figure 23

TABLE 16
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE MIDDLE SANTA CRUZ SUBAREA

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Agave schottii var. *treleasei* Trelease agave	1	S1	FSC FSS HS	Narrow endemic. Direct impacts by road or recreational facility construction may impact local populations.	Oro Valley quad, Pusch Ridge, 1994 USFS Tucson North quad, Finger Rock Canyon, 1987 USFS Sabino Canyon quad, Sabino Canyon 1987 USFS; Esperero Canyon, 1988 USFS. Agua Caliente Hill quad, Molino Canyon, 1976 USFS.	Occurs in isolated, relatively secure locations. However, direct site impacts should be avoided
Glaucidium brasilianum cactorum Cactus ferruginous pygmy-owl	1	S1	FE FSS WSC	Habitat destruction and alteration, historic and present. Groundwater pumping, channelization, urbanization, historic livestock grazing? Farming and agricultural uses? Wood cutting. Disturbance by bird watchers. Small population subject to stochastic events. Possibility of disease, including emerging diseases, and loss of viable food supply as a result of drought and/or climate change.	Avra quad., 1998 Private Jaynes quad 4 sites, 1995-1999 all private. Tucson North quad. 1970's private. Sabino Canyon quad. 1951, 1976 USFS, 1953 private. Agua Caliente Hill quad, 1980's USFS. Tanque Verde Peak quad 1994 private; 1975 private; 1995 NPS Rincon Peak quad 1999 USFS	A small portion of this subarea, in the Cat Mountain quad, is included in Critical Habitat

TABLE 16
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE MIDDLE SANTA CRUZ SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Argia sabino Sabino canyon damselfly or Sabino dancer	1	S?	FSC FSS	Very narrow distribution. Predation by introduced and native fish and introduced crayfish. Drought. Habitat loss through groundwater use and upstream diversions.	Sabino Canyon quad. Upper Sabino Canyon, 1988 USFS	Also known from Molino Canyon USFS and (?) Jalisco, Mexico.
Coryphantha scheeri var. *robustispina* Pima pineapple cactus	1	S2	FE HS	Narrow distribution, much of which is on private and Indian lands and much of which has been developed. Development, off-road vehicle traffic.	60 records for Pima Co. 15 for this subarea. Cat Mountain quad: 3: BLM, BOR, Private. Tucson quad: 1: City of Tucson. San Xavier Mission, 1, 1993 private; Tucson SW, 2, 1992 private; Tucson SE, 2, 1998, 1999 private and State; Vail: 6: 2 private, 3 BOR, 1 State	May not be a valid variety using today's standards.
Cyprinodon macularius macularius Desert pupfish	1	S1	FE WSC	Habitat loss through groundwater pumping and watershed changes. Competition and predation by introduced species. Dewatering of habitats, stream impoundment, channelization, domestic livestock grazing, timber harvesting, mining, road construction, polluting, and stocking non-natives.	Cat Mountain quad. 1998 private	There are no natural populations of this subspecies remaining in Arizona. A reintroduced population exists at Cold Springs in Graham County,. There are also several refugia populations in private ponds and aquariums.

TABLE 16
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE MIDDLE SANTA CRUZ SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Gila intermedia Gila chub	1	S2	FC FSS WSC	Non-native species, competition and predation. Habitat loss by groundwater pumping and channelization. Flooding. Drought. Dredging. Poor water quality. Livestock grazing (trampling by cattle, watershed changes).	Sabino Canyon quad, Sabino Canyon 1998 USFS	Probably a viable population in Sabino Creek. In 1999 an attempt was made to rid the creek of non-native fish.
Muhlenbergia dubioides Box canyon muhly	1	S1	FSS	Very narrow distribution.	Sabino Canyon quad, Lower Bear Canyon 1961, Sabino Canyon 1948 USFS	
Muhlenbergia xerophila Weeping muhly	1	S1	FSS	Very narrow distribution.	Agua Caliente Hill quad, Molino Canyon 1945 USFS	
Poeciliopsis occidentalis occidentalis Gila Topminnow	1	S2	FE FSS WSC	Non-native species, competition and predation. Habitat loss by groundwater pumping and channelization. Flooding. Drought. Dredging. Poor water quality. Livestock grazing (trampling by cattle, watershed changes).	Agua Caliente Hill quad, Redington Road, Yellowstone Tank 1985 USFS. Piety Hill quad, The Lake, NNW of Redington Road 1983 USFS. Cat Mountain quad 1999 Private	Yellowstone Tank: Fish were present in 1987, but tank was dry in and there were no fish in 1993. The Lake fish were stocked in 1982, last recorded in 1984. Repeated surveys found no fish. In February 2000 The Lake was dry.
Accipiter gentilis apache	2	S3	F-petitioned,	Habitat destruction by logging and forest clearing. Possibly	Mt. Lemmon quad, Samaniego Ridge trail	Petitioned for listing as endangered, 90-day finding

TABLE 16
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE MIDDLE SANTA CRUZ SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Apache northern goshawk			FSS WSC	consequences of fire suppression leading to major timber fires. Organized recreational and sports use. Global climate change. Disturbance by recreationists, cattle grazing, mining, road building and other forest disturbances are site specific threats alleged by Center for Biodiversity.	1993 USFS. Mount Bigelow quad, several records1993-1996 USFS.	determined that listing was not warranted 6/29/98. Suit filed 2/25/99 to list as endangered.
Allium gooddingii Goodding onion	2	S3S4	FSS ANP-HS	Livestock grazing, logging/timber management, organized recreational and sports use	Mt. Lemmon quad, several sites, 1986-1993 USFS	Only known sites in Pima Co.
Coccyzus americanus occidentalis Western yellow-billed cuckoo	2	S3	F-petitioned FSS WSC	Habitat destruction and alteration, historic and present. Groundwater pumping, channelization, urbanization, historic livestock grazing? Farming and agricultural uses? Wood cutting. Reduction of acreage in pecan farming.	Tanque Verde Peak quad, Tanque Verde Wash, 1985 Private	Positive 90-day finding on petition, 2/17/00
Echinomastus erectocentrus var. *erectocentrus* Needle-spined pineapple cactus	2	S3	FSC S SR	Very narrow distribution. Land development and off-road vehicles might impact this species.	Tanque Verde Peak quad Rocking K, 1994 Private Vail quad, 1966, 1981 Private Vail quad, 1966, 1981 Private	

TABLE 16
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE MIDDLE SANTA CRUZ SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Leptonycteris curasoae yerbabuenae Lesser long-nosed bat	2	S2	FE WSC	Alleged to be related to reduction of numbers of maternity colonies and decline in size of remaining maternity colonies in Arizona and Sonora due to exclusion and disturbance. Additionally, thought to be negatively affected by large reductions in acreage of native agaves over large areas of northern Mexico due to excessive harvesting for local manufacture of mescal and tequila. Excessive browsing by livestock on newly emergent flower stalks of *Agaves* has also been suggested as possibly decreasing foraging opportunities and thus contributing to declines among these bats.	Mt. Lemmon quad, Red Ridge 1986 USFS. Tanque Verde Peak quad, Box Canyon Crevice 1993 NPS Vail quad. Rincon Mountains 1968, 1988 Private	There was formerly a maternity roost in Colossal Cave. With much effort, bats were excluded and driven away. They may return if the cave is managed properly for them. The Colossal Cave Mountain Park website lists this species as present, not in the cave but roosting in cliffs.
Plecotus townsendii pallescens Pale Townsend's big-eared bat	2	S3S4	FSC	Disturbance of roosts by recreationists and renewed mining.	Vail quad, Rincon Valley, 1986 Private	This species is probably more common in Pima Co. than records indicate. Reported from Colossal Cave, which it uses as a maternity roost.
Rana yavapaiensis Lowland leopard frog	2	S4	SC FSS WSC	Groundwater pumping, disease, water pollution, invasive non-native species, ozone loss, unknown causes of population declines	Oro Valley quad, Canada del Oro Wash 1991,USFS 1994 Private Mt. Lemmon quad, Upper Sabino Canyon 1982	Introduced bullfrogs are established in Sabino Canyon. One Piety Hill site (The Lake) was dry and flood damaged in

TABLE 16
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE MIDDLE SANTA CRUZ SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
					USFS. Sabino Canyon quad, Sabino Canyon 1979 USFS. Piety Hill quad, 2 sites, 1979, 1993 USFS.	February 2000.
Strix occidentalis lucida Mexican spotted owl	2	S3S4	FT WSC FSS	Habitat destruction by logging. Possibly consequences of fire suppression leading to major timber fires. Organized recreational and sports use and recreational development. Global climate change.	Mt. Lemmon quad, 8 records, 1990-1997 all USFS. Mount Bigelow quad, 8 records, 1987-1998 all USFS. Sabino Canyon quad, Sabino Canyon 1991 USFS. Agua Caliente Hill quad, Bear Canyon, 1989 USFS.	Critical Habitat for this species had been designated in 1995, but rescinded in 1998. Most, if not all, of it was in this subarea. On 3/14/00 a federal judge ordered FWS to determine critical habitat by 1/15/01.
Thamnophis eques megalops Mexican garter snake	2	S2S3	FSC FSS WSC	Predation by bullfrogs. Aquatic and riparian habitat degradation and destruction.	Sabino Canyon quad, Sabino Canyon 1952 Private, Fort Lowell area 1960 Private.	

TABLE 16
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE MIDDLE SANTA CRUZ SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Tumamoca macdougalii Tumamoc globeberry	2	S3	FSS SR	Threats include urbanization, farming, overgrazing, recreation, habitat conversion, javelina (eating tubers), off-road vehicle use, pesticides.	Avra quad, 6 sites, 1984-1990, Private, BLM, NPS, State. Jaynes quad, 1984 Private. Sabino Canyon quad, Sabino Canyon, 1988 USFS. Cat Mountain quad, 13 sites, 1984-1988 Private, BLM, State. Tucson quad, 1986 Private. Tucson East quad, 1987 Private. San Xavier Mission quad, 2 sites, 1988 private.	This species was formerly listed as endangered, but was delisted because it was found to be more common than thought at the time of listing.

Quads: Oro Valley, Mt. Lemmon, Mt. Bigelow, Avra, Jaynes, Tucson North, Sabino Canyon, Agua Caliente Hill, Piety Hill, Cat Mountain, Tucson, Tucson East, Tanque Verde Peak, San Xavier Mission, Tucson SW, Tucson SE, Vail

Star Pass Resort developers. As part of this, important wildlife corridors between the Park and Tumamoc Hill were set aside for preservation (Pima County-Open Space 2000). Tumamoc Hill is the oldest scientific desert research area in the world that has remained free of domestic livestock (Pima County-Science 1999). It is surrounded by urban growth. The corridors preserved by Starr Pass will provide critical linkages to the Park. Pima County is working on two Arizona Preserve Initiative applications affecting 420 acres of State Land in the area, including Tumamoc Hill. If the proposed parcels are not acquired they will surely be developed in the near future, bringing the impacts of urbanization to the very edge of the Park.

2. Mt. Lemmon Highway Base

Sixty acres of private property are proposed for acquisition on the west side of the Catalina Highway, abutting the Pusch Ridge Wilderness. Their value is in buffering the wilderness boundary and protecting upland palo verde-saguaro habitat of the Catalina foothills.

3. Agua Caliente Creek

Three private parcels totaling 150 acres are proposed for acquisition along the upper reach of Agua Caliente Creek, abutting the Coronado National Forest boundary. As an alternative to outright purchase of one of the parcels, the most ecologically critical portion may be sought. Their value is related to the extraordinary riparian corridor leading from the Forest lands. Agua Caliente is the most significant watercourse in the northeast portion of the Tucson Basin and drains into the Tanque Verde Creek. Both watercourses have been identified as areas of shallow groundwater (PAG 2000).

4. Sabino Canyon

This target acquisition area includes approximately 450 acres of private properties that would protect the confluence of Sabino and Bear Creek and the associated riparian and upland habitat. It extends north from Snyder Road (the possible location for a future crossing of Sabino Creek) to the Forest boundary. Sabino Creek has perennial flows in this area and supports a fully developed riparian gallery of cottonwood and sycamore trees. Upland vegetation is palo verde-saguaro habitat. Conservation easements may serve as an alternative to acquisition. If not protected by some method, the area could accommodate over 90 homes under current zoning.

5. Tanque Verde Creek

Two properties totaling 460 acres along Tanque Verde Creek have been identified for protection, either by acquisition or conservation easements. The parcels contain strong riparian values and are perhaps the most densely vegetated undeveloped parcels remaining along Tanque Verde Creek. Both properties are subject to floodplain regulations, setbacks, and restrictive riparian protection compliance so the regulatory constraints may provide an effective alternative to acquisition (Pima County-Acquisition 2000).

D. Summary of Potential Stressors to Biological Resources

Primary stressors to biological resources within the Middle Santa Cruz Subarea include habitat loss, alteration and degradation; habitat fragmentation; human use and overuse; a decline in ground water levels; decline in stream surface flows; competition and predation by invasive species; and disease. The current ownership and management pattern within the Middle Santa Cruz Subarea is dominated by the Tucson urbanized area, which covers more than half of the subarea (Figure 24). Significant areas of status 1 land occur to the northeast, interspersed with category 3b lands.

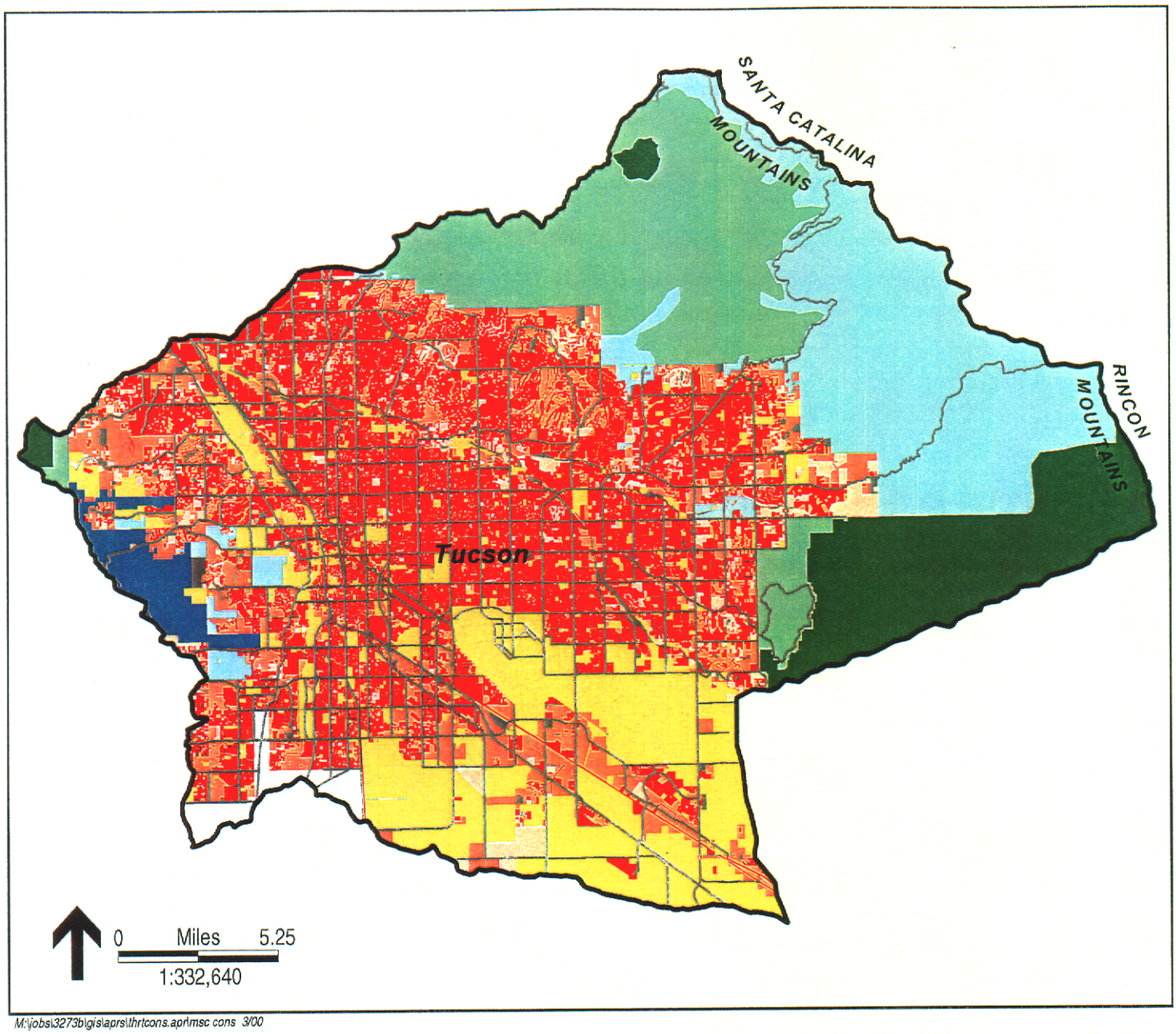
Habitats most at risk include areas of shallow groundwater, stream reaches with perennial flows, stands of mixed riparian and xeroriparian woodlands associated with the Santa Cruz River and its tributaries, and palo verde mixed scrub associations in uplands. Aquatic habitats, both existing and those that are created in the future as part of the planned riparian restoration projects, are or will be at risk from competition and predation by non-native and invasive species.

Activities contributing to biological stress are summarized on Table 17. These include aquifer overdraft due to pumping for urban use and agriculture, urbanization of the Tucson Basin, unregulated development in outlying areas, construction of roadways and utility corridors, wash channelization, diversion of stream flows, aggregate mining of watercourses, disease associated with mosquito populations, and increasing recreational use of open space areas. Groundwater pumping in remaining areas of shallow ground water is of concern, especially in the Tanque Verde area and in the Sabino Creek watershed.

Private lands adjacent to Tucson Mt. Park and Coronado National Forest are under increasing development pressure and certain key parcels identified by the Open Space Master Plan are of particular concern due to their high biological resource values. Some have exceptional riparian habitat that could be compromised if not brought under formal protection strategies. Other parcels adjacent to Tucson Mt. Park are either within or near Map Unit 2 of Critical Habitat designation for the CFPO.

Recent voter approval to include treated CAP water for potable use will be a positive step in decreasing reliance on groundwater pumping and will eventually allow some wells within the Tucson Basin to be closed. Recent agreement between Pima County and the City of Tucson will allow the County to utilize greater amounts of effluent for riparian restoration and recharge and by making it more affordable, will work towards replacing the use of ground water for golf courses and other turf areas.

The recent draft jeopardy decision by the USFWS regarding the impacts of Santa Cruz River Basin CAP recharge projects on the endangered Gila topminnow could have a profound effect on uses of CAP water in the Tucson Basin, and could also affect the use of effluent. It is unclear to what extent the ongoing Section 7 consultation will impact projects within the Middle Santa Cruz Subarea and elsewhere throughout the Santa Cruz Basin.



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Level of Threat Represented by Conservation Status
in the Middle Santa Cruz Subarea

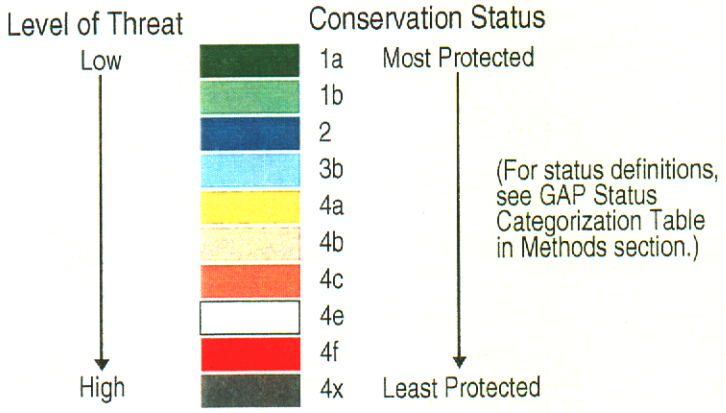


Figure 24

TABLE 17
LAND USE ACTIVITIES WITHIN LAND OWNERSHIP/MANAGEMENT CATEGORIES OF THE MIDDLE SANTA CRUZ SUBAREA

Ownership or Management Category	Land Uses and Activities											
	Conversion of Vegetative Cover	Conversion of Ranches	Conversion of Agricultural Lands	Competition/Predation by Invasive Species	Lot-Splitting & Urbanization	Groundwater Pumping	Water Diversion & Impoundments	Recreational Uses	Mining	Roadways	Livestock Grazing	Removal of Plants
Coronado National Forest- unreserved (49,524 acres)	x	-	-	x	-	x	x	x	x	x	x	x
Pusch Ridge- Wilderness (41,635 acres)	-	-	-	x	-	-	*	x	✪	x	x	✪
Rincon Mountain Wilderness (4,970 acres)												
Santa Catalina RNA (881 acres)												
Saguaro National Park East (4,556 acres)												
Saguaro National Park West (698 acres)												
Saguaro National Park West Wilderness (796 acres)												
Saguaro National Park Wilderness (22,056 acres)	-	-	-	x	-	-	*	x	✪	x	✪	✪
Tucson Mountain Park (6,465 acres)	x	-	-	x	-	x	x	x	✪	x	✪	✪
TNC Easements (69 acres)												
Tohono O'Odham Nation Unreserved (3,856 acres)												
Tucson Open Space (1,097 acres)												
Pima County Open Space (2,808 acres)												

TABLE 17
LAND USE ACTIVITIES WITHIN LAND OWNERSHIP/MANAGEMENT CATEGORIES OF THE MIDDLE SANTA CRUZ SUBAREA
(continued)

Ownership or Management Category	Land Uses and Activities											
	Conversion of Vegetative Cover	Conversion of Ranches	Conversion of Agricultural Lands	Competition/Predation by Invasive Species	Lot-Splitting & Urbanization	Groundwater Pumping	Water Diversion & Impoundments	Recreational Uses	Mining	Roadways	Livestock Grazing	Removal of Plants
Pima County Unreserved – State Lands (2,754 acres)												
Tucson Unreserved - State Land (16,585 acres)	x	*	x	x	*	x	x	x	x	x	x	x
South Tucson Unreserved – Private Lands (627 acres)												
Pima County Unreserved – Private Lands (102,764 acres)												
Marana Unresedrved – Private Lands (868 acres)												
Tucson Unreserved – Private Lands (98.796 acres)	x	x	x	x	x	x	x	x	x	x	x	x

x = occurs
- = does not occur
* = potential to occur
✪ = historic but not present occurrence

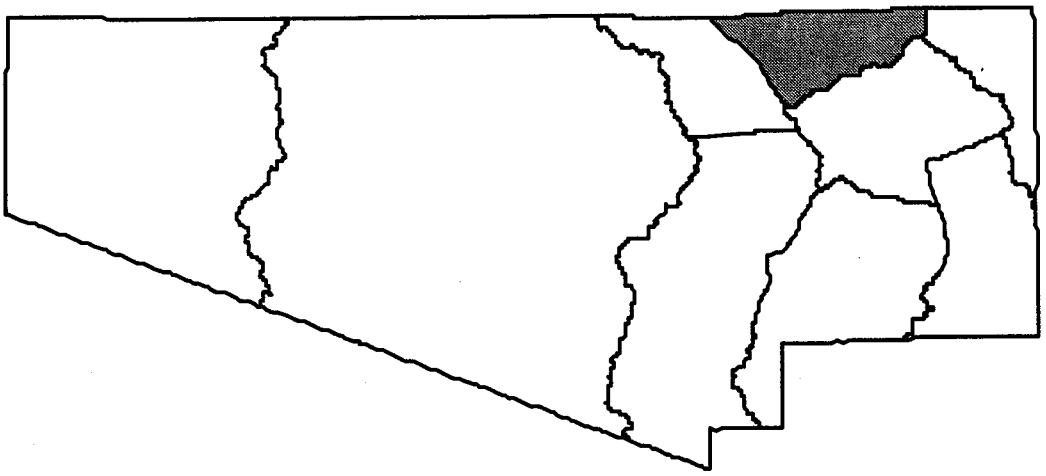
Indiscriminate/irresponsible use of public lands has resulted in habitat loss and degradation. The Redington Pass area is one area in particular where the dispersed intense use has resulted in numerous wildcat road and trails used by off-road recreationalists. Other public lands in the subarea and throughout the County have problems with invasive species, roadkill, and wildlife disturbance.

Tortolita Fan

Sub Area 5

VII. Tortolita Fan (Subarea 5)

The Tortolita Fan Subarea includes all the watersheds that drain the Tortolitas, as well as the communities of Tortolita, Catalina, Oro Valley, and portions of Marana east of the Santa Cruz River (Figure 25). It encompasses the far western portion of the Catalina Mountains, the southern portion of the Tortolita Mountains and the alluvial fan, and is largely contained to the east and north by federally and state-owned or protected mountain preserves.



Tortolita Fan Subarea Location in Pima County
Figure 25

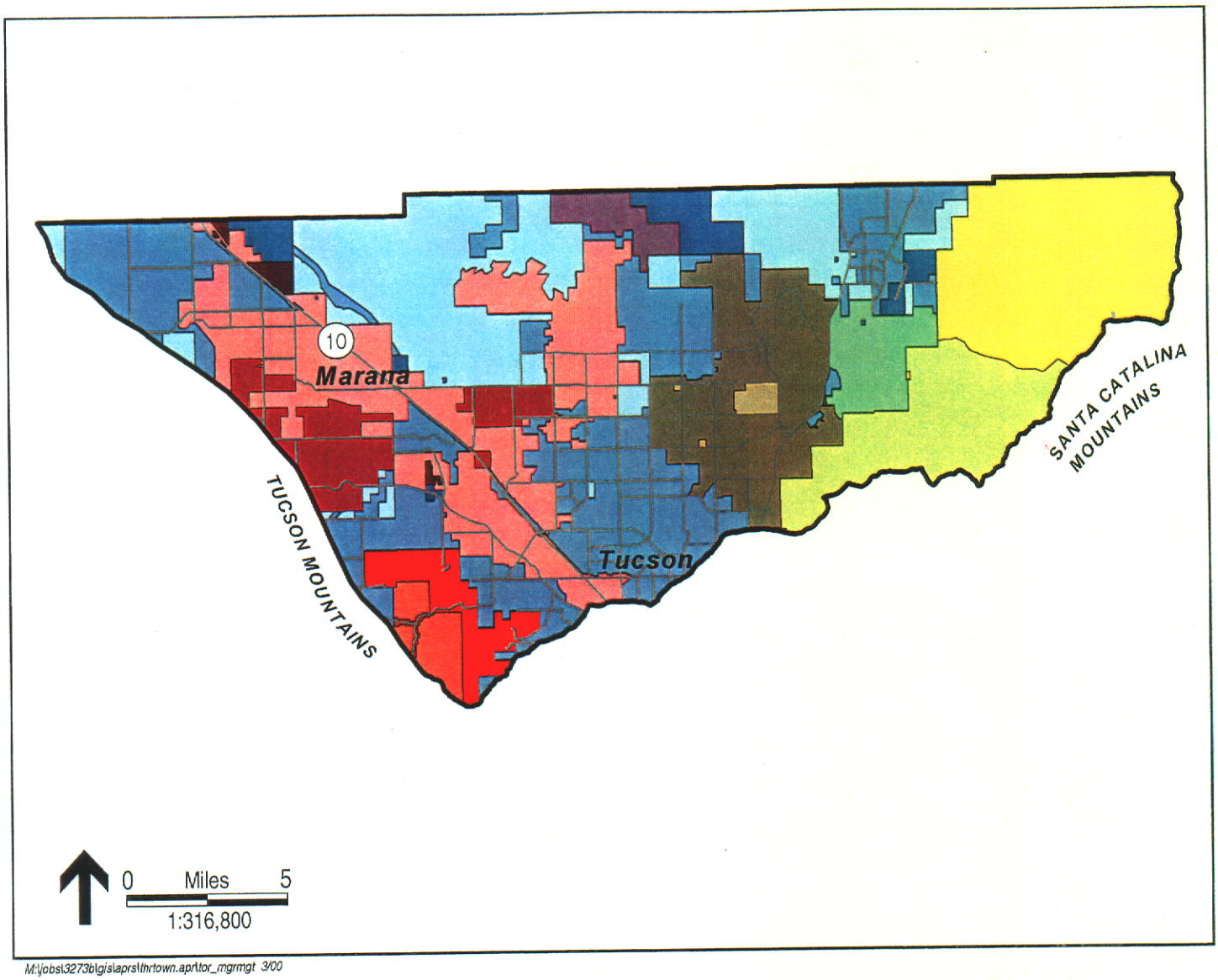
A. Potential Threats and Stressors

1. Land Use and Landscape Character

The landscape character has drastically changed during the last 20 years, from an area of rural homesites separated by large areas of undisturbed undeveloped land, to one with numerous subdivisions, lot-split areas, master-planned communities, and commercial developments (Figure 26).

a. Town of Marana

The Marana General Plan (Town of Marana 1997) indicates the future Town Center, neighborhood commercial anchor, and community commercial development areas as economic development zones shown to occur west of I-10, north and south of Tangerine Road. This is within the area of high-density ironwood forest and designated Critical Habitat for the CFPO. If built as planned, the development of this area, coupled with the recent development of residential subdivisions and golf courses in the Tortolita foothills



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Land Ownership and Land Management
in the Tortolita Fan Subarea

- Arizona State Parks Board - Catalina State Park
- Arizona State Parks Board - Unreserved
- Marana - Open Space
- Marana Unreserved - Private Lands
- Marana Unreserved - State Trust Lands
- NPS - Saguaro National Park West
- NPS - Saguaro National Park West Wilderness Area
- Oro Valley Unreserved - Private Lands
- Oro Valley Unreserved - State Trust Lands
- Pima County - Open Space
- Pima County - Tortolita Mountain Park
- Pima County Unreserved - Private Lands
- Pima County Unreserved - State Trust Lands
- USFS - Coronado National Forest (unreserved)
- USFS - Pusch Ridge Wilderness Area
- Major Road or Highway

Figure 26

poses a potential stress not only to the CFPO but also to other species dependent on the ironwood forest and wash habitats. An additional 9,159 homes may be built on 5,600 acres in the Dove Mountain area at the base of the Tortolita foothills.

Marana's lack of a strong Native Plant Protection Ordinance and riparian protection ordinance raises valid concerns, particularly relating to vegetative communities of known special significance such as ironwood forests and riparian areas.

On the west side of I-10 Marana has seen and fostered the conversion of cultivated fields and agricultural lands to residential subdivisions. Recent rezonings reflect this conversion of land use. To a great extent this has been made possible by the County's bank protection along the Santa Cruz River. Damage to agricultural fields and residential properties after major floods in 1983 and 1993 triggered this ongoing bank protection effort. The urbanization of the area between Orange Grove Road and Avra Valley Road, is reflective of their three-tiered "crescent concept" of having most of the urbanized area on the east side of the Silverbell Road and the river, and having the area west of the river and north of Twin Peaks Road set aside for ranches, farms, and other large-scale agribusiness uses. While the lack of bank protection on most of the west bank of the Santa Cruz raises concerns for increased flooding of that western area, it opens up a range of opportunities for riparian restoration projects supported by effluent.

Primary threats to biological resources in Marana include habitat loss and fragmentation, conversion of agricultural lands to higher intensity uses, and the decline in groundwater levels. At this time the primary constraint to quality growth within Marana is the lack of wastewater treatment capacity. Except for a very small area, they rely on the County's treatment plant at Ina Road or individual septic tanks. Marana currently has no plans to build a treatment plant, but Pima County has plans to expand their capacity at Ina Road (Pima County-Wastewater 2000).

b. Town of Oro Valley

The General Plan for Oro Valley (Town of Oro Valley 1996) reflects a tremendous growth in population in recent years, and establishes an intent to annex additional lands for future anticipated growth. The population in 1990 was 6,670; the land use plan provides for an increase to approximately 125,000 by 2020. Much of the development has been and will continue to be built out within the constraints of planned area developments, such as Ranch Vistoso. These master plans have resulted in the setting aside of significant amounts of natural open space. There is increasing pressure to develop the land adjacent to the portion of Honey Bee Canyon that is within the town boundary. A resort is planned for the Stone Canyon area, just west of Honey Bee Canyon. Both of these drainages have well-developed riparian habitat and extend between the Tortolita Mountain Park and Big Wash.

The General Plan establishes an "urban growth boundary" along its northern and western boundaries. This encroaches somewhat on an area outside their boundaries that is identified as a master planned community on the west side of Big Wash. The plan identifies the protection of the Sonoran Desert environment as a cornerstone and presents guidelines and strategies to ensure sensitive development. For example, development around Tortolita Park is limited to a minimum of one house per five acres. One of their strategic implementation actions is to lobby the Governor's Office to

establish preserve status for the State Land area adjacent to Tortolita Mountain Park. The town has adopted strict standards and ordinances for hillside development, native plant preservation, and riparian protection.

The Canada del Oro wash, the primary watercourse, has been channelized and bank protected along most of its length for flood control purposes. This brought the adjacent lands out of the floodplain and resulted in numerous medium to high density residential subdivisions and golf courses along its length.

Primary threats to biological resources in Oro Valley include habitat loss, habitat fragmentation and groundwater pumping to support the growing population. Principal constraints to development are the rough terrain and wide, natural washes. Also, they rely on the County's wastewater treatment plant at Ina Road or individual septic tanks.

c. Proposed Towns of Tortolita and Casas Adobes

These communities have been engaged in a struggle for legal status for the last several years, in a desire to incorporate as separate towns. Tortolita is located between Oro Valley and Marana and is characterized by large lot homesites derived from lot-splitting. The residents are committed to maintaining the rural, undeveloped character of the area. Casas Adobes has been developed over the years along the Oracle Road corridor. It is characterized by older subdivisions, large lot homesites, and commercial development along Oracle and Ina Roads. Infill of commercial projects and residential development continues.

d. Community of Catalina

Like all the communities in the subarea, Catalina has experienced significant growth in population, particularly in the last 30 years. Except for commercial development along the Oracle Road corridor the area is predominantly low density (Pima County 1996). There are several subdivisions but lot-splitting and wildcat subdividing has been the prevalent method of residential development. This unregulated development of much of Catalina has resulted in densities higher than 12 of 13 similar lot-split areas studied by Pima County in 1998. Catalina development has encroached on floodplains and destroyed riparian areas (Pima County 1998). The primary effect on biological resources has been significant habitat loss, fragmentation, and introduction of exotic species.

e. Ranching

Ranching has been an inherent part of the Tortolita Subarea for over 100 years. Several ranches continue to operate in the vicinity of Tortolita Mountain Park, along the west and east sides of the mountains (Pima County-Mt. Parks 2000). Increased pressure from urban growth and development in this part of Pima County and in southern Pinal County raise concerns regarding the potential for conversion of these ranch lands to higher intensity land uses.

2. Effects of Population Growth

During the last 20 years there has been rapid population growth and associated residential development within the Tortolita Subarea. Population forecasts for the next

20 years project a three- to four-fold increase (USDI-BOR 2000). Much of the growth has been in and is planned for the area now designated as Critical Habitat for the CFPO, Map Unit 4. As such, it has occurred within areas of ironwood forests and relatively dense saguaros, palo verdes, and mesquite bosques. Development has relied extensively on the channelization of many small intermittent watercourses that drain the Tortolita and Catalina Mountains and the alluvial bajada of the Tortolitas. The result has and continues to be a significant loss of vegetation and habitat, both in upland and riparian areas.

The heavily dissected alluvial bajada is an area of sheet flow. Once disturbed, these landscape types are very erosive. When land disturbance triggers erosion it can quickly accelerate and affect upstream and downstream conditions. Direct modification of the watercourse, downcutting, and loss of xeroriparian and upland vegetation can essentially transform an area of rich biodiversity into one low biological resource value. This is a serious concern for the Tortolita Fan area and elsewhere in other subareas (e.g., Sahuarita area).

The increasing population growth places a tremendous burden on groundwater—the area's traditional water supply. As in other parts of the county, groundwater levels have been declining because the rate of groundwater withdrawal has exceeded the rate of natural recharge to the aquifer. According to the Southern Arizona Regional Water Management Plan Feasibility Report (SARWMS) being drafted by the BOR, seven future golf courses are planned for the Tortolita Subarea: four in Marana and three in Oro Valley. The future water delivery requirements to meet the demands of these seven golf courses and the existing seven golf courses will be over 6,000 acre-feet per year for normal requirements and over 16,000 acre-feet per year for peak requirements (USDI-BOR 2000). (See related discussion under Water Use.)

Marana's CAP allotment is relatively small at 47 acre-feet per year. Even if they receive an additional CAP allocation from Tucson (or other sources) and acquire effluent rights for turf irrigation, the projected explosive growth of Marana will require a tremendous increase in groundwater mining (USDI-BOR 2000). Past rates of groundwater pumping have significantly altered the biologically rich Santa Cruz River, including the loss of endangered and other native fish and plants (Pima County-Water Resources 2000). Increased groundwater pumping would continue this deterioration. The groundwater elevation is estimated to have dropped up to 100 feet in the last 50 years in portions of the Marana area, mostly due to groundwater use for irrigated crops. Perennial flows in segments of the Santa Cruz River are supported by effluent discharged from the County's Ina Road Wastewater Treatment Plant.

Currently, the water companies of Oro Valley, Marana, and the Metropolitan Domestic Water Improvement District use a total of over 15,000 acre-feet per year and are projected by population forecasts to use over 47,000 by the year 2018. If the amount of CAP allocations and effluent utilized in the future was maximized, their groundwater use could be reduced to under 6,000 acre-feet per year (BOR 2000). A final finding of "jeopardy" by the U.S. Fish and Wildlife Service on CAP use in the Santa Cruz River basin would be a significant impediment to the viability of using CAP water to reduce groundwater dependence, and would consequently be a significant threat to the biological resources of the Tortolita Subarea. Likewise, the lack of existing infrastructure

to deliver CAP and effluent poses similar concerns. (See discussion under Water Uses, below.)

Direct stress on biological resources due to declining groundwater levels include a deterioration in the health and vitality of vegetation, particularly in riparian habitat areas, which support the highest diversity of wildlife species.

3. Transportation

The road network in the Tortolita Subarea is well developed and fragments much of the subarea, particularly in the southern and western portions (Figure 27). However, significant areas in the north and east portion of the subarea are still relatively unfragmented by highways and roads.

a. Tangerine Road Proposed Widening

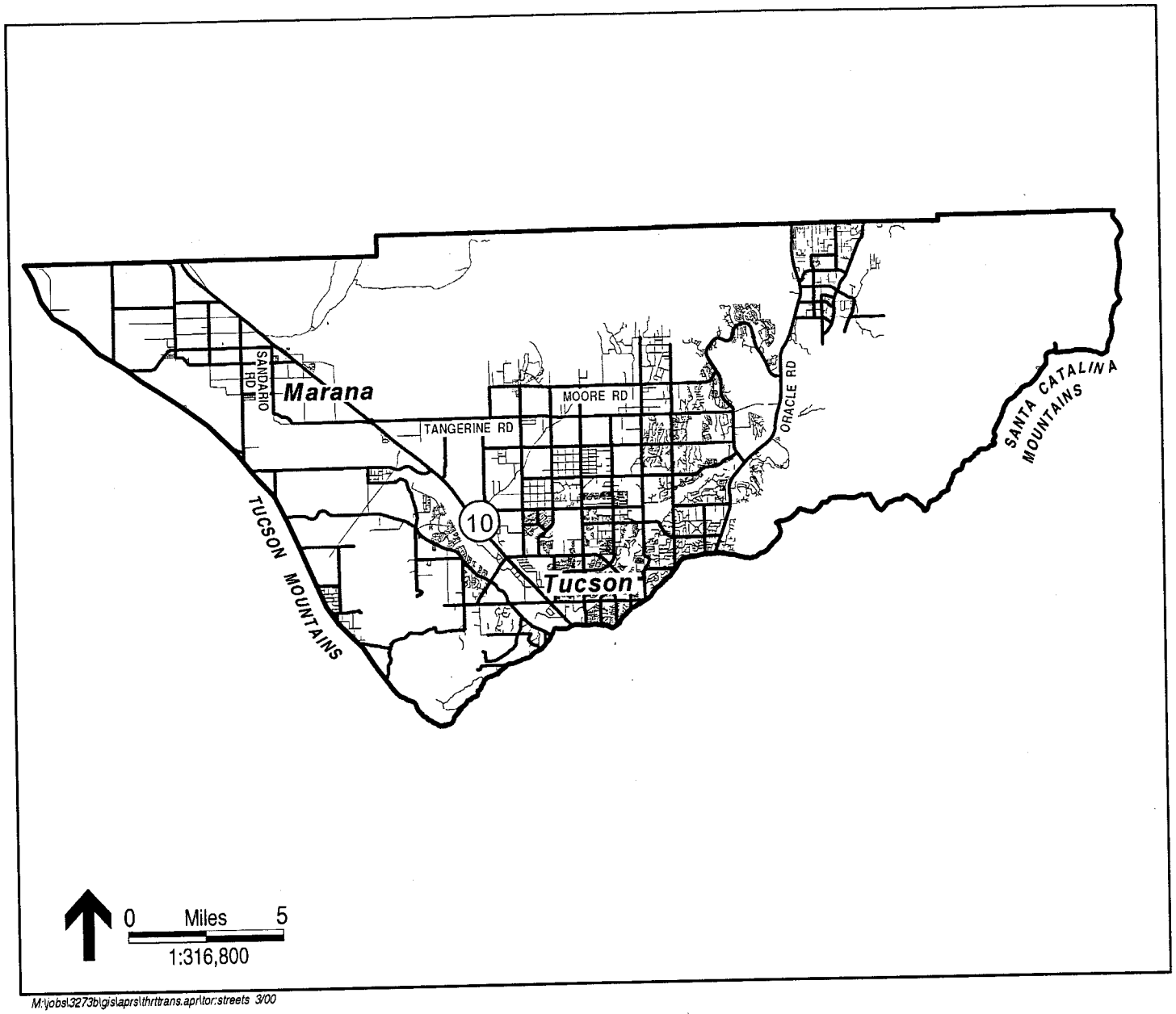
Tangerine Road is a state route with a planned right-of-way of 300 feet and eventual widening to four to six lanes between I-10 and Oracle Road. It crosses multiple watercourses, small and large. Its eventual widening raises concerns for wildlife movement and the protection of adjacent riparian vegetation. A key feature of the County's Long Range Transportation Plan (Pima County 1986) is the extension of Tangerine Road to the southwest to Sandario Road, and connecting to San Joaquin Road further south. It would involve the complexities and impacts associated with crossing the Santa Cruz River and the CAP canal, bank protection issues, and would be tied to a proposal to expand the Avra Valley Airport—all elements that pose stresses on the biological resources of the area. Habitat loss and fragmentation would be direct results.

b. Marana's Loop Road

Another major roadway reflected by the Marana General Plan (but not the County's Plan or the Metropolitan Transportation Plan) is a future loop road extending west from the Dove Mountain area of the Tortolitas west and northwest to I-10 near the County line. If built, this would cross the CAP canal, at least two large watercourses (Derrio and Cottonwood Washes), many smaller watercourses and would require the removal and displacement of a significant amount of ironwood forest and riparian vegetation and associated wildlife, all within Critical Habitat for the CFPO. This loop road is also reflected on the County's Comprehensive Plan for the Avra Valley/Tortolita Subregion (Pima County 1997).

4. Water Uses

Areas of naturally occuring streams and shallow groundwater occur in several portions of the subarea, in addition to the Santa Cruz River (Figure 28 and Table 18). Water is a key issue in this subarea, and a number of infrastructure projects will have an effect on the availability of water for habitat and wildlife uses.



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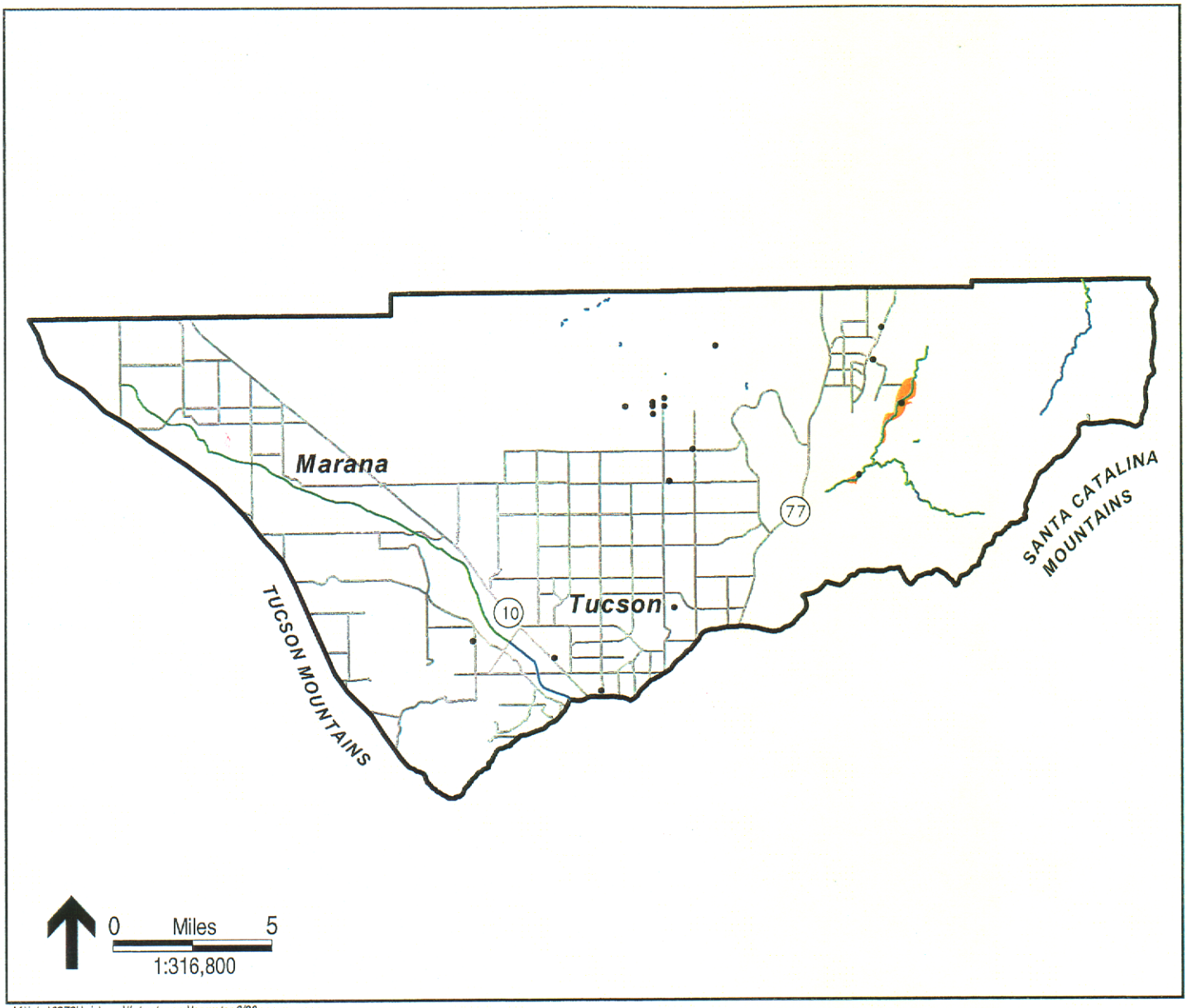
Road Network

in the Tortolita Fan Subarea

Highway or Major Road
Local Road

Figure 27



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Surface Groundwater and Streams
in the Tortolita Fan Subarea

Suspected Shallow Groundwater Areas
(based on well data and aerial imagery)

Well with Depth to Water less than 50 feet
(ADWR Well 55-Registry and GWSI databases)

Perennial Reach
Intermittent Reach

Major Street or Highway

Figure 28

TABLE 18
STREAM CHARACTERISTICS OF THE TORTOLITA FAN SUBAREA

Stream Name	Miles of Perennial Flow	Miles of Intermittent Flow	Acres of Hydro-mesoriparian Habitat	Acres of Class A Riparian Habitat	Acres of Shallow Groundwater	Pygmy-Owl Habitat	Fish Species	Leopard Frogs
Santa Cruz River	6.8	15.7	3500	N/A	N/A	Yes	N/A	N/A
Wild Burro Canyon	0.7	0	N/A	N/A	N/A	No	N/A	N/A
Honey Bee Canyon	0.2	0	N/A	N/A	N/A	No	N/A	N/A
Canada Agua	0	0.0069	N/A	N/A	N/A	No	N/A	N/A
Ruelas Canyon	0.1	0	N/A	N/A	N/A	No	N/A	N/A
Twentyseven Wash	0	0	0	51	N/A	No	0	N/A
Sutherland Wash	0	6.5	N/A	121	483	No	N/A	N/A
Cargodera Canyon	0	0.2	N/A	N/A	N/A	No	N/A	N/A
Canada del Oro	4.2	1.2	303	N/A	N/A	No	2a	N/A
Palisade Canyon Creek	0	4.5	N/A	N/A	N/A	No	N/A	N/A
Lemmon Creek	2.7	0	N/A	N/A	N/A	No	1b	N/A
La Milagrosa Canyon	0	0.9	N/A	N/A	N/A	No	N/A	N/A

N/A = not applicable.

a. Proposed CAP Terminal Storage Facility

The BOR is considering and analyzing the possibility of building a Direct Delivery system to serve the northwest Tucson region. It would be composed of a surface reservoir, water treatment plant, and distribution system. The turnout, reservoir, and a treatment facility would be located east of I-10, approximately one mile north of Tangerine Road, with the conveyance pipeline following the alignment of Moore Road extending east to Rancho Vistoso. (A majority of the golf courses are located north of and parallel to Moore Road.) To the extent possible the distribution system would follow existing roadway rights-of-way, but a portion would be constructed in undisturbed habitats. Altogether the project is estimated to result in the loss of over 300 acres of designated Critical Habitat for the CFPO. The full impact on vegetated areas is unknown at this time, in part because the recreational component has not been defined. Elements and features such as picnic sites, campgrounds, and trails would result in additional acres of direct disturbance and habitat loss. Once treated, the water would be used for potable distribution, greatly reducing the amount of groundwater pumping by the water companies of Oro Valley, Marana, and the Metropolitan Domestic Water Improvement District. The storage reservoir would be sized at over 100 acres and would include a recreational component (i.e., swimming, fishing, camping, and boating).

b. Proposed CAP Recharge and Recovery System

As a separate but related project, the BOR is also considering a plan that would construct a turnout at the CAP canal at Moore Road as described above, and build conveyance systems to two recharge basins and direct discharge points: one at the confluence of Big Wash and Honey Bee Canyon Wash and one west of the Canyon del Oro Wash near Overton Road. The turnout and a treatment facility would be located near I-10 and Moore Road with the conveyance pipeline following the alignment of Moore Road extending east to Rancho Vistosa. A spur pipeline would be built to serve the Dove Mountain area and there would be other subsidiary lines between there and its terminus at Big Wash. The four basins at Big Wash would total approximately 15 acres; the eight basins at the Oasis site near the CDO wash would total 40 acres. Direct impacts to vegetation include loss of 55 acres of desert wash habitat for recharge basins, 145 acres of saguaro-ironwood habitat for pipeline construction, and additional loss of desert wash habitat for dikes at the recharge sites. Impacts to wildlife include loss of habitat, temporary disturbance due to construction noise and activities, and potential impacts to sensitive species such as desert tortoise, lesser long-nosed bat, CFPO, and other species.

c. Lower Santa Cruz Replenishment Project

This is associated with a larger Pima County Flood Control Project that includes a levee and bank protection system along the Santa Cruz River, extending north from the community of Rillito to the County line. A series of basins will be excavated outside the primary incised river channel but within the 100-year floodplain. Excavated material from the basins will be used to construct the flood control levee. This project is under construction.

d. Draft Biological Opinion on CAP

Directly affecting these and other uses of CAP water, the USFWS issued a jeopardy decision in their recent draft Biological Opinion of the impacts of Santa Cruz River Basin recharge projects on the endangered Gila topminnow. The BOR and the USFWS are continuing to work through the Section 7 consultation process. As part of their Biological Assessment the BOR will be constructing two fish barriers along the Santa Cruz River near Pima Mine Road and will implement other measures to offset potential impacts to the endangered fish which exists upstream between Tubac and Nogales. It is unclear to what extent the ongoing Section 7 consultation will impact CAP delivery and recharge projects within the Tortolita Subarea and elsewhere throughout the Santa Cruz basin.

e. Lower Santa Cruz Replenishment Project (LSCRP)

This is associated with a larger Pima County Flood Control Project that includes a levee and bank protection system along the Santa Cruz River, extending north from the community of Rillito to the County line. The LSCRP is being constructed to recharge CAP water through the use of eight excavated outside the primary incised river channel but within the 100-year flood plain. Excavated material from the basins will be used to construct the flood control levee. This project is under construction.

f. Effluent Discharge

Perennial flows along the Santa Cruz River result from effluent discharged from the Ina and Roger Road treatment plants. This effluent-dominated stream flow supports areas of hydromesic riparian woodland vegetation (consisting of mesquite, saltcedar and Goodding willow). These areas of hydromesic vegetation constitute a large percentage of the total for the entire Tucson Basin (BOR 2000) and would not exist in the absence of the effluent discharge (Malcolm Pirnie 1995). (See additional discussion under Middle Santa Cruz Subarea.)

g. Avra Valley Recharge Project (AVRP)

The Avra Valley Recharge Project recharges CAP water into four basins along the west side of the Santa Cruz River, south of Tangerine Road. The area once served as a sand and gravel extraction pit.

h. Effluent Distribution System

Currently, reclaimed water pipelines extend to the Dove Mountain area in the Tortolita Mountain Foothills and to Arthur Pack Regional Park. An additional pipeline is proposed to bring effluent to the Canada del Oro basin. A significant portion of the effluent would be used to serve golf courses along the Canada del Oro that are currently using groundwater and to support riparian restoration projects.

Effluent flows into the subarea and use of CAP water play a major role in recharging the aquifer. Both the BOR projects and increased effluent distribution would benefit the Tortolita Subarea by allowing the CAP and reclaimed water to be used in lieu of pumped groundwater for irrigation of golf courses and other turf areas. Additionally it would

provide a critical water source for riparian restoration projects within the Canada del Oro basin.

5. Recreation

Coronado National Forest, including the Pusch Ridge Wilderness, and the Catalina State Park provide important and popular recreational opportunities for the subarea. Tortolita Park receives less use, primarily by hikers. At the rate of development along the northwestern boundaries of the Catalinas, the State Park in coming years may hold the few areas of public access to the northwestern slopes of the mountains (Arizona State Parks Board 1991). Although the Wilderness area is somewhat insulated and protected by the proximity of the State Park, it has been a victim to human overuse. It receives so much use by hikers that it is questionable whether the potential for a "wilderness experience" still exists here (USFS 2000—Senn). Protection of a small herd of bighorn sheep in the wilderness area has been primary concern, and the high degree of use the trails receive is thought to be a factor in the lack of recent sightings (AG&FD 2000). Recreational opportunities include hiking, camping, horseback riding, picnicking, and mountain biking. In some areas trail use has resulted in erosion problems. The major issue relating to biological resources is human overuse associated with the rapid urbanization of the surrounding area. A small number of Bighorn sheep occupy the Pusch Ridge Wilderness. Their numbers have declined over the years and wildlife biologists studying the situation believe this may be in part due to increased numbers of people using the wilderness trails (AG&FD 2000).

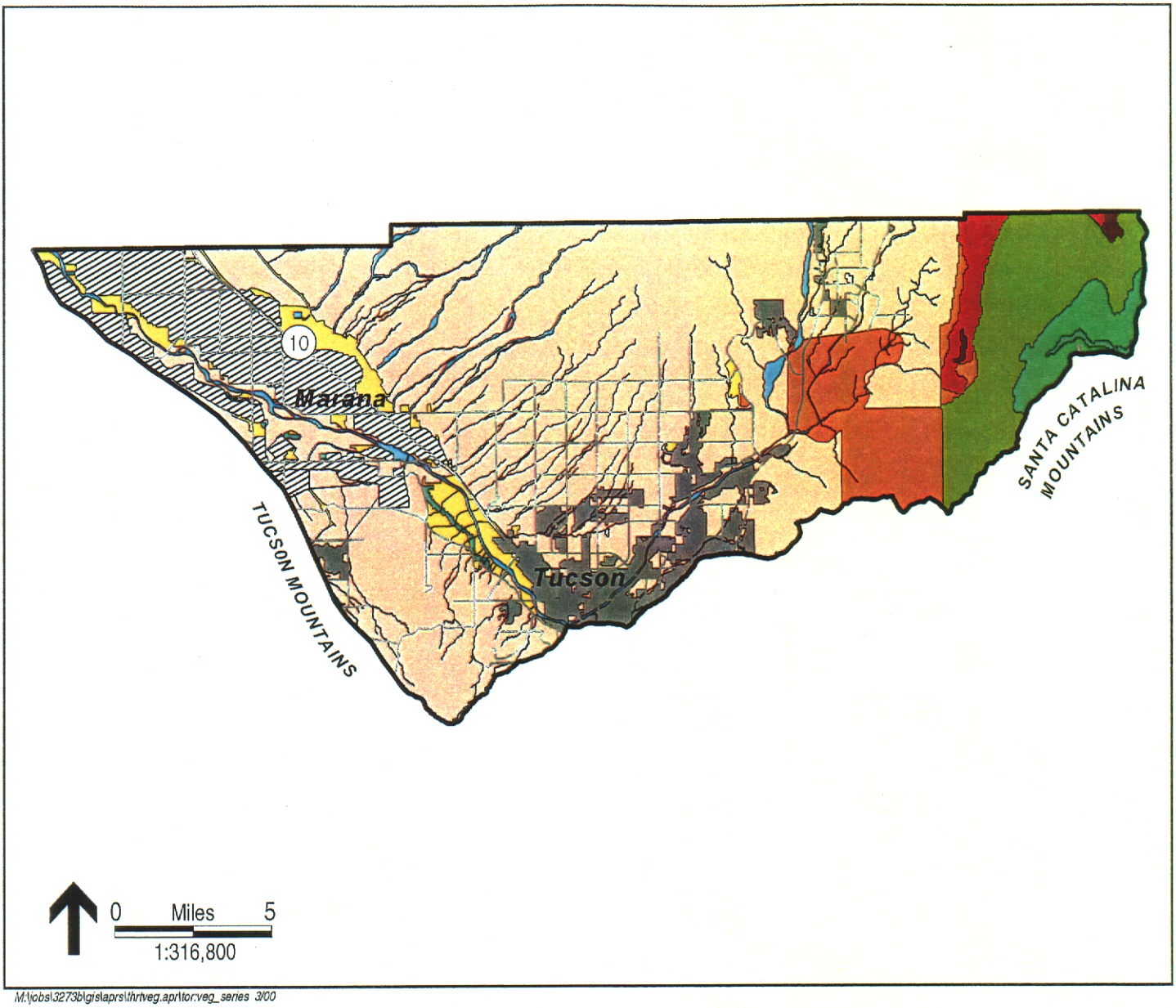
B. Biological Resources

1. Vegetation and Land Cover

Habitat within the Tortolita Fan Subarea consists primarily of palo verde-mixed cacti habitat. The western portion of the subarea supports heavy agricultural development interspersed with creosote-bursage and mixed scrub habitat within drainages. The city of Tucson occupies the center of the subareas' southern edge. The eastern portion of the subarea contains areas of higher elevation and supports mixed grass scrub, mixed evergreen sclerophyll, oak, pine, and douglas-fir-mixed-conifer forest habitats (Figure 29).

2. Critical Habitat

As discussed above, much of the Tortolita subarea has been designated Critical Habitat for the CFPO Map Unit 4. It consists of private, state, and county lands. It contains stands of ironwood, acacia, saguaro, mesquite bosques, several washes, and is considered to be of the highest quality pygmy-owl habitat known. Activities that pose a threat to the Critical Habitat for the CFPO include removing or destroying vegetation; water diversion, impoundment or groundwater pumping that alters water quality or quantity to an extent that riparian vegetation is significantly affected; and recreational activities that appreciably degrade vegetation (USDI-USFWS 1999).



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Vegetation and Land Cover
in the Tortolita Fan Subarea

Vegetation Communities (BLP Classification)

- 122.61 Douglas-Fir-Mixed-Conifer
- 122.62 Pine
- 123.31 Encinal (Oak)
- 124.71 Mesquite
- 133.32 Manzanita
- 133.36 Mixed-Evergreen Sclerophyll
- 143.15 Mixed Grass-Scrub
- 154.11 Creosote-Bursage
- 154.12 Paloverde-Mixed Cacti
- 223.22 Mixed Broadleaf
- 234.71 Mixed Scrub
- 243.53 Cordgrass

Other Land Cover Types

- 999.1 Agriculture
- 999.2 Urban
- Major Road or Highway

Figure 29

3. Incidental Take Permit

In 1998 USFWS approved a Habitat Conservation Plan for the Lazy K Bar Guest Ranch, located at the northern end of the Tucson Mountains. The ranch owners wanted to construct new buildings and has committed to restoring 32 acres of CFPO habitat. The permit included an agreement to stop construction if one or more CFPO were harmed or killed.

4. Species at Risk

A total of 11 Status 1 and 2 Vulnerable Species occur within the subarea (Table 19).

C. Existing and Proposed Preserves

Both Catalina State Park and Tortolita Mountain Park are located within this subarea and have adjacent areas that have been identified for expansion by the Open Space Acquisition Master Plan (Pima County-Open Space 2000). The Tortolita East Biological Corridor is a 3,441-acre proposed addition consisting almost entirely of State Trust Land. This would adjoin the eastern expansion boundary of the park and link it with the proposed expansion area of Catalina State Park. In doing this a connection between the Catalina and Tortolita Mountains would be created, thereby protecting segments of significant wash corridors: Upper Honeybee, Big Wash, Sutherland Wash, and Twenty-Seven Wash, and facilitating wildlife movement between the areas. Additionally, a 14,000-acre area of natural open space located west and south of Tortolita Park is proposed for acquisition. This area is almost entirely State Land and has been designated CFPO Critical Habitat, Map Unit 4. A total of 16,185 acres of State Land were covered by an Arizona Preserve Initiative application to reclassify these lands for purposes of conservation. That application is under review by Arizona State Lands Department.

A recent proposal by the Town of Oro Valley would annex 4,620 acres of State Land in the area of the Tortolita East Biological Corridor. Their General Plan designates this area as open space but that could be changed by Plan amendment (*Tucson Citizen* 2000).

The presence of much privately held and State Land adjacent to the existing preserves presents the possibility of these lands being developed at much higher intensities and conversion from open space and ranch lands to subdivisions and master planned communities. In some cases the rugged terrain is a constraint to development.

D. Summary of Potential Stressors to Biological Resources

The primary biological stressors of the Tortolita Subarea are habitat loss, habitat fragmentation, conversion of vegetative cover, competition by non-native species/human use, and overuse and decline in groundwater levels. The current ownership and management pattern of the Tortolita Subarea is fragmented, with the landscape dominated by urban uses of the Tucson metropolitan area (Figure 30). Although there are significant areas of status 4a and 3b status lands, they are generally fragmented by more intensive uses.

TABLE 19
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE TORTOLITA FAN SUBAREA

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Accipiter gentilis apache Apache northern goshawk	2	S3	F-petitioned, FSS WSC	Habitat destruction by logging and forest clearing. Possibly consequences of fire suppression leading to major timber fires. Organized recreational and sports use. Global climate change. Disturbance by recreationists, cattle grazing, mining, road building and other forest disturbances are site specific threats alleged by Center for Biodiversity.	Mt. Lemmon quad 1993, USFS	
Agave schottii var. *treleasei* Trelease agave	1	S1	FSC FSS ANP	Narrow endemic. Direct site impacts by road building and recreational development may impact local populations.	Oro Valley quad, Pusch Ridge, 1994 USFS Tucson North quad, Finger Rock Canyon, 1987 USFS	Occurs in isolated, relatively secure locations.
Allium gooddingii Goodding onion	2	S3S4	FSS ANP-HS	Livestock grazing, logging/timber management, organized recreational and sports use	Mt. Lemmon quad 1986 USFS	
Buteo swainsoni Swainson's hawk	2	S3	FSS	Migratory species in this area. No specific threats likely to apply here.	West of Marana quad 1993 private	
Glaucidium brasilianum cactorum	1	S1	FE FSS	Habitat destruction and alteration, historic and present. Groundwater	Multiple records: Desert Peak quad 3 Private.	Most of the known records for this species are from this

TABLE 19
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE TORTOLITA FAN SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Cactus ferruginous pygmy-owl			WSC	pumping, channelization, urbanization, historic livestock grazing? Farming and agricultural uses? Wood cutting. Disturbance by bird watchers. Small population subject to stochastic events. Possibility of disease, including emerging diseases, and loss of viable food supply as a result of drought and/or climate change.	Tortolita Mountains quad 1 State. Ruelas Canyon quad 34 records, Private. Avra quad 1 Private. Jaynes quad 4 Private. Tucson North quad 1 Private.	planning unit.
Leptonycteris curasoae yerbabuenae Lesser long-nosed bat	2	S2	FE FSS WSC	Mining, hiking, organized recreational and sports use: direct impacts to roosts (caves and inactive mines), disturbance of roosting bats. Livestock grazing, new roadways, new utilities, off –road driving, low-level overflights and military training activities: alleged and potential or possible impacts to food plants, roosts, disturbance of roosting bats.	Mt. Lemmon quad Red Ridge 1986 USFS.	
Muhlenbergia xerophila Weeping muhly	1	S1	FSS	Very narrow distribution.	Tucson North quad, Finger Rock Canyon 1999 USFS	
Poeciliopsis occidentalis occidentalis	1	S2	FE FSS	Non-native species, competition and predation. Habitat loss by	Oracle quad, Canada del	Possibly washed down from Romero Canyon site? No record

TABLE 19
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE TORTOLITA FAN SUBAREA
(continued)

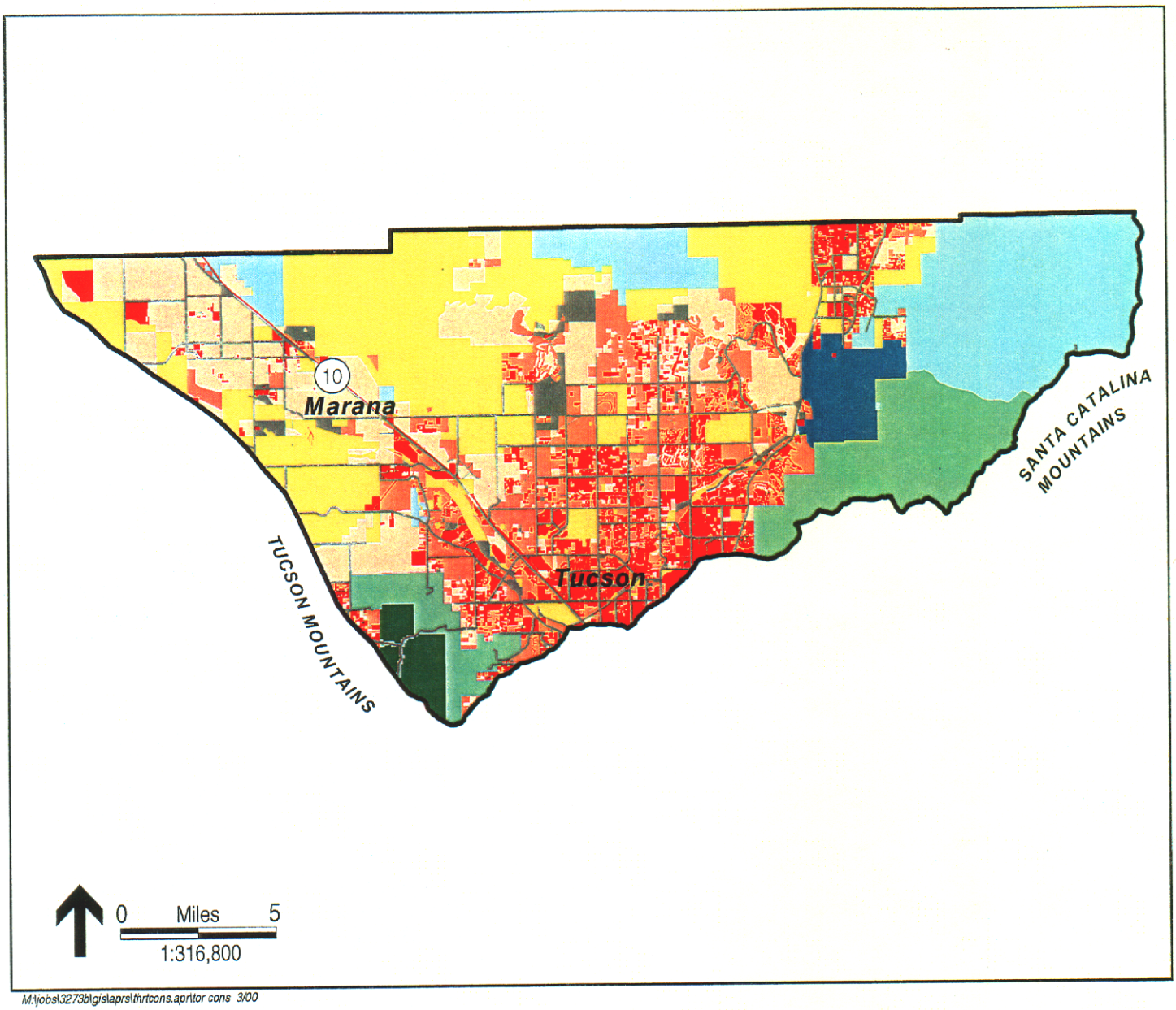
Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Gila topminnow			WSC	groundwater pumping and channelization. Flooding. Drought. Dredging. Poor water quality. Livestock grazing (trampling by cattle, watershed changes).	Oro 1982 USFS.	of this site in Weedman et al. 1997.
Rana yavapaiensis Lowland leopard frog	2	S4	SC FSS WSC	Groundwater pumping, disease, water pollution, invasive non-native species, ozone loss, unknown causes of population declines	Oro Valley quad, Canada del Oro Wash 1191 USFS, 1994 Private. Mt. Lemmon quad, Upper Sabino Canyon 1982, USFS	
Strix occidentalis lucida Mexican spotted owl	2	S3S4	FT WSC FSS	Habitat destruction by logging. Possibly consequences of fire suppression leading to major timber fires. Organized recreational and sports use. Global climate change.	Mt. Lemmon quad, 8 records, 1990-1997 all USFS.	Critical Habitat for this species had been designated in 1995, but rescinded in 1998.. On 3/14/00 a federal judge ordered FWS to determine critical habitat by 1/15/01.

TABLE 19
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE TORTOLITA FAN SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Tumamoca macdougalii Tumamoc globeberry	2	S3	FSS ANP-SR	Mining, canals (CAP), urbanization (commercial and residential, including lot-splitting/wildcat subdivision), aggregate or fill removal, livestock grazing?, landfills, new roadways and utilities, conversion of desert lands to crop lands, golf courses, parks, off-road driving. Competition with exotics. Consumption by javelina.	West of Marana quad 1993 1986 BLM . Ruelas Canyon quad, 1987, 1985 private Avra quad, multiple records, private, state, BLM, NPS Jaynes quad 1984 private	This species was formerly listed as endangered, but was delisted because it was found to be more common than thought at the time of listing.

NOTE: Other species may occur in this subarea, but are not included in HDMS records. Known with certainty (K. Kingsley, personal observations or available literature) are: song sparrow (*Melospiza melodia*) (1); Abert's towhee (*Pipilo aberti*) (1); burrowing owl (*Athene cunicularia*) (2); Blue silverspot butterfly (*Speyeria nokomis caerulescens*) (2) (probably extinct in Pima Co.); Le Conte's thrasher (*Toxostoma lecontei*) (2); Bell's vireo (*Vireo belli)* (2).

Quads: Desert Peak, Tortolita Mts., Oracle Junction, Oracle, West of Marana, Marana, Ruelas Canyon, Oro Valley, Mt. Lemmon, Avra, Jaynes, Tucson North



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Level of Threat Represented by Conservation Status
in the Tortolita Fan Subarea

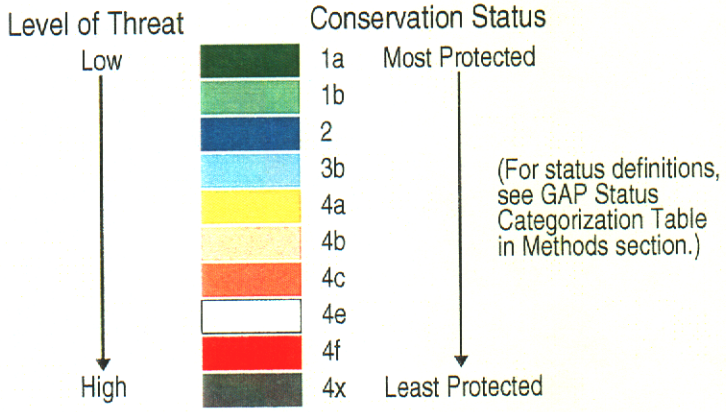


Figure 30

Activities contributing to biological stress are summarized on Table 20. These can be mostly attributed to the effects of urbanization—including the roadways and infrastructure to support development. During the last 20 years there has been rapid population growth and associated residential development within the Tortolita Subarea population forecasts for the next 20 years project a three- to four-fold increase (BOR 2000). Much of the growth has been in and is planned for the area now designated as Critical Habitat for the CFPO, Map Unit 4. As such, it has occurred within areas of Ironwood forests and relatively dense saguaros, palo verdes, and mesquite bosques. Development has relied extensively on the channelization of many small intermittent watercourses that drain the Tortolita and Catalina Mountains and the alluvial bajada of the Tortolitas. The result has and continues to be a significant loss of vegetation and habitat, both in upland and riparian areas. The heavily dissected alluvial bajada is an area of sheet flow. Once disturbed, these landscape types are very erosive. When land disturbance triggers erosion it can quickly accelerate and affect upstream and downstream conditions. Direct modification of the watercourse, downcutting, and loss of xeroriparian and upland vegetation can essentially transform an area of rich biodiversity into one low biological resource value. This is a serious concern for the Tortolita Fan area and elsewhere in other subareas (e.g., Sahuarita area). Habitats most at risk include Critical Habitat for the CFPO, the remaining ironwood forests, riparian, and xeroriparian areas, stream segments with perennial flows, and areas of shallow groundwater. The private and State Lands adjacent to the existing preserve areas are also at risk of being developed at higher intensity levels. The consequences of lot-splitting are a continued stress to biological resources, particularly in Catalina and Tortolita. The significance of the planned extension of CAP water, whether treated or untreated, cannot be overstated. It will result in large amounts of habitat loss. Conversely, if it is not built the area's demand for water will continue groundwater pumping at an accelerated rate, and expanded opportunities for riparian restoration will be lost. It is unclear to what extent the ongoing Section 7 consultation will impact projects within the Tortolita Fan Subarea and elsewhere throughout the Santa Cruz basin.

TABLE 20
LAND USE ACTIVITIES WITHIN LAND OWNERSHIP/MANAGEMENT CATEGORIES OF THE TORTOLITA FAN SUBAREA

Ownership or Management Category	Land Uses and Activities										
	Conversion of Agricultural Lands	Conversion of Ranches	Lot-Splitting & Urbanization	Cultivated Land	Groundwater Pumping	Water Diversion & Impoundments	Recreational Uses	Mining	Roadways	Livestock Grazing	Removal of Plants
Coronado National Forest (23,610 acres)	-	x	-	-	*	x	x	x	x	x	x
Pusch Ridge Wilderness (14,350 acres)											
Marana Open Space (877 acres)											
Catalina State Park (5,453 acres)	-	✪	-	✪	*	*	x	-	x	✪	✪
Tortolita Mountain Park (3,001 acres)	-	✪	-	-	*	*	x	-	x	✪	✪
Saguaro National Park West (5,515 acres)											
Saguaro National Park West Wilderness (2,985 acres)											
Marana Unreserved State Trust Land (8,825 acres)	-	*	*	*	x	x	x	x	x	x	x
Pima County Open Space (5,278 acres)											
Pima County Unreserved – State Trust Land (31,017 acres)	-	*	*	-	x	x	x	x	x	x	x
Oro Valley Unreserved – State Trust Land (881 acres)											
Oro Valley Unreserved – Private Lands (19,018 acres)											
Marana Unreserved – Private Land (33,154 acres)											
Pima County Unreserved – Private Lands (49,511 acres)	x	x	x	x	x	x	x	x	x	x	x

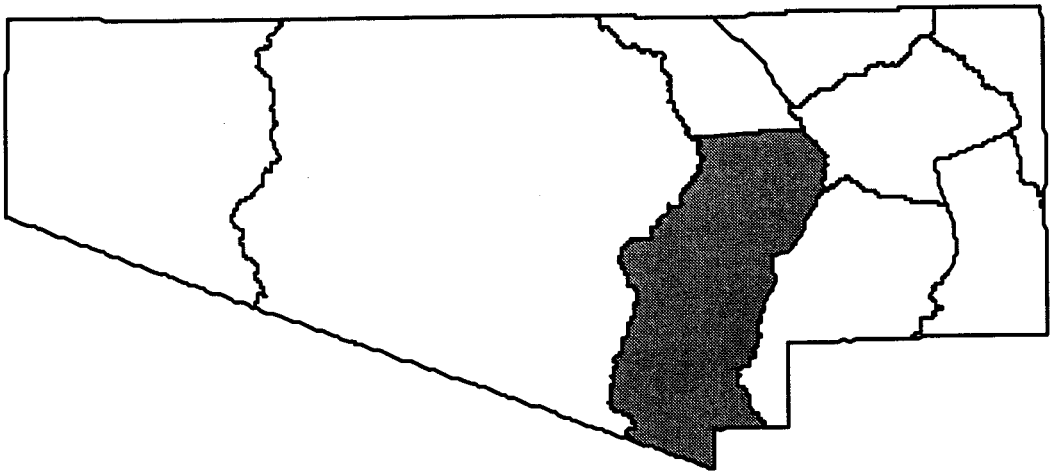
x = occurs
- = does not occur
* = potential to occur
✪ = historic but not present occurrence

Altar Valley

Sub Area 6a

VIII. Altar Valley (Subarea 6a)

The Altar Valley Subarea includes the southern extent of the Brawley Wash watershed between the Sierrita and Cerro Colorado Mountains and the Baboquivari Mountains (Figure 31). It includes the southward-flowing watersheds around Sasabe, at the U.S.-Mexico border.

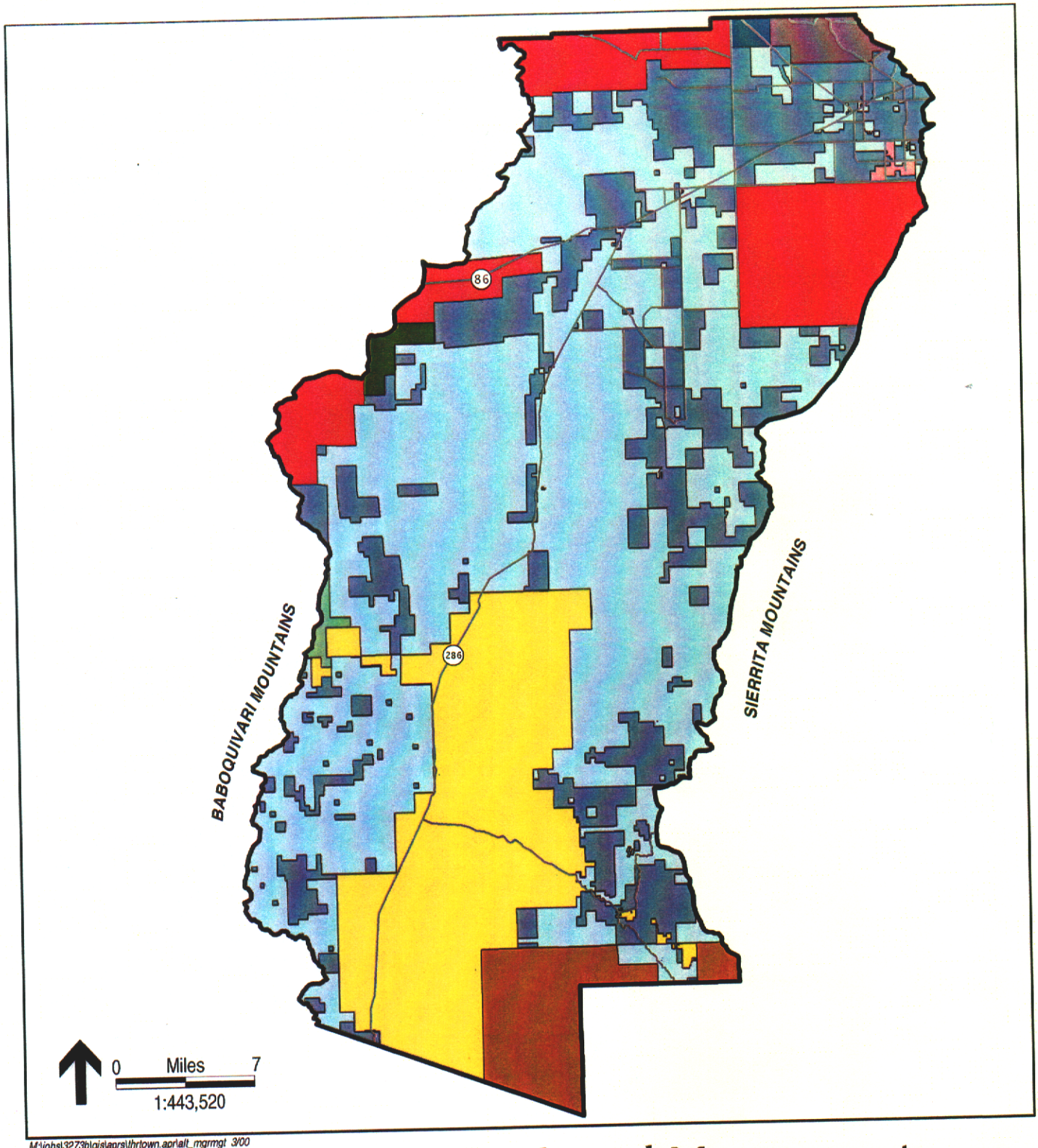


Altar Valley Subarea Location in Pima County
Figure 31

A. Potential Threats and Stressors

1. Land Use and Landscape Character

The subarea is characterized by the relatively undeveloped, open landscape of the Altar Valley (Figure 32). Ranching has been the predominant land use of the area since the late 1800s. Part of the ranch lands are privately owned, but the majority of the grazing allotments are on leased State Lands. Grazing allotments also extend to the Coronado National Forest and a few areas of BLM land. Overgrazing, particularly when combined with drought as in the 1890s, has caused severe habitat alteration and degradation problems (Pima County 1999). Much of Altar Valley that was historical semidesert and Sonoran savanna grasslands have developed into habitats similar to Sonoran desert scrub (Brown 1994). Although grazing management regulations have become much more stringent and the impacts of current grazing are less severe, past damage to the watershed remains in the form of altered vegetative communities, erosion, and incised channels (USDI-BAWR 2000). The once open grasslands of tall grasses declined and have been replaced by mesquite, acacia, burroweed, and snakeweed directly as a result of human activities of livestock grazing, fire suppression, and wild hay harvesting (Tellman 2000). Erosion and downcutting of Brawley Wash continues to be a concern of the area ranchers and the managers at the Buenos Aires Wildlife Refuge (BAWR). Gabions have been used in some areas (USDI-BAWR 2000).



Land Ownership and Land Management
in the Altar Valley Subarea

- BLM - Baboquivari Wilderness Area
- BLM - Coyote Mountain Wilderness Area
- BLM - Silverbell Resource Conservation Area
- BLM - Unreserved
- BOR - BOR Wildlife Corridor
- Pascua Yaqui Nation - Unreserved
- Tohono O'Odham Nation - Unreserved
- Pima County - Tucson Mountain Park
- Pima County Unreserved - Private Lands
- Pima County Unreserved - State Trust Lands
- USFS - Coronado National Forest (unreserved)
- USFWS - Buenos Aires National Wildlife Refuge
- Major Road or Highway

Figure 32

Ranch conversion leading to subdivisions and lot-splitting is a growing concern for the area. Ramifications such as habitat loss and fragmentation, encroachment into floodplains, increased downcutting, destruction of riparian areas, erosion, increased groundwater pumping all are sources of significant stress to biological resources.

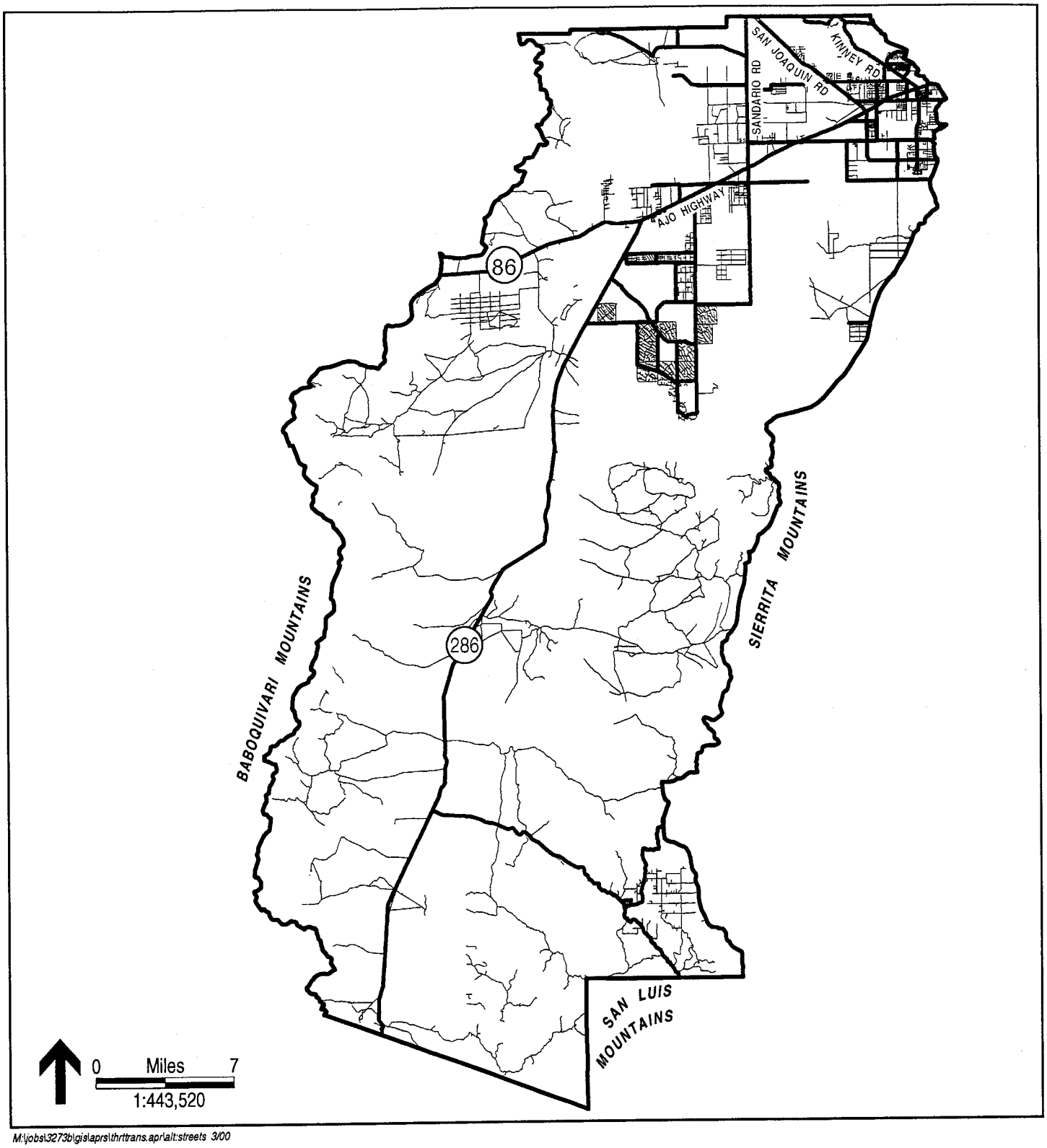
Residential development is primarily rural. There are several platted subdivisions in the subarea, but lot-splitting and wildcat subdividing have been the prevalent means of development, particularly in the areas around Sasabe, Tucson Mountain Park, and adjacent to the Ajo Highway. The Comprehensive Plan shows most of the area is planned for medium and low intensity rural (Pima County 1997). Commercial development continues to increase along Ajo Highway east and west of Kinney Road. A large block of land zoned Industrial is located along Ajo Highway surrounding Ryan Airfield. Although most of the land not inside the airfield boundaries is vacant and undeveloped at this time, there exists the potential for very intensive land uses on over 3,000 acres. This is of particular concern not only because of the potential for large scale habitat loss but also its proximity to Black Wash and Brawley Wash. Those wash areas are noted as Resource Conservation on the Land Use Plan for the Tucson Mountains South Half Subregion. A recent study by the Desert Museum found an area along the Brawley Wash has ironwood densities nearly twice that found in the Tortolita Mountains and the County Administrators' office is advocating greater protection for ironwood communities.

Mining could have a negative impact on this subarea due to the presence of medium to high potential for mineral resources in the San Luis Mountains, which form the upper southwestern watershed of Arivaca Creek. Effects on biological resources from mining could include large-scale degradation of intact areas, habitat loss and fragmentation, potential for downstream watershed contamination, and intensive groundwater pumping to support mine operations. Habitats most affected would be the riparian communities along Arivaca Creek and the Cienega.

2. Transportation

The Altar Valley subarea is essentially bisected by SR-286, with a high density of highways and roads in the northern end of the subarea and moderate to low density in other areas (Figure 33).

Ajo Highway, SR-286, Sandario Road, Kinney Road, and San Joaquin Road are the main roadways in the area. Pima County's Long Range Transportation Plan shows as a key feature, a loop road connecting Valencia Road with San Joaquin Road around the west side of Saguaro National Park and looping back through Avra Valley to Marana. It parallels the general alignment of the CAP aqueduct. As planned, the roadway would be built as a controlled access facility, with a 300-foot-wide right-of-way. The present segment of Sandario Road through the Park would be abandoned when this roadway is completed (Pima County 1986). Building such a large roadway would result in loss of much habitat, including areas of ironwood, grasslands, and Critical Habitat for the CFPO. Further, the roadway would likely be followed by an increase the rate of population growth and development within the Altar and Avra Valleys. A possible benefit may be that other roads in addition to the section of Sandario Road could be closed, and other smaller unpaved roads would receive less traffic.



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Road Network
in the Altar Valley Subarea

Highway or Major Road
Local Road

Figure 33

There has been a desire on the part of the Tohono O'odham Nation to have the Arizona Department of Transportation (ADOT) widen Ajo Highway (SR-86) between Tucson and Ajo. ADOT's recent study indicates current traffic conditions do not appear to warrant widening throughout, but spot improvements may be made between Tucson and Ajo to improve safety. If the roadway is widened in the future, impacts associated with increased traffic and widening would occur (i.e., habitat loss, spread of invasive species and increased roadkill.)

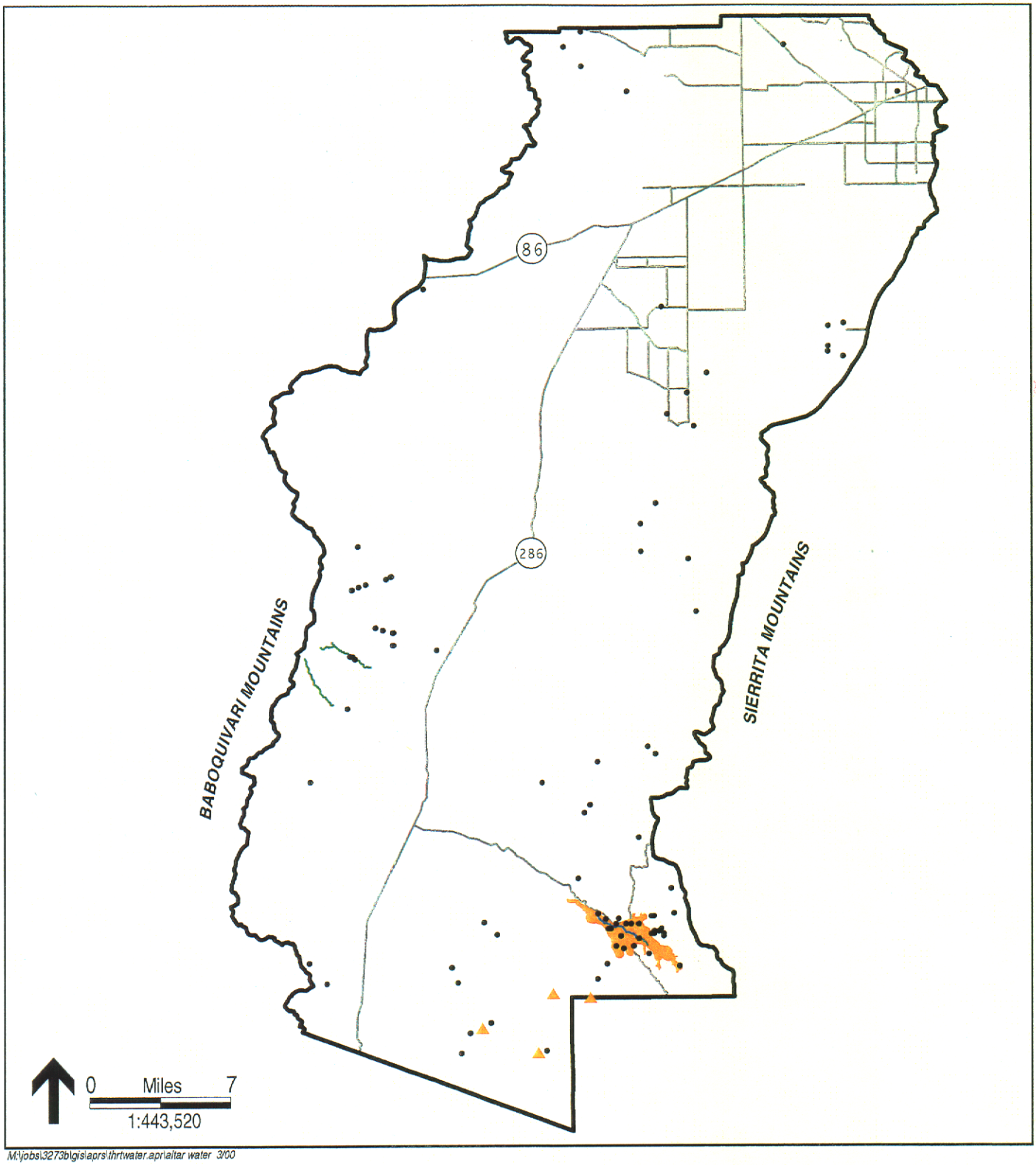
SR-286 between the community of Three Points and the border town of Sasabe runs through the central portion of the valley, through the Buenos Aires Wildlife Refuge. Traffic is expected to increase along this roadway due to increased regional tourism and increased truck traffic resulting from NAFTA. Road-kill of wildlife species is a potential source of stress, particularly within the Buenos Aires National Wildlife Refuge.

The TAA operates Ryan Airfield on the Ajo Highway. General aviation services for small aircraft are provided here (TAA 2000). The master plan for this facility projects steady growth during the next 20 years requiring the expansion of facilities and addition of a paved cross-wind runway (Tucson Business 1998). Since 1990 TAA has been purchasing properties and vacating lots within a wildcat subdivision to the west for safety and buffering of the airport.

3. Water Use

As with other areas outside of the service area for Tucson Water, this subarea is dependent upon groundwater pumping for water. There are several small water companies and numerous private wells, some with depth to water at less than 50 feet (PAG 2000). Several areas of shallow groundwater are found in the southern part of the subarea in the area of Arivaca Creek, lake, and cienega (Figure 34 and Table 21). These areas support unique habitats of riparian woodland and the cienega. The lot-split development pattern of this area raises concern for these areas because of the amount of groundwater pumping. Increased rates of withdrawal could negatively affect the surface stream flows and shallow groundwater available to support the associated riparian and cienega habitats. Surface water flow of Arivaca Creek is an essential component of the riparian habitat along the creek and is also important for many of the wildlife species of the Bueno Aires National Wildlife Refuge. Surface flows are regulated by a dam southeast of Arivaca. Arivaca Cienega is formed downstream. The cottonwood-willow and cienega habitats support an extremely high density of breeding birds (USDI-USFWS 1999). The western yellow-billed cuckoo is found here.

The increased growth and lot-split development pattern of this area raises concern for these areas because of the amount of groundwater pumping. Increased rates of withdrawal could negatively affect the surface stream flows and shallow groundwater available to support the associated riparian and cienega habitats. Loss of the cienega, the tall, mature cottonwoods and willows would result in fewer nesting sites for numerous bird species and would represent a loss of an essential habitat component for other wildlife species. In May 1999 the USFWS applied to ADWR for an instream flow permit for the reach of Arivaca Creek downstream from the cienega to insure adequate water is reserved to maintain the surface flows and vegetation.



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Surface Groundwater and Streams
in the Altar Valley Subarea

- Suspected Shallow Groundwater Areas (based on well data and aerial imagery)
- Well with Depth to Water less than 50 feet (ADWR Well 55-Registry and GWSI databases)
- Possible Shallow Groundwater Area (based on vegetation assemblages)
- Perennial Reach
- Intermittent Reach
- Major Street or Highway

Figure 34

TABLE 21

STREAM CHARACTERISTICS IN THE ALTAR VALLEY SUBAREA

Stream Name	Miles of Perennial Flow	Miles of Intermittent Flow	Acres of Hydro-mesoriparian Habitat	Acres of Class A Riparian Habitat	Acres of Shallow Groundwater	Pygmy-Owl Habitat	Fish Species	Leopard Frogs
Solano Wash	0	0	0	42	N/A	Yes	0	N/A
Sabino Wash	0	0	0	353	N/A	Yes	0	N/A
Saucito Wash	0	0	0	92	N/A	Yes	0	N/A
Penitas	0	0	0	230	N/A	No	0	N/A
Champarrado Wash	0	0	0	52	N/A	No	0	N/A
Sopori Wash	0	0	970	0	1,551	No	0	N/A
Thomas Canyon	0	3	0	195	N/A	Yes	N/A	N/A
Jupiter Canyon	0	0	0	35	N/A	Yes	0	N/A
Brown Canyon	0	3.4	N/A	124	N/A	Yes	N/A	N/A
Shaffer Wash	0	0	0	39	N/A	Yes	0	N/A
Weaver Canyon	0	0	0	40	N/A	Yes	0	N/A
Las Moras Wash	0	0	0	121	N/A	Yes	0	N/A
Pozo Hondo Wash	0	0	0	85	N/A	Yes	0	N/A
Asolido Wash	0	0	0	86	N/A	Yes	0	N/A
Unnamed tributary to Arivaca Creek	0	0	0	82	N/A	No	0	N/A
Arivaca Creek	2.7	0.7	1,051	23	3311	Yes	N/A	N/A
Yellow Jacket Wash	0	0	0	44	N/A	No	0	N/A
McCafferty Canyon	0	0	0	80	N/A	No	0	N/A
Cedar Canyon	0	0	N/A	N/A	Yes	No	0	N/A
Apache Canyon	0	0	0	55	N/A	No	0	N/A
Jalisco Canyon	0	0	0	48	N/A	No	0	N/A
Cuadro Wash	0	0	0	28	N/A	Yes	0	N/A
Fraguita Wash	0	0	N/A	N/A	Yes	No	0	N/A

TABLE 21
STREAM CHARACTERISTICS IN THE ALTAR VALLEY SUBAREA
(continued)

Stream Name	Miles of Perennial Flow	Miles of Intermittent Flow	Acres of Hydro-mesoriparian Habitat	Acres of Class A Riparian Habitat	Acres of Shallow Groundwater	Pygmy-Owl Habitat	Fish Species	Leopard Frogs
East Fork Apache Canyon	0	0	N/A	N/A	Yes	No	0	N/A
La Osa Wash	0	0	N/A	54	N/A	Yes	0	N/A
San Luis Wash	0	0	N/A	N/A	Yes	No	0	N/A
Arrieta Wash	0	0	N/A	N/A	Yes	No	0	N/A
Fresnal Wash	0	0	N/A	N/A	Yes	No	0	N/A

N/A = not applicable.

Water quality has been a problem at Arivaca Lake. Runoff from upstream sources resulted in such high pollutant levels in fish that they cannot be eaten. All fish caught in the lake must be released. Historic mining activities at higher elevations upstream from the lake are thought to be the source of contamination (USDI-BAWR 2000).

Competition and predation by invasive and non-native species (e.g., bullfrogs, large-mouth bass, and other stocked sport fish) in the lake and creek is a source of stress for native frogs and the Mexican garter snake.

The CAP aqueduct crosses through the valley to the Hayden-Udall Treatment Plant near Ajo Highway and Kinney Road. The Regional Recharge Plan prepared by the Arizona Department of Water Resources reflects several proposed CAP recharge basins in this subarea. One site located near the confluence of the Brawley and Black Washes; the other site is located along Brawley Wash, south of Ajo Highway. Neither of these sites are being actively investigated. Between them they would have a capacity of over 80,000 acre-feet per year (ADWR 1998). If built they would require the removal of many acres of vegetation but would contribute to reduced groundwater pumping within the Tucson basin.

The BOR originally considered a site in the Tucson Mountain Park for a storage reservoir for CAP water and alternatively, a multi-purpose lake with a recreational component. A proposal currently being considered calls for a terminal storage reservoir near Black Wash where there is a turnout for the Pascua Yaqui Reservation.

As partial mitigation for the CAP impacts to biological resources, an area of approximately 2,500 acres was purchased and set aside for conservation. This "Tucson Mitigation Corridor" (TMC) is located between Tucson Mountain Park and the Garcia Strip of the Tohono O'odham Nation and was intended to provide an undeveloped wildlife movement corridor between the two areas. It consists of two tracts separated by the CAP aqueduct. The area is fenced and managed for wildlife resources by Pima County. There is an existing well, several stock tanks and several wildlife drinkers. Special status species within the TMC include Tumamoc globeberry, Thornber fishhook cactus, and night-blooming cereus. If the San Joaquin loop roadway was built, it could extend through the middle of the TMC, thereby impacting wildlife movements through the corridor.

The Altar Valley was at one time more intensively farmed than today, particularly north of Ajo Highway. In the 1960s the City of Tucson began to purchase farms in order to utilize the groundwater for municipal purposes. Now most of the fields are abandoned and have been taken over by invasive grass and weed species. Some of the fields were planted with exotic grasses which continue to be a problem (Tellman 2000).

4. Recreation

Opportunities for recreation within the Altar Valley Subarea are found in the Saguaro National Park, the Tucson Mountain Park, Coronado National Forest, Buenos Aires National Wildlife Refuge, and the Baboquivari and Coyote Mountain Wilderness Areas. Recreation use includes a full range of activities such as hiking, camping, mountain biking, target practice, hunting, bird watching, and wildlife viewing. Old Tucson and the Arizona-Sonora Desert Museum are two of the biggest tourist attractions of the region.

Tucson Mountain Park has been one of the Tucson area's most popular outdoor recreation destinations for many decades, and presently offers a variety of recreational opportunities, mostly low impact. Trails access is being enhanced and more people use the Park every year. The park is bisected by roads, Kinney and Gates Pass, that carry high volumes of traffic. Effects on biological resources include resource damage from "wildcat" trails, disturbance of wildlife by domestic pets, growing presence of exotic grasses and other species, wildlife disturbance by human use/overuse and road-killed wildlife (Pima County-Mt. Parks 1999). At over 121,000 acres the BAWR occupies a large part of the southern portion of the valley and offers unimproved camping and exceptional wildlife viewing.

B. Biological Resources

1. Vegetation and Land Cover

Habitat within the Altar Valley Subarea consists primarily of mixed grass scrub and drainages containing mixed scrub vegetation. In the east and west there are limited areas of oak-pine and oak forests. In the northern portion of the subarea the habitat is dominated by palo verde-mixed cacti interspersed with areas of creosote-bursage, creosote-tarbush, agricultural fields, and urban development. In the southeast corner of the subarea there is a wetland supporting cattail (Figure 35).

2. Critical Habitat

Critical Habitat for the CFPO, Map Unit 1, has been designated for the land between the BAWR and the Tohono O'odham Nation, south of Ajo Highway to the U.S. border. It is characterized by semidesert and Sonoran savanna grasslands with a series of xeroriparian washes extending from the Baboquivari Mountains to Altar and Brawley washes. There are a few isolated saguaros at the north end of the unit. There are several known CFPO sites in the unit. The most recent sites were in riparian and xeroriparian habitats. Activities that pose a threat to the Critical Habitat for the CFPO include removing or destroying vegetation; water diversion, impoundment, or groundwater pumping that alters water quality or quantity to an extent that riparian vegetation is significantly affected; and recreational activities that appreciably degrade vegetation (USDI-USFWS 1999).

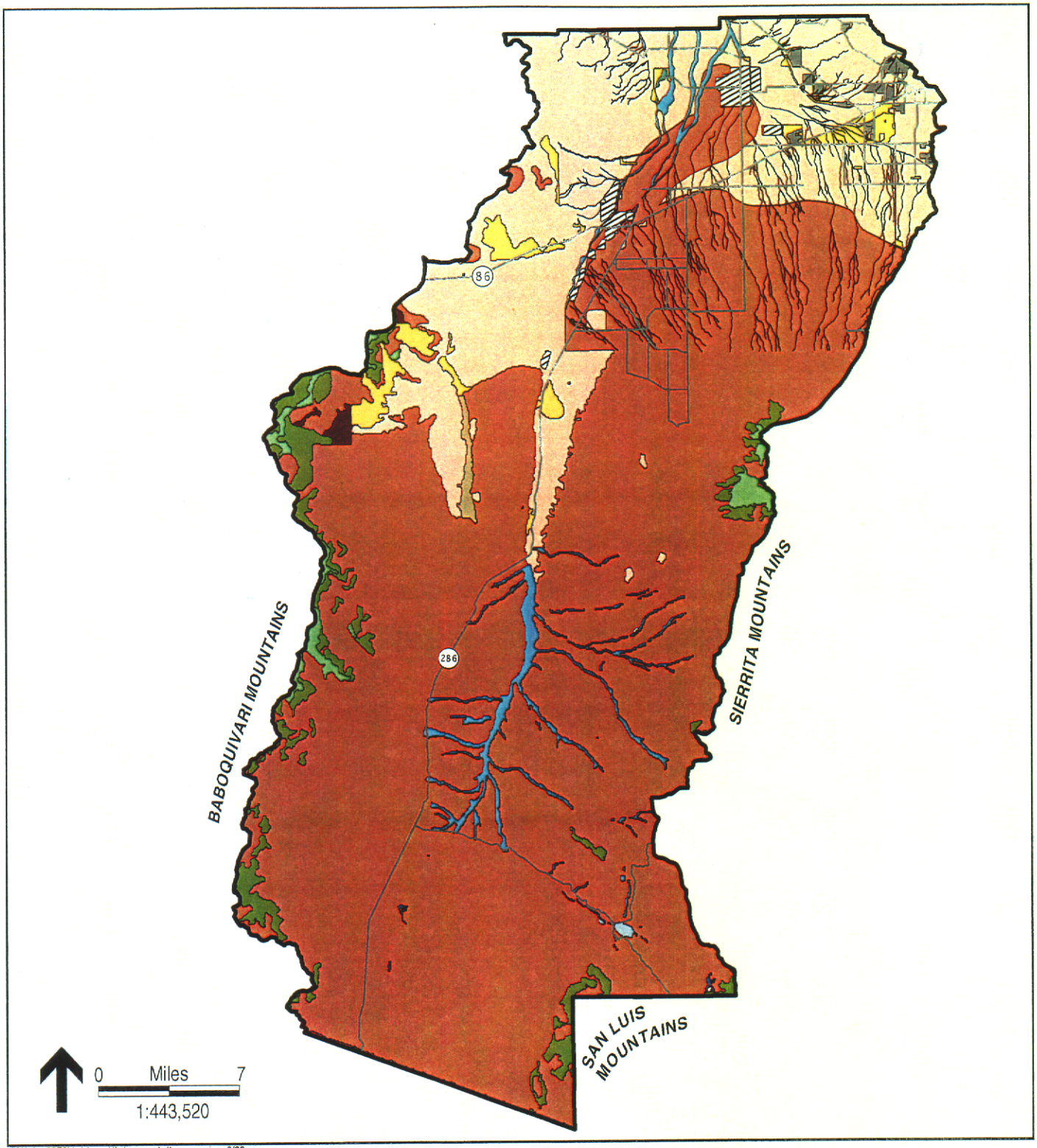
In February 2000 the USFWS gave notice of a petition to consider listing the yellow-billed cuckoo as endangered. If the listing is determined to be warranted and the USFWS may designate critical habitat. This species prefers dense riparian thickets. Habitat for this bird along the Arivaca Creek, where its presence has been documented.

3. Species at Risk

A total of 15 Status 1 and 2 Vulnerable Species occur within the subarea (Table 22).

C. Existing and Proposed Preserves

Several additions to the preserves mentioned above have been identified by both the Open Space Acquisition Plan and the Mountain Parks Plan. Several parcels of private land have been identified to expand Tucson Mountain Park on the south and west sides



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Vegetation and Land Cover
in the Altar Valley Subarea

Vegetation Communities (BLP Classification)

- 123.31 Encinal (Oak)
- 123.32 Oak-Pine
- 133.32 Manzanita
- 133.36 Mixed Evergreen Sclerophyll
- 143.15 Mixed Grass-Scrub
- 153.21 Creosotebush-Tarbush
- 154.11 Creosote-Bursage
- 154.12 Paloverde-Mixed Cacti
- 223.22 Mixed Broadleaf
- 224.53 Cottonwood-Willow
- 234.71 Mixed Scrub
- 244.71 Cattail

Other Land Cover Types

- 999.0 Unclassified
- 999.1 Agriculture
- 999.2 Urban
- 999.3 Water
- Major Road or Highway

Figure 35

TABLE 22
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE ALTAR VALLEY SUBAREA

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Amsonia kearneyana Kearney's Blue Star	1	S1	FE FSS HS	Extreme rarity, canyon bottom habitat vulnerable to flooding. Protection of populations from disturbance. Physical damage from livestock. Seed predation.	Baboquivari Peak, Brown Canyon 1991 State, 1998 Private, 1996, 1998 BLM; Thomas Canyon 1982 Private1998 BLM	The original natural population was on the Tohono O'odham Nation land. An artificial population was established by transplants in Brown Canyon; Buenos Aires National Wildlife Refuge.
Colinus virginianus ridgwayi Masked Bobwhite	1	S1	FE WSC	Extreme rarity. Historic overgrazing and drought. Predation. Fire suppression. Invasive non-native plant species. Unknown reasons for failure to become re-established after reintroductions.	Fresno Wash quad Altar Wash 1975 FWS Buenos Aires NWR Las Guljas quad Puertocito Wash and Arivaca Wash 1980 FWS Buenos Aires NWR	This species is found only on Buenos Aires NWR and is being reintroduced.
Coryphantha scheeri var. *robustispina* Pima pineapple cactus	1	S2	FE HS	Narrow distribution, much of which is on private and Indian lands and much of which has been developed. Development, off-road vehicle traffic.	60 records for Pima Co. 23 for this subarea. Brown Mountain quad, 4 records 1990-1992 Private and BOR Cat Mountain quad: 3: BLM, BOR, Private San Pedro quad, 2 records 1992 BOR Three Points quad, 5 records 1989 State, 4 1992 BOR. San Xavier	May not be a valid variety using today's standards.

TABLE 22
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE ALTAR VALLEY SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
					Mission SW quad 2 records 1991, 1992 BOR San Xavier Mission quad 1993 Private. Palo Alto Ranch quad 1982 State. Fresno Wash quad 2 records 1987 State. Penitas Hills quad 1987 State Presumido Peak 1992 FWS	
Cyprinodon macularius macularius Desert pupfish	1	S1	FE WSC	Habitat loss through groundwater pumping and watershed changes. Competition and predation by introduced species. Dewatering of habitats, stream impoundment, channelization, domestic livestock grazing, timber harvesting, mining, road construction, polluting, and stocking non-natives.	Cat Mountain quad. 1998 private	There are no natural populations of this subspecies remaining in Arizona. A reintroduced population exists at Cold Springs in Graham County,. There are also several refugia populations in private ponds and aquariums.

TABLE 22
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE ALTAR VALLEY SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Glaucidium brasilianum cactorum Cactus ferruginous pygmy-owl	1	S1	FE FSS WSC	Habitat destruction and alteration, historic and present. Groundwater pumping, channelization, urbanization, historic livestock grazing? Farming and agricultural uses? Wood cutting. Disturbance by bird watchers. Small population subject to stochastic events. Possibility of disease, including emerging diseases, and loss of viable food supply as a result of drought and/or climate change.	Palo Alto Ranch quad 5 records 1999 State. Penitas Hills quad 3 1999 State. Mildred Peak quad 1999 State. Las Guijas quad 1982 FWS. Presumido Peak quad 1999 FWS Wilbur Canyon quad 1998, 1999 FWS Sasabe quad La Osa Wash 1999 Private.	Subarea is included in Critical Habitat
Muhlenbergia xerophila Weeping muhly	1	S1	FSS	Very narrow distribution.	Baboquivari Peak quad Thomas Canyon 1982 Private.	
Poeciliopsis occidentalis occidentalis Gila topminnow	1	S2	FE FSS WSC	Non-native species, competition and predation. Habitat loss by ground-water pumping and channelization. Flooding. Drought. Dredging. Poor water quality. Livestock grazing (trampling by cattle, watershed changes).	Cat Mountain quad 1999 Private Arivaca quad. Altar Valley, Arivaca Creek drainage, 1989, private	

TABLE 22
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE ALTAR VALLEY SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Rana chicahuensis Chiricahua leopard frog	1	S3	FC FSS WSC	Disease. Introduced predators/competitors. Loss of habitat, groundwater pumping, water diversions. Center for Biological Diversity alleges threats are: "continued degradation and destruction of Southwest riparian areas by livestock grazing, groundwater pumping, water diversion, and dams. They are also threatened by exotic species, such as the bull frog and the large-mouth bass, which compete with and prey on the frog"	Wilbur Canyon quad 1986 FWS. Arivaca quad, Arivaca Creek, 1992 private. Murphy Peak quad, Tumacacori Mtns. 2 sites. 1989 USFS. Bartlett Mtn. quad 1992 USFS.	CBD sued to list as endangered 8/27/99
Coccyzus americanus occidentalis Western yellow-billed cuckoo	2	S3	F-petitioned FSS WSC	Habitat destruction and alteration, historic and present. Groundwater pumping, channelization, urbanization, historic livestock grazing? Farming and agricultural uses? Wood cutting. Reduction of acreage in pecan farming.	Saucito Mtn. quad Sopori Wash 1980 Private Wilbur Canyon quad, Arivaca Creek, 1993 FWS. Arivaca quad. Wilbur Wash 1994 private Arivaca Creek 1994 FWS	Positive 90-day finding on petition, 2/17/00

TABLE 22
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE ALTAR VALLEY SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Panthera (=*Felis*) *onca* Jaguar	2	S1	FE WSC	Shooting, trapping. Extreme edge of species range.	Baboquivari Peak quad 1996 State.	In 1988, a jaguar was observed in Altar Valley and in the Baboquivari Mountains March of 1996, a jaguar was spotted and confirmed with video and photographs. Unconfirmed sightings have been reported in the Buenos Aires National Wildlife Refuge
Lasiurus blossevillii (=*borealis*) Western red bat	2	S2	FSS WSC	Habitat loss as a result of groundwater pumping, channelization, wood cutting, leading to loss of riparian areas. Farming and agricultural uses, specifically secondary poisoning and reduction of food supply resulting from insecticide use.	Sasabe quad Arroyo del Sasabe 1993 FWS	
Plecotus townsendii pallescens Pale Townsend's big-eared bat	2	S3S4	FSC	Disturbance of roosts by recreationists and renewed mining.	Stevens Mtn. quad 1995 BLM. Samaniego Peak quad Tascuela Canyon 1996 BLM. Cerro Colorado quad Las Guijas Mountains 1996 BLM. Arivaca quad Fraguita Spring 1986, 1991 USFS.	This species is probably more common in the area than the records indicate.

TABLE 22
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE ALTAR VALLEY SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
					Bartlett Mtn. quad 1986 USFS	
Rana yavapaiensis Lowland leopard frog	2	S4	SC FSS WSC	Groundwater pumping, disease, water pollution, invasive non-native species, ozone loss, unknown causes of population declines	Arivaca quad, Arivaca Creek 1981 private.	
Thamnophis eques megalops Mexican garter snake	2	S2S3	FSC FSS WSC	Predation by bullfrogs. Aquatic and riparian habitat degradation and destruction.	Arivaca quad, Arivaca Creek, 1981 private	
Tumamoca macdougalii Tumamoc globeberry	2	S3	FSS SR	Threats include urbanization, farming, overgrazing, recreation, habitat conversion, javelina (eating tubers), off-road vehicle use, pesticides.	Brown Mountain quad 5 sites 1984 Private and State. Cat Mountain quad, 13 sites, 1984-1988 Private, BLM, State. San Pedro quad 1986 BLM Three Points quad 3 sites 1984 BLM San Xavier Mission quad, 2 sites, 1988 private.	This species was formerly listed as endangered, but was delisted because it was found to be more common than thought at the time of listing.

QUADS: La Tortuga Butte, Cocoraque Butte, Brown Mtn. Cat Mountain, San Pedro, Three Points, San Xavier Mission SW, San Xavier Mission, Kitt Peak, Palo Alto Ranch, Stevens Mtn., Samaniego Peak, Baboquivari Peak, Fresno Wash, Penitas Hills, Batamote Hills, Aguirre Peak, Mildred Peak, Las Guijas, Cerro Colorado, Saucito Mtn., Caponera Peak, Presurnido Peak, Wilbur Canyon, Arivaca, Murphy Peak, Sasabe, Cumero Mountain, Bartlett Mountain.

(Pima County-Open Space 1999) and a recent action by the County Board of Supervisors adds an additional 746 acres of private land on the south side.

The proposed Cerro Colorado Mountain Park would cover over 14,000 acres of mountainous terrain and high-desert grassland east of the BAWR. Although most of the area is State Land, approximately one-third is privately owned and otherwise subject to lot-splitting. Another acquisition of areas along the Penitas Wash would link the BAWR and the Cerro Colorado Mountains and provide a valuable biological corridor between the two areas. The wash and watershed helps sustain riparian habitat in the BAWR. A rare spotted jaguar was reportedly seen in the range in 1997 and the area supports masked bob-white quail, both endangered (Pima County-Mt. Parks 1999). Conversion of the land character from undeveloped open space to lot-splitting or other higher intensity uses would compromise the ability to protect the wildlife and unique habitats present here.

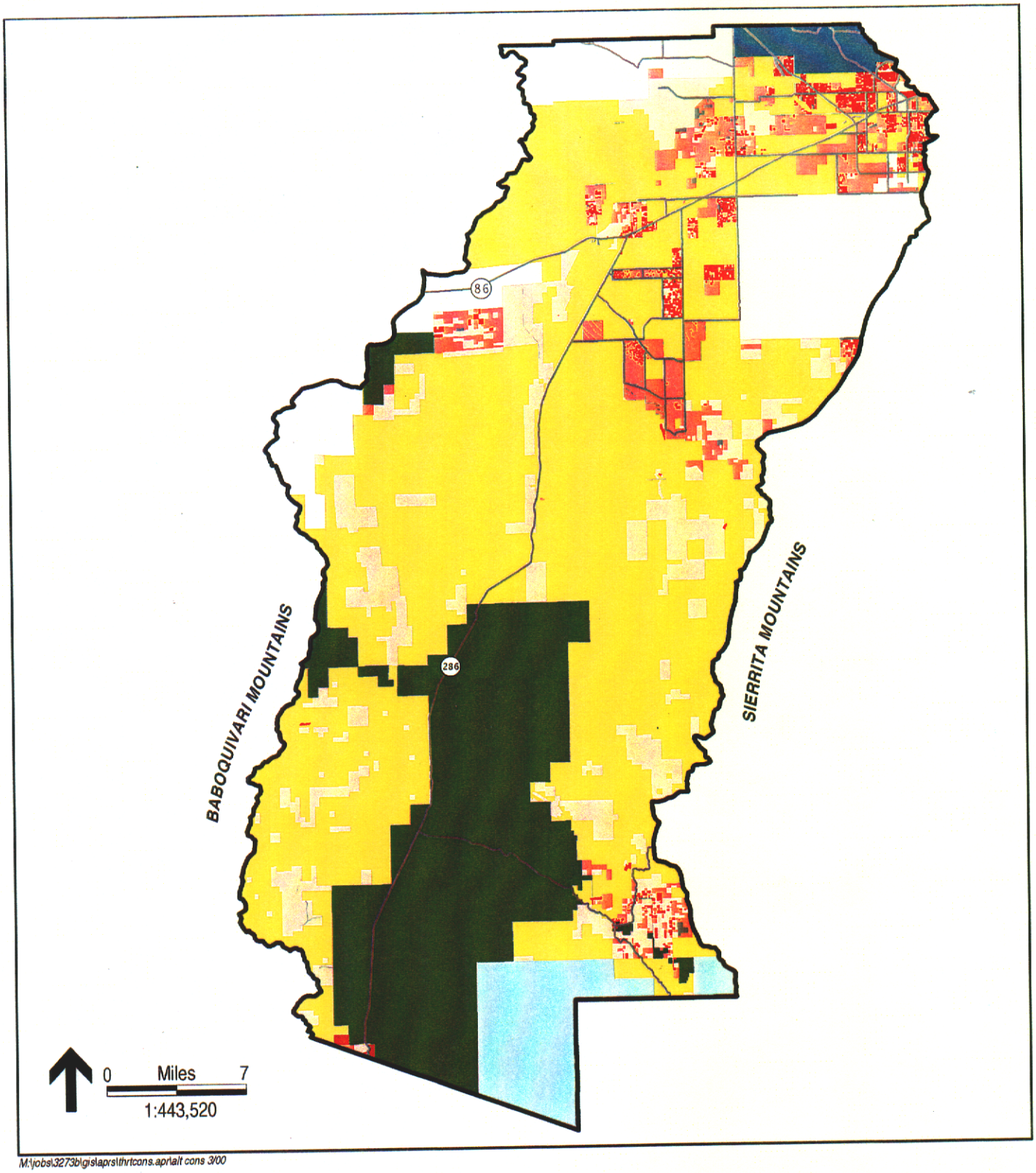
The BAWR is the largest ungrazed grassland in the state (Pima County-Land Stewardship 2000). Although there is a strong presence of Lehman's lovegrass there are also thousands of acres of sacaton and other tall grasses. Fire is used aggressively as the primary management tool to maintain the healthy grassland and to rid the Refuge of mesquite, burroweed, and snakeweed (USDI-BAWR 2000). Surveys for Pima pineapple cacti are conducted prior to burns. The biggest stressor to the Refuge's biological resources at this time is the huge number of undocumented aliens (UDAs) crossing over the U.S./Mexico border. On a daily basis fences are cut, new trails are made, trash is dropped, and plants are damaged or cut down according to Wayne Shifflet, Refuge Manager. These impacts are compounded by increased efforts by the Border Patrol result in both increased use of existing dirt roads along the border and new trails or roads made by patrol vehicles (USFS, Henn, 2000 and USDI-BAWR 2000). The border crossing station has been recently improved and expanded but it is only open between 8:00 A.M. to 8:00 P.M. An influx of UDAs occurs every night.

The BAWR has ownership of almost all of the Arivaca Creek that extends southeast to the Arivaca Lake and Cienega. Arizona Game & Fish Department own the lake area. The BAWR is continuing to acquire land around these unique and valuable biological resources (USDI-BAWR 2000). (See related discussion under Water Uses.)

D. Summary of Potential Stressors to Biological Resources

The primary biological stressors of the Altar Valley subarea are habitat degradation, habitat fragmentation, conversion of vegetative cover, invasive species, human use, and overuse and decline in water quality (downstream from historically mined areas). The current ownership and management pattern within the Altar Subarea is a gradient from highest level of conservation in the south (Buenos Aires Wildlife Refuge) to urbanization in the north, and with extensive ranchlands between (Figure 36).

Activities contributing to biological stress are summarized on Table 23. These can be most attributed to the effects of drought, overgrazing, fire suppression, introduction of invasive species, recreational activities, lot-splitting, mining, and illegal border crossings. Habitats most at risk include Critical Habitat for the CFPO, semidesert and Sonoran savanna grasslands, areas of ironwood forests, riparian and xeroriparian areas (particularly along Arivaca Creek), the Arivaca Cienega, stream segments with perennial



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Level of Threat Represented by Conservation Status
in the Altar Valley Subarea

Level of Threat: Low → High

Conservation Status: Most Protected → Least Protected

1a	
2	
3b	
4a	
4b	
4c	
4e	
4f	
4x	

(For status definitions, see GAP Status Categorization Table in Methods section.)

Figure 36

TABLE 23
LAND USE ACTIVITIES WITHIN LAND OWNERSHIP/MANAGEMENT CATEGORIES OF THE ALTAR VALLEY SUBAREA

Ownership or Management Category	Land Uses and Activities											
	Conversion of Vegetative Cover	Conversion of Ranches	Lot-Splitting & Urbanization	Cultivated Land	Groundwater Pumping	Water Diversion & Impoundments	Recreational Uses	Illegal Border Crossings	Mining	Roadways	Livestock Grazing	Removal of Plants
Coronado National Forest (30,362 acres)	x	x	-	-	*	x	x	x	x	x	x	x
Baboquivari Wilderness (2,058 acres)	x	-	-	-	*	*	x	-	-	x	✪	✪
Coyote Mountain Wilderness (3,726 acres)												
BLM Unreserved (55 acres)												
BOR Wildlife Corridor (1,938 acres)												
Pascua Yaqui Nation Unreserved (1,158 acres)												
Tonono O'Odham Nation Unreserved (72,769 acres)												
Tucson Mountain Park (7,152 acres)	x	-	-	-	x	*	x	-	-	x	✪	✪
Buenos Aires Wildlife Refuge (121,279 acres)	x	-	-	-	*	*	x	x	-	x	✪	✪
State Land (317,368 acres)	x	*	*	*	x	x	x	x	x	x	x	x
Private Lands (155,808 acres)	x	x	x	x	x	x	x	x	x	x	x	x

x = occurs
- = does not occur
* = potential to occur
✪ = historic but not present occurrence

flows, and areas of shallow groundwater. Potential for conversion of ranches, lot-splitting, and wildcat subdividing are serious and growing concerns, particularly in areas adjacent to existing preserves. Increased growth in these areas would contribute to increased habitat fragmentation and has serious implications for increased groundwater pumping.

Retaining adequate surface flows and ground water levels to support the Arivaca Creek and Cienega is one of the primary consideration for this subarea. The instream flow request filed by the USFWS seeks to achieve that on a long-term basis. Status 1 and 2 vulnerable species directly affected by this include the Gila topminnow, Chiricahua leopard frog, lowland leopard frog, western yellow-billed cuckoo, and the Mexican garter snake.

Competition and predation by invasive and non-native species (e.g., bullfrogs, large-mouth bass, and other stocked sport fish) in the lake and creek is a source of stress for native frogs and the Mexican garter snake.

Mining could have a negative impact on this subarea due to the presence of medium to high potential for mineral resources in the San Luis Mountains, which form the upper southwestern watershed of Arivaca Creek. Effects on biological resources from mining could include large-scale degradation of intact areas, habitat loss and fragmentation, potential for downstream watershed contamination, and intensive groundwater pumping to support mine operations. Habitats most affected would be the riparian communities along Arivaca Creek and the Cienega.

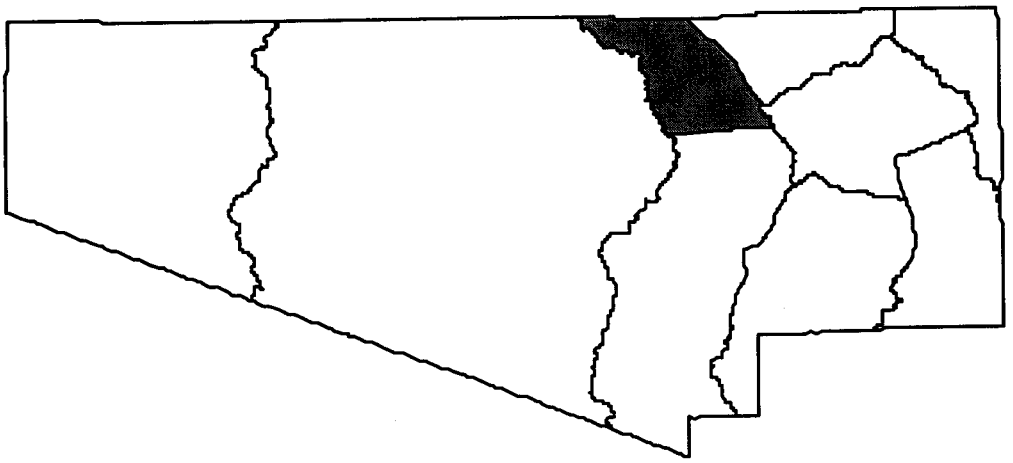
If the loop roadway shown by the County's Long Range Transportation Plan is built to extend San Joaquin Road the alignment could bisect the Tucson Mitigation Corridor established by the BOR. This would result in habitat loss and fragmentation and serve as a barrier to wildlife movements that the TMC provides between Tucson Mountain Park and the Tohono O'odham Nation. The TMC is entirely with Map Unit 2 of CFPO Critical Habitat.

Avra Valley

Sub Area 6b

IX. Avra Valley (Subarea 6b)

The Avra Valley Subarea includes the northern extent of the Brawley Wash watershed north of Mile Wide Road, between the Santa Cruz River and the Tohono O'odham Nation (Figure 37). It includes the Silver Bell, Waterman, and Roskruge Mountains on the west and the Tucson Mountains on the east.

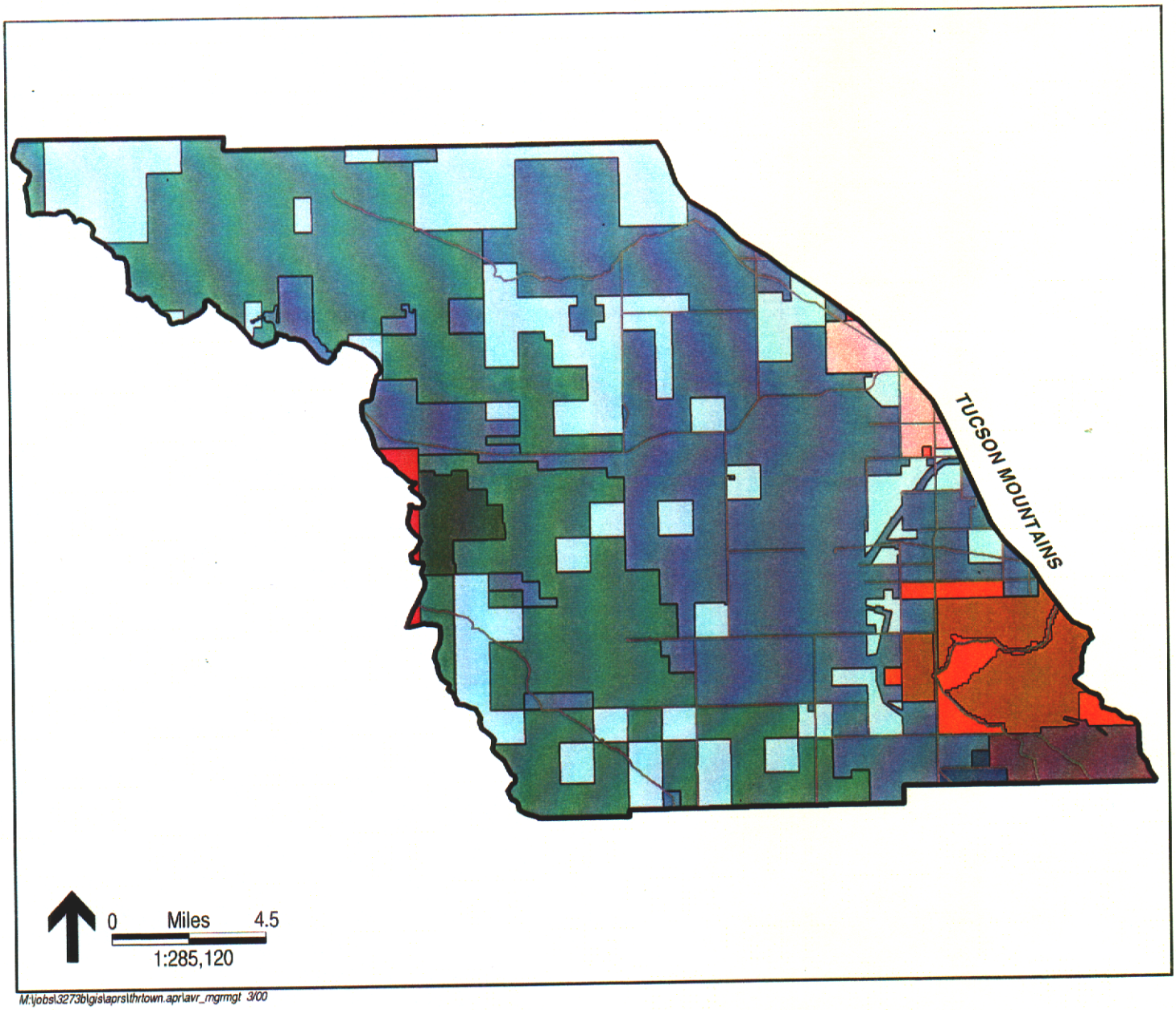


Avra Valley Subarea Location in Pima County
Figure 37

A. Potential Threats and Stressors

1. Land Use and Landscape Character

The subarea character changes from one of a relatively undeveloped open and mountainous landscape on the west side, to one of rural residential homesites in the eastern portion of the Marana area (Figure 38). The County's Conceptual Land Use Element shows the western private lands as Rural Planning District and the eastern portion surrounding Marana as an Urban Planning Sector. The Subregion Plan indicates much of the Brawley Wash area as Resource Conservation (Pima County 1989). Although there are a number of residential subdivisions, the predominant means of development in the subarea has been by lot-splitting and wildcat subdividing. Typifying this is the Picture Rocks area, said to be the largest wildcat subdivision area in the state with a population of approximately 10,000 people (Star 2000). It is located at the northwest side of Saguaro National Park. Problems in this and other lot-split areas in the valley that affect biological resources include dust, erosion and runoff problems associated with unpaved roads, increasing groundwater pumping, encroachment into floodplain areas (Pima County 1998), removal of vegetative cover, damage to and/or removal of xeroriparian vegetation, and introduction and spread of exotic species. These



Land Ownership and Land Management
in the Avra Valley Subarea

- BLM - Silverbell Resource Conservation Area
- BLM - Waterman Mountains ACEC
- BOR - BOR Wildlife Corridor
- Marana Unreserved - Private Lands
- Marana Unreserved - State Trust Lands
- NPS - Saguaro National Park West
- NPS - Saguaro National Park West Wilderness Area
- Pima County - Tucson Mountain Park
- Pima County Unreserved - Private Lands
- Pima County Unreserved - State Trust Lands
- Tohono O'Odham Nation - Unreserved
- Major Road or Highway

Figure 38

result in habitat loss and fragmentation, decline in groundwater levels, and competition and predation by invasive species.

Conversion of agricultural land to residential uses continues at an increasing rate, particularly in the area of Marana. Although the Marana Future Development Plan (Town of Marana 1999) indicates lands west of the Santa Cruz as open space agriculture, lot splitting has occurred and residential subdivisions have been built there.

Irrigated agricultural fields once displaced much of the native vegetation in the valley. Many of the farmlands have been purchased by Tucson Water starting in the 1960s for groundwater pumping rights to support the municipal water supply system. The abandoned fallow fields are no longer irrigated and have been at times covered with tumbleweeds and seeded with non-native grasses. Competition by non-native and invasive species is a stressor to adjacent biological resources, particularly resulting from the proliferation of non-native grasses. (See related discussion under Water Uses.)

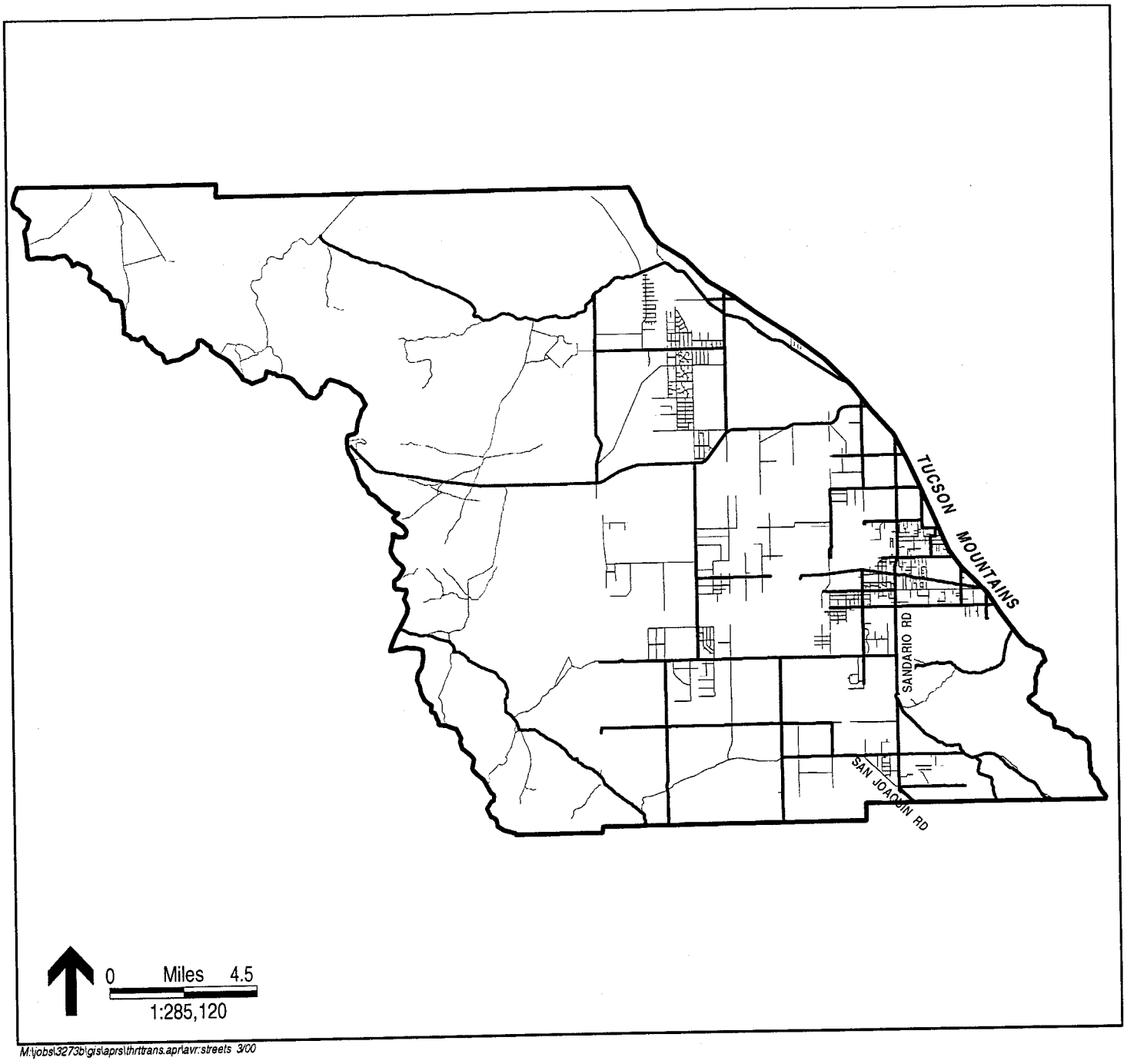
Mining began in the Silver Bell Mountains in the early 1900s, when ASARCO began acquiring properties. They have operated the Silver Bell open-pit copper mine that is still active. In 1992 a land exchange between ASARCO and the BLM resulted in the expansion of the mine and the setting aside of the Waterman Mountains Area of Critical Environmental Concern (ACEC). The Waterman Mountains ACEC supports and is managed specifically to protect the endangered Nichol's Turk's Head Cactus. Mineral rights have been withdrawn from the ACEC (Pima County-Land Stewardship 2000).

Much of the subarea consists of public lands. With the exception of the Silver Bell Mine, most of the Silver Bell, Waterman, and Roskruge Mountains are either BLM or State Lands (Pima County-Mt. Parks 1999). Any of the BLM lands outside of the Silver Bell Mountains RCA and the Waterman Mountains ACEC are considered to be up for disposal and State Lands are potentially developable as well. If these lands were available for development they would be at risk for lot-splitting and the associated problems that are prevalent in the eastern portion of the valley. Also, mining is still an allowed use within the Silver Bell RCA (Pima County-Land Stewardship 2000). If mining is actively pursued on these BLM lands it would result in some level of habitat loss and degradation.

2. Transportation

Major roads within the Avra Valley Subarea include Sandario, Avra Valley, and Picture Rocks Road (Figure 39). Numerous smaller (and many unpaved) roads dissect the valley floor, particularly in the eastern half. Many of these are associated with past and present farms and lot-split areas. As a result the remaining habitat is highly fragmented.

The County's Long Range Transportation Plan (Pima County 1986) shows a loop road in this subarea as a key feature. It would connect at Tangerine Road, extend to the southwest paralleling the CAP around the west side of Saguaro National Park and loop back through Altar Valley to connect with San Joaquin Road. If built, this roadway would cross the CAP canal, the Santa Cruz River, and would be tied to an expansion of the Avra Valley Airport. The roadway is planned as a controlled access facility, with a 300-foot-wide right-of-way. The present segment of Sandario Road through the park would be abandoned when this roadway is completed. Building such a large roadway would



Road Network
in the Avra Valley Subarea

Highway or Major Road
Local Road

Figure 39

result in loss of much habitat, including areas of ironwood, grasslands, and Critical Habitat for the CFPO. Further, the roadway would likely be followed by an increase the rate of population growth and development within the Altar and Avra Valleys. A possible benefit may be that other roads in addition to the section of Sandario Road could be closed, and other smaller unpaved roads would receive less traffic.

Picture Rocks Road provides easy access for the numerous residents on the north and west flanks of the Tucson Mountains and Saguaro National Park. It crosses through the Saguaro National Park and is experiencing increased traffic due to the growing population in Avra Valley, particularly in Picture Rocks area. Sandario Road also crosses the Park on the west side.

Avra Valley Airport is located near Avra Valley and Sanders Road. It handles small aircraft only. The County's Long Range Transportation Plan mentions the expansion of the airport as part of a complex multipurpose proposal for transportation and flood control.

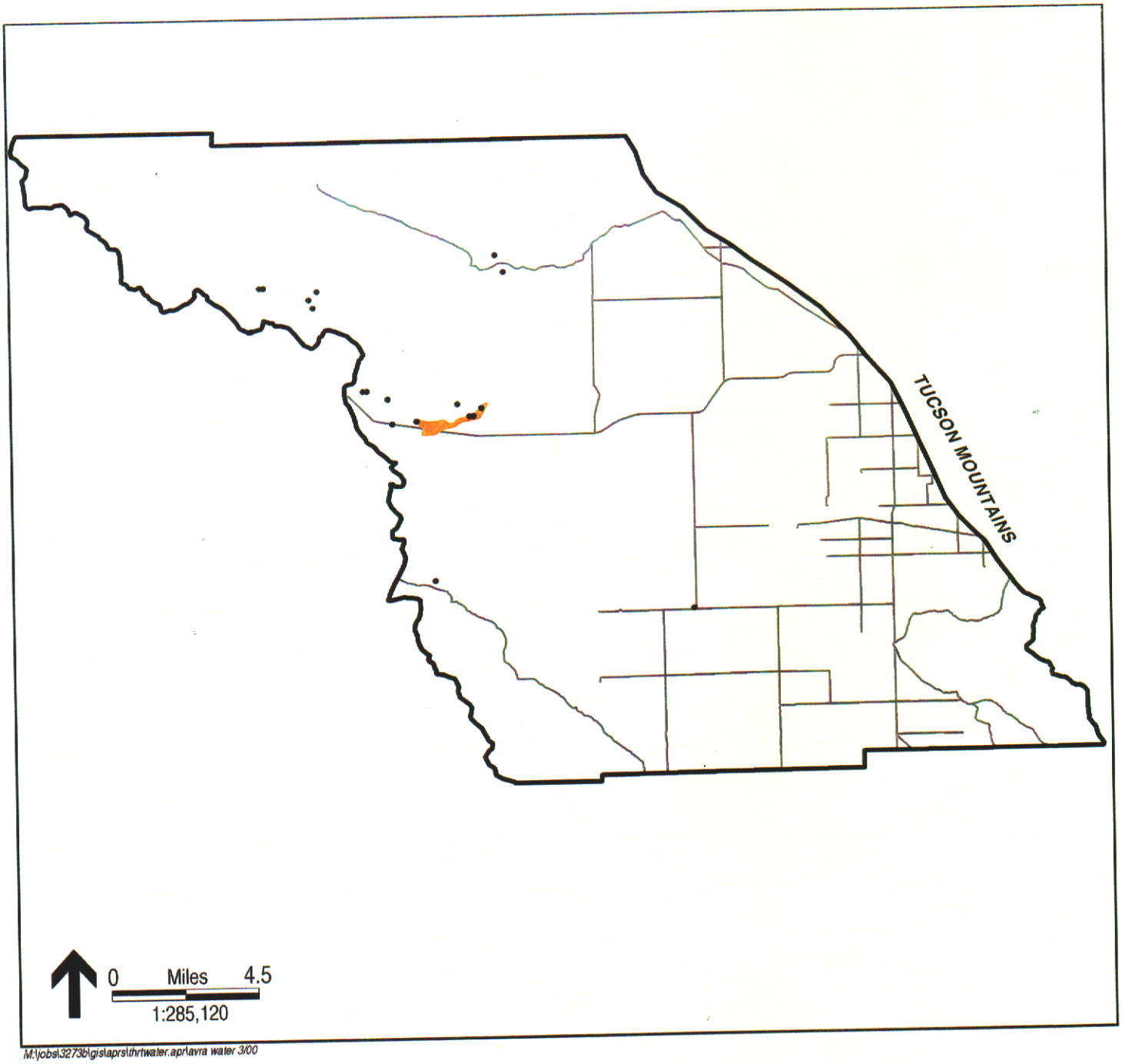
3. Water Use

Groundwater is the primary source of water for the Avra Valley. There are several private water companies and numerous private wells. Additionally, the Avra Irrigation District and the Cortaro-Marana Irrigation District supply agricultural and domestic water. Historic and ongoing groundwater pumping has resulted in a 50- to 150-foot decline in depth to groundwater since 1945 in this subarea. Depth to water is 400 feet or more in the city of Tucson's well-fields west of Brawley Wash. Based on well data and the vegetation present just east of the Silver Bell Mine, an area of shallow ground water has been identified along Cocio Wash between the Silver Bell and Waterman Mountains (Pima County-Water Resources 1999). Considering the upstream proximity of the Silver Bell Mine, their water requirements, and use of solvent extraction of ores this shallow groundwater area may be vulnerable to contamination. No areas of perennial flow have been documented on this subarea (Figure 40 and Table 24).

The Avra Irrigation District, the Cortaro-Marana Irrigation District, and BKW Farms have used a total of 25,000 acre-feet of CAP water per year under a program in which the farms agree to pump less groundwater in return for subsidized use of CAP water. Additionally, the Cortaro-Marana Irrigation District uses approximately 3,000 acre-feet of effluent per year (Tellman 2000).

Combined, the use of CAP water and effluent within the Avra Valley Subarea help reduce groundwater dependency and contribute to recharge of the regional aquifer. Although recharge basins reflect a large amount of surface area that was once covered with native vegetation, they can be built in areas that have already experienced a conversion of vegetative cover such as abandoned farm lands and sand and gravel pits. Biological stresses associated with these alternative water sources include the potential for introduction of non-native aquatic species.

Directly affecting uses of CAP water, the USFWS issued a jeopardy decision in their recent draft Biological Opinion of the impacts of Santa Cruz River Basin recharge projects on the endangered Gila topminnow. The BOR and the USFWS are continuing to work through the Section 7 consultation process. As part of their Biological Assessment



Surface Groundwater and Streams
in the Avra Valley Subarea

Suspected Shallow Groundwater Areas
(based on well data and aerial imagery)

Well with Depth to Water less than 50 feet
(ADWR Well 55-Registry and GWSI databases)

Major Street or Highway

Figure 40

TABLE 24

STREAM CHARACTERISTICS OF THE AVRA VALLEY SUBAREA

Stream Name	Miles of Perennial Flow	Miles of Intermittent Flow	Acres of Hydro-mesoriparian Habitat	Acres of Class A Riparian Habitat	Acres of Shallow Groundwater	Pygmy-Owl Habitat	Fish Species	Leopard Frogs
Blanco Wash	0	0	0	70	No	N/A	0	N/A
Cocio Wash	0	0	0	23	No	369	N/A	N/A

N/A = not applicable.

the BOR will be constructing two fish barriers along the Santa Cruz River near Pima Mine Road and will implement other measures to offset potential impacts to the endangered fish which exists upstream between Tubac and Nogales. It is unclear to what extent the ongoing Section 7 consultation will impact CAP delivery and recharge projects within the Avra Valley Subarea and elsewhere throughout the Santa Cruz basin.

4. Recreation

The Saguaro National Park Tucson Mountain Park District is the primary recreational opportunity with facilities within the subarea. The park is bisected by Picture Rocks, Sandario, and Kinney Roads, which carry high volumes of traffic; and Golden Gate Road, a lesser traveled road. Effects on biological resources within the Park include habitat degradation and fragmentation. These are primarily a result of resource damage from "wildcat" trails and park access, disturbance of wildlife by domestic pets, growing presence of exotic grasses and other species, wildlife disturbance by human use/over-use and road-killed wildlife (Pima County-Mt. Parks 1999). Visible evidence of past mining activities are found throughout the Park. All open shafts have been fenced and posted (USDI-NPS 1995)

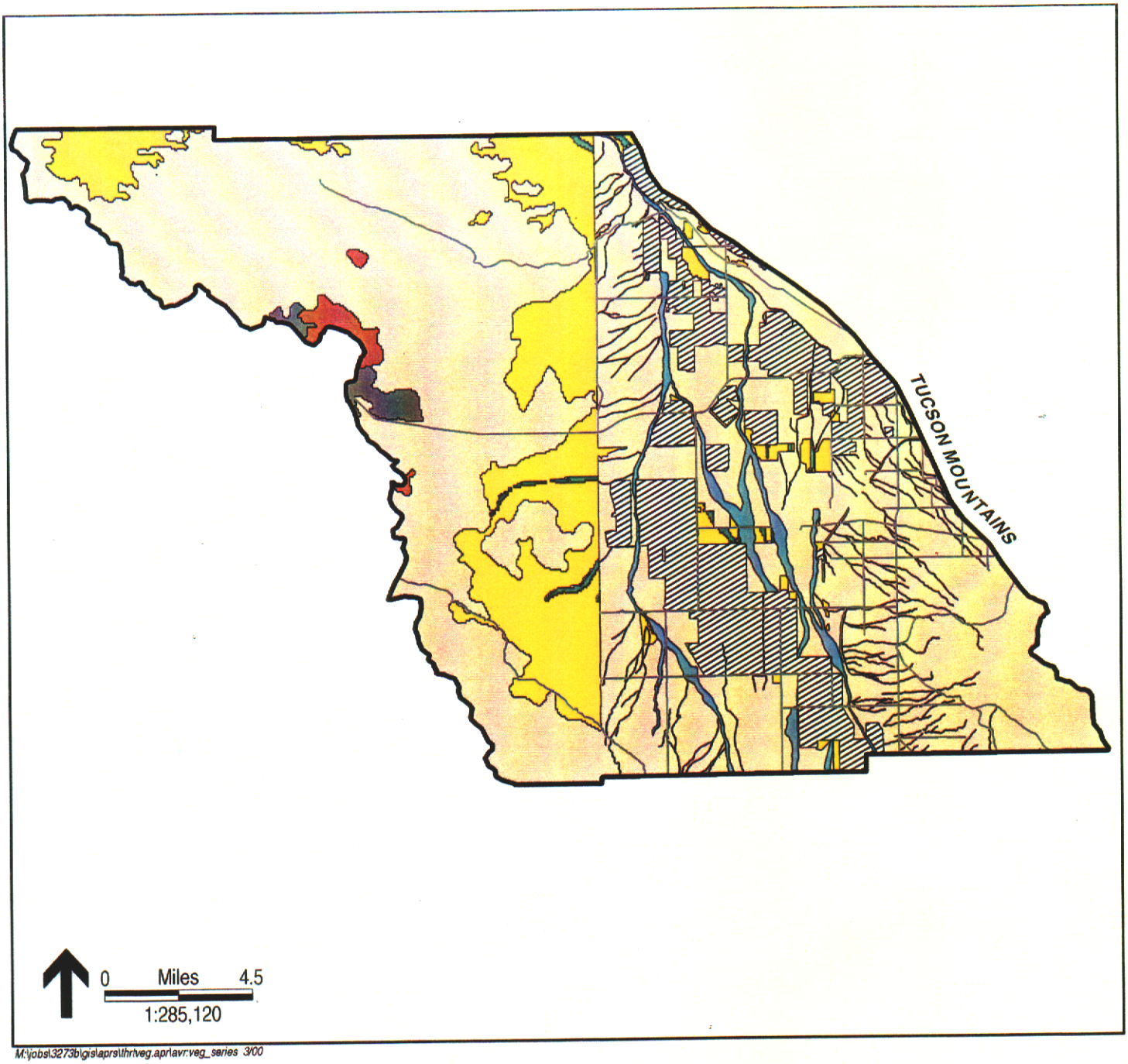
Saguaro National Park experiences increased visitor use every year and lacks enough staff to provide adequate supervision of the 20,000 plus acres (USDI-NPS 1995). Alternative actions discussed under the General Management Environmental Assessment include closing portions of Golden Gate and Picture Rocks Roads and subsequent reclamation. This would decrease habitat fragmentation, increase desert habitat, eliminate the roads as barriers to wildlife movement and reduce road kills (USDI-NPS 1987).

Other recreational opportunities in the subareas include the Silver Bell RCA, the Waterman Mountains ACEC, and the Roskruge Mountains. Although these areas are in excellent natural condition for the most part, they are accessed by off-road vehicles on numerous jeep trails for recreational purposes. Recreational use is mostly limited to hiking, horseback riding, mountain biking, and ORV/ATV use. Although there are no facilities and visitor use is low, vehicular use is expected to increase (USDI-BLM 1988). Plant and reptile theft and wildcat dumping have been documented (Pima County-Mt. Parks 1999).

B. Biological Resources

1. Vegetation and Land Cover

Habitat within the Avra Valley Subarea consists primarily of palo verde-mixed cacti. In the eastern part of the subarea, drainages dominated by mixed scrub vegetation are interspersed with agricultural fields and small areas of creosote-bursage (Figure 41). In the western part of the subarea there is limited urban development associated with mixed grass scrub and larger sections of creosote-bursage vegetation. Limited riparian habitat may exist near the base of the Tucson Mountains.



Vegetation and Land Cover
in the Avra Valley Subarea

Vegetation Communities (BLP Classification)

- 143.15 Mixed Grass-Scrub
- 154.11 Creosote-Bursage
- 154.12 Paloverde-Mixed Cacti
- 223.22 Mixed Broadleaf
- 234.71 Mixed Scrub

Other Land Cover Types

- 999.1 Agriculture
- 999.2 Urban
- Major Road or Highway

Figure 41

2. Critical Habitat

Portions of Map Units 2 and 3 of designated Critical Habitat for the CFPO is located within the Avra Valley Subarea. Map Unit 2 is located in the southwestern portion of the Valley. It connects habitat on the Tohono O'odham Indian Nation to habitat in Saguaro National Park West and the Tucson Mountain Park. Map Unit 3 extends north from Saguaro National Park into the Marana area, connecting suitable habitat there with Unit 4 in the Tortolita Fan Subarea. These areas consist of Sonoran desert scrub (including regionally significant ironwood communities), mesquite bosques interspersed by washes, and some retired agricultural lands. Activities that pose a threat to the Critical Habitat for the CFPO include removing or destroying vegetation; water diversion, impoundment, or groundwater pumping that alters water quality or quantity to an extent that riparian vegetation is significantly affected; and recreational activities that appreciably degrade vegetation (USDI-USFWS 1999).

3. Species at Risk

A total of 6 Status 1 and 2 Vulnerable Species occur within the subarea (Table 25).

C. Existing and Proposed Preserves

Silver Bell Mountain Park is a potential park proposed as a "Future Project" by the Sonoran Desert Conservation Plan (Pima County 1998). It would cover over 117,000 acres and would include the northern portion of the BLM's Silver Bell RCA as well as additional adjacent BLM and State Lands. These lands contain significant habitat for bighorn sheep and desert tortoise and offer considerable recreation potential (Ragged Top, the most prominent landform in the Silver Bells, is a bighorn sheep lambing area.) If unprotected, they will likely be negatively affected by anticipated increased use from the growing population in Avra Valley and throughout the Tucson basin (Pima County-Mt. Parks 2000). Much of the BLM land has been designated for mining. Increased mining in this area would result in habitat loss, alteration, degradation, and fragmentation.

The proposed Waterman-Roskruge Mountain Park includes the Waterman Mountains ACEC, the southern portion of the BLM's Silver Bell RCA as well as additional adjacent BLM lands, over 12,000 acres of State Land, and 3,011 acres of private land for a total of 56,031 acres. It covers a good portion of both the Waterman and Roskruge Mountains and would provide connectivity between them for wildlife movement. The Nichol's Turk's Head cactus, the Pima pineapple cactus (both endangered species), and Pima Indian Mallow are found here in the desert scrub vegetation. A small herd of bighorn sheep from the Silver Bell Mountains comes to this area at times (Pima County- Mt. Parks 1999). The boundaries of the proposed park would include nearly the entire portion of Map Unit 2 of designated Critical Habitat for the CFPO.

A recent study, Desert Ironwood Primer (Arizona-Sonora Desert Museum [ASDM] 2000) identified an area at Ragged Top in the Silver Bell Mountains to have one of the highest densities of ironwood trees in Pima County. Further, it is one of three sites in southern Arizona that contribute the highest values of significance to biodiversity conservation. The study identified the Ragged Top site as one that should be given new protection and for strengthened conservation management. Outside of the proposed park boundaries are two other sites that were given similar recognition by the study: one is at Cocoraque

TABLE 25
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE AVRA VALLEY SUBAREA

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Coryphantha scheeri var. *robustispina* Pima pineapple cactus	1	S2	FE HS	Narrow distribution, much of which is on private and Indian lands and much of which has been developed. Development, off-road vehicle traffic.	60 records for Pima Co. 7 for this subarea. Brown Mountain quad, 4 records 1990-1992 Private and BOR Cat Mountain quad: 3: BLM, BOR, Private	This species is probably not found in this subarea, but in 6A, and on quads that overlap the two subareas.
Cyprinodon macularius macularius Desert pupfish	1	S1	FE WSC	Habitat loss through groundwater pumping and watershed changes. Competition and predation by introduced species. Dewatering of habitats, stream impoundment, channelization, domestic livestock grazing, timber harvesting, mining, road construction, polluting, and stocking non-natives.	Cat Mountain quad. 1998 private	There are no natural populations of this subspecies remaining in Arizona. A reintroduced population exists at Cold Springs in Graham County,. There are also several refugia populations in private ponds and aquariums.
Echinocactus horizonthalonius var. *nicholii* Nichol's turk's head cactus	1	S2	LE HS	Limited Distribution. Roads, OHVs, mining activities (past).	Silver Bell West quad 3 sites: 1954, 1975 Private 1951 State Silver Bell East quad 2 sites: 1998 Private Waterman Peak quad 7 sites: 1998 State, Private, BLM; 1991 Private.	Also on Tohono O'odham land.

TABLE 25
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE AVRA VALLEY SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Glaucidium brasilianum cactorum Cactus ferruginous pygmy-owl	1	S1	FE FSS WSC	Habitat destruction and alteration, historic and present. Groundwater pumping, channelization, urbanization, historic livestock grazing? Farming and agricultural uses? Wood cutting. Disturbance by bird watchers. Small population subject to stochastic events. Possibility of disease, including emerging diseases, and loss of viable food supply as a result of drought and/or climate change.	Avra quad., 1998 Private Jaynes quad 4 sites, 1995-1999 all private.	Subarea is included in Critical Habitat
Poeciliopsis occidentalis occidentalis Gila topminnow	1	S2	FE FSS WSC	Non-native species, competition and predation. Habitat loss by groundwater pumping and channelization. Flooding. Drought. Dredging. Poor water quality. Livestock grazing (trampling by cattle, watershed changes).	Cat Mountain quad 1999 Private	

TABLE 25
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE AVRA VALLEY SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Tumamoca macdougalii Tumamoc globeberry	2	S3	FSS SR	Threats include urbanization, farming, overgrazing, recreation, habitat conversion, javelina (eating tubers), off-road vehicle use, pesticides.	Silver Bell East quad 1988 BLM West of Marana quad 1986 BLM Waterman Peak 1982, 1984 BLM West of Avra 5 sites: 1973, 1984 Private 1984(2), 1989 BLM Avra quad, 6 sites, 1984-1990, Private, BLM, NPS, State. Jaynes quad, 1984 Private. Cocoraque Butte quad 4 sites 1986, 1989(2) BLM 1989 State Brown Mountain quad 5 sites 1984 Private and State. Cat Mountain quad, 13 sites, 1984-1988 Private, BLM, State. Tucson quad, 1986 Private. Tucson East quad, 1987 Private. San Xavier Mission quad, 2 sites, 1988 private.	This species was formerly listed as endangered, but was delisted because it was found to be more common than thought at the time of listing.

Quads: Greene Reservoir, Friendly Corners, Gap Tank, Silver Bell West, Silver Bell East, West of Marana, Marana, Waterman Peak, West of Avra, Avra, Jaynes, La Tortuga Butte, Cocoraque Butte, Brown Mtn., Cat Mountain

Rock and Ironwood Picnic Area on either side of Brawley Wash (within the Altar Valley Subarea).

The Desert Ironwood Primer identifies ironwood as a habitat-modifying *keystone species*—a species that exhibits strong influences on the distribution and abundance of associated species. While in the past wood-cutting has been thought to be the most serious threat to ironwood, now scientists are considering the introduction of buffelgrass to be the principal threat to ironwood habitats and the rare plants within them (ASDM 2000). It is highly invasive, decreases plant diversity, and is a highly combustible biomass. It burns hot enough to kill most legume and cactus seedlings and other plants within ironwood communities.

Based on this comprehensive information on the ironwood, the County will be considering actions and policies to give protection to ironwood areas.

If the proposed park lands that are outside of the BLM's RCA/ACEC areas were to become available for development they would be at risk not only for increased recreational uses but also for lot-splitting and the associated problems that are prevalent in the eastern portion of the valley. Also, mining is still an allowed use within the Silver Bell RCA (Pima County-Land Stewardship 2000). This would result in varying levels of habitat loss, degradation, and fragmentation, particularly to the ironwood community as described above.

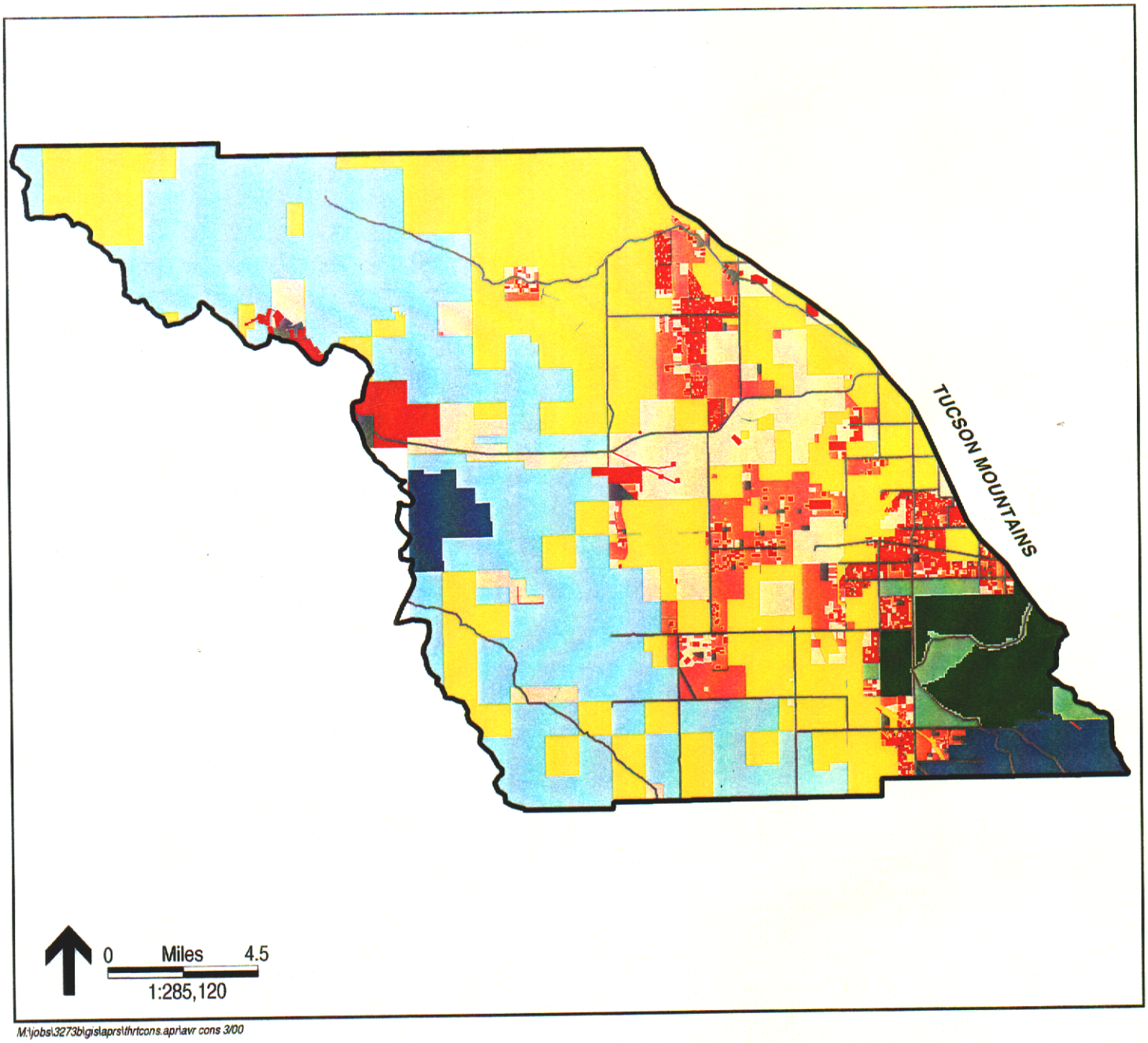
D. Summary of Potential Stressors to Biological Resources

The primary biological stressors of the Avra Valley Subarea are habitat loss, alteration and degradation, habitat fragmentation, conversion of vegetative cover, competition by non-native species (especially exotic grasses), human use and overuse, and the decline in groundwater levels. Although there is a considerable amount of higher intensity uses scattered throughout his subarea, the current ownership and management pattern within the Avra Valley Subarea provides substantial opportunity for conservation (Figure 42).

Activities contributing to biological street are summarized on Table 26. These can be mostly attributed to the effects of a history of agricultural use of the valley, groundwater pumping to support agricultural uses, residents and the Tucson Basin; and urbanization in the form of lot-splitting, subdivisions, and the roadways and infrastructure to support such development. The population of the eastern portion of Avra Valley is growing rapidly, predominantly by lot-splitting and wildcat subdividing (Pima County Impact-2000). The consequences of lot-splitting are a continued stress to biological resources, particularly in the Picture Rocks area.

Potential exists for the transfer of land from public (BLM and State Lands) to private ownership, and the subsequent conversion of native vegetated lands to higher intensity urbanized areas dependent upon groundwater pumping. This is a particular concern where these public lands are located adjacent to existing preserves and/or within proposed preserves.

The potential for increased mining exists. Much of the BLM land throughout the Silver Bell RCA has been designated for mining. Increased mining in this area would result in habitat loss, alteration, degradation and fragmentation, and disruption of habitat use



Level of Threat Represented by Conservation Status
in the Avra Valley Subarea

Level of Threat
Low
High

Conservation Status
1a Most Protected
1b
2
3b
4a
4b
4c
4e
4f
4x Least Protected

(For status definitions, see GAP Status Categorization Table in Methods section.)

Figure 42

TABLE 26
LAND USE ACTIVITIES WITHIN LAND OWNERSHIP/MANAGEMENT CATEGORIES OF THE AVRA VALLEY SUBAREA

Ownership or Management Category	Land Uses and Activities											
	Conversion of Vegetative Cover	Conversion of Agricultural Lands	Competition/Predation by Invasive Species	Lot-Splitting & Urbanization	Cultivated Land	Groundwater Pumping	Water Diversion & Impoundments	Recreational Uses	Mining	Roadways	Livestock Grazing	Removal of Plants
Saguaro National Park West (4,218 acres)	x	-	x	-	-	x	*	x	✪	x	✪	✪
Saguaro National Park West Wilderness (9,209 acres)												
Tucson Mountain Park (4,503 acres)	x	-	x	-	-	x	*	x	✪	x	✪	✪
Silver Bell RCA (69,566 acres)	x	-	x	-	-	*	*	x	x	x	✪	x
Waterman Mts. ACEC (3,206 acres)	x	-	x	-	-	*	*	x	✪	x	✪	*
BOR Wildlife Corridor (779 acres)	x	-	x	-	-	*	*	x	x	x	x	x
Tohono O'Odhame Nation Unreserved (881 acres)												
Marana Unreserved State Land (3,242 acres)	x	-	x	*	*	x	x	x	x	x	x	x
Pima County Unreserved State Land (44,469 acres)	x	-	x	*	*	x	x	x	x	x	x	x
Marana Unreserved – Private (90 acres)												
Pima County Unreserved Private Lands (81,207 acres)	x	x	x	x	x	x	x	x	x	x	x	x

x = occurs
- = does not occur
* = potential to occur
✪ = historic but not present occurrence

patterns by the bighorn sheep here. The BLM's Proposed Resource Management Plan requires special stipulations be attached to any mineral lease agreements and closes 800 acres in the Ragged Top lambing area to vehicular use. These policies and actions are intended to prevent habitat damage to bighorn sheep areas, prevent the animals from abandoning significant portions of the habitat, prevent impacts by ORVs, and reduce impacts from mining activities.

Habitats most at risk include Critical Habitat for the CFPO, habitat for bighorn sheep, the remaining ironwood forests, riparian and xeroriparian areas, and the area of shallow groundwater east of Silver Bell mine. The private and State Lands adjacent to the existing preserve areas are also at risk of being developed at higher intensity levels.

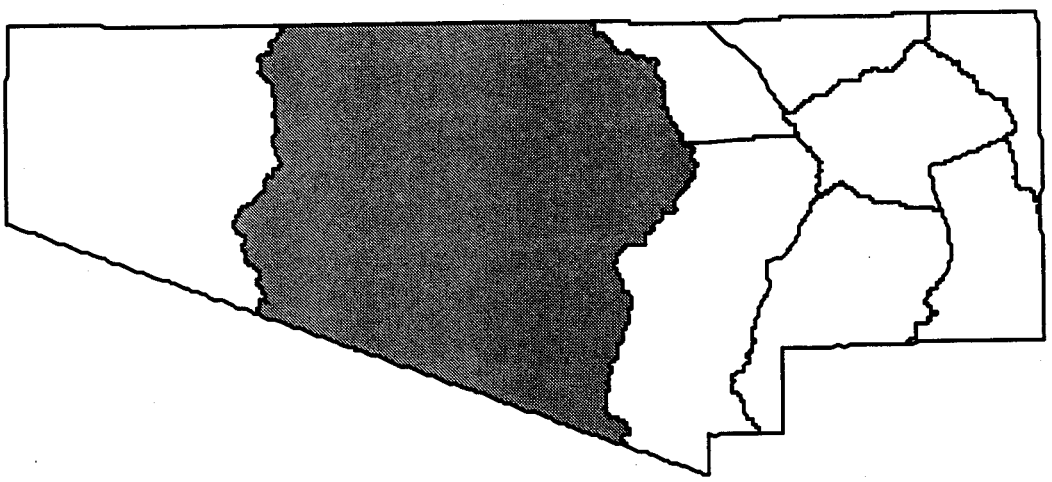
The use of CAP water and effluent for agricultural purposes in Avra Valley will continue to be an important way to reduce groundwater pumping. Opportunities for effluent use in support of riparian restoration projects along the Santa Cruz are now expanded since the County and City have come to terms on effluent use.

Tohono O'odham

Sub Area 7

X. Tohono O'odham (Subarea 7)

Tohono O'odham Nation occupies the middle third of Pima County (Figure 43) and most of this subarea (Figure 44). Although the Nation is not included in the scope of this overview study, there are several areas of discussion for inclusion here.



Tohono O'odham Subarea Location in Pima County
Figure 43

a. The Department of the Interior is obligated under the Southern Arizona Water Rights Settlement Act to deliver 66,000 acre-feet of water per year to the San Xavier and Schuk Toak Districts of the Nation. Of this, 37,800 acre-feet is CAP water suitable for agriculture and 28,200 acre-feet is effluent which the Secretary of the Interior will use to secure other water sources (Pima County-Water Resources 1999).

The Nation plans to cultivate and irrigate fields in the "Garcia Strip" of the Schuk Toak District using a portion of the water. The CAP line was designed with a turnoff for the purpose of supplying them water. They are beginning to develop 2,668 acres for agricultural purposes. Previously undisturbed desert vegetation is being removed and the washes are being channelized in areas adjacent to the fields for this project (Tellman 2000). Stressors to biological resources resulting from this include habitat loss and fragmentation, conversion of vegetative cover and the potential for competition by invasive species. The "Garcia Strip" is directly south and west of Map Unit 2 of designated Critical Habitat for the CFPO and has similar vegetative communities.

Land Ownership and Land Management
in the Tohono O'Odham Subarea

- BLM - Baboquivari Wilderness Area
- BLM - Coyote Mountain Wilderness Area
- BLM - Silverbell Resource Conservation Area
- BLM - Unreserved
- BLM - Waterman Mountains ACEC
- NPS - Organ Pipe Cactus NM Wilderness Area
- NPS - Organ Pipe Cactus National Monument
- Pima County Unreserved - Private Lands
- Pima County Unreserved - State Trust Lands
- Tohono O'Odham Nation - Unreserved
- Major Road or Highway

Figure 44

At the San Xavier District CAP the Nation has plans to use their CAP allocation by releasing water into the Santa Cruz River and tributaries and initiate restoration projects there. These projects have potential for recreating and

enhancing riparian and xeroriparian habitats. The Nation is also considering using CAP water to reconstruct the mesquite bosque that once grew south of San Xavier Mission.

b. Within the Tohono O'odham Subarea are three watersheds: the San Simon Valley, the Santa Rosa Valley, and the Aguirre Valley (Table 27). The Aguirre Valley is one of the largest watersheds in Pima County and represents one of the largest areas of relatively undisturbed desert landscape that remains

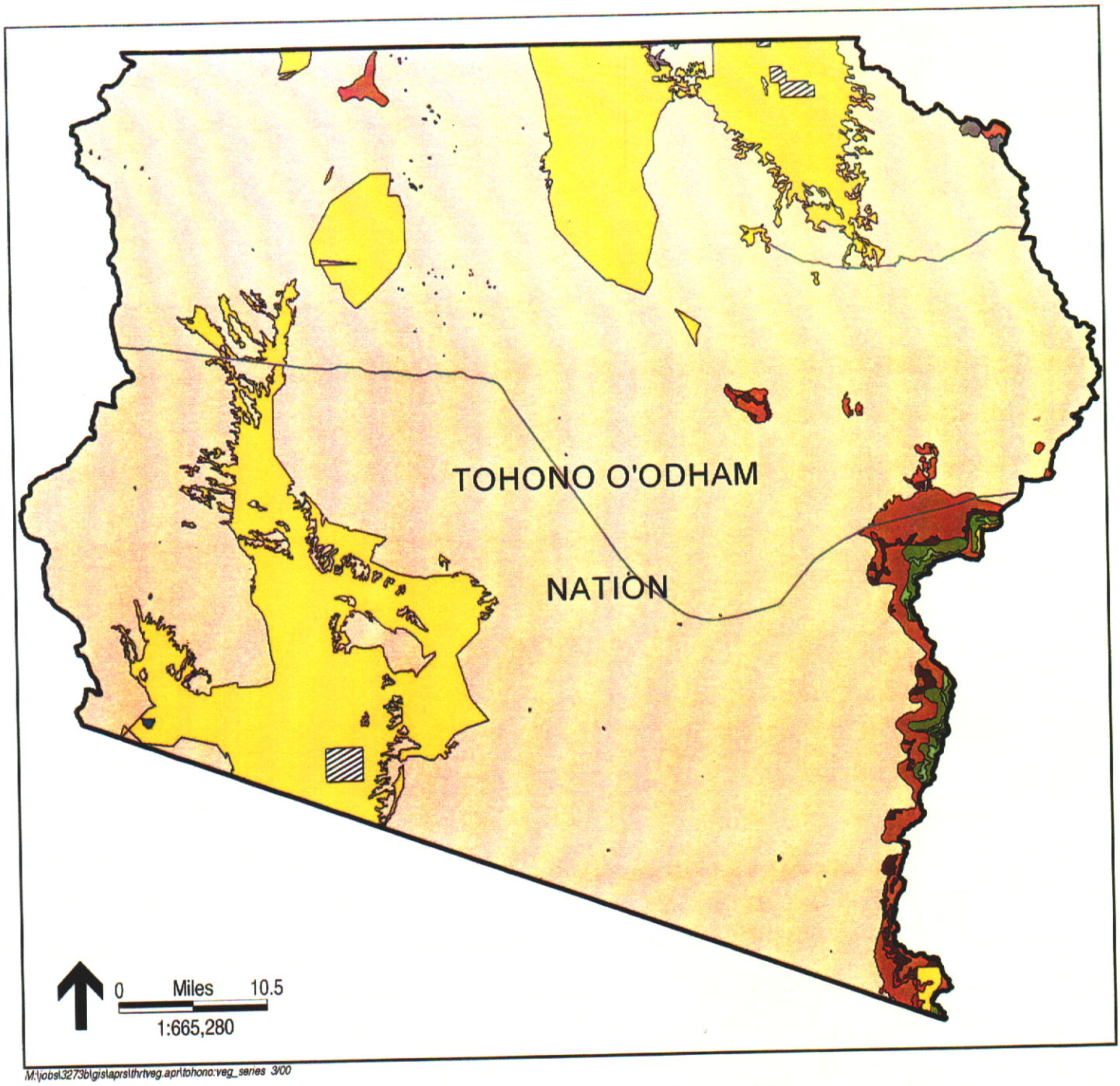
c. Habitat within the Tohono O'Odham Subarea is dominated by palo verde-mixed cacti and creosote-bursage. The southeastern edge of the subarea is characterized by mixed grass scrub interspersed with manzanita, oak, and oak-pine forest and small stands of mixed evergreen sclerophyll. Areas of agricultural use are found in the northeast and southwest portions of the subarea. Urban development has also occurred in the northeast portion of the subarea. Standing water is located in the southwestern portion of the subarea and may support some riparian vegetation (Figure 45).

d. The degree of threat or conservation status of Nation lands was not assessed (Figure 46). Small areas of Federal, State, and private lands occur along the east and west margins of the Study area, primarily in BLM and State Trust lands.

TABLE 27
STREAM CHARACTERISTICS IN THE TOHONO O'ODHAM SUBAREA

Stream Name	Miles of Perennial Flow	Miles of Intermittent Flow	Acres of Hydro-mesoriparian Habitat	Acres of Class A Riparian Habitat	Acres of Shallow Groundwater	Pygmy-Owl Habitat	Fish Species	Leopard Frogs
Aguirre Wash	0	0	0	79	N/A	No	0	N/A

N/A = not applicable.



Vegetation and Land Cover
in the Tohono O'Odham Subarea

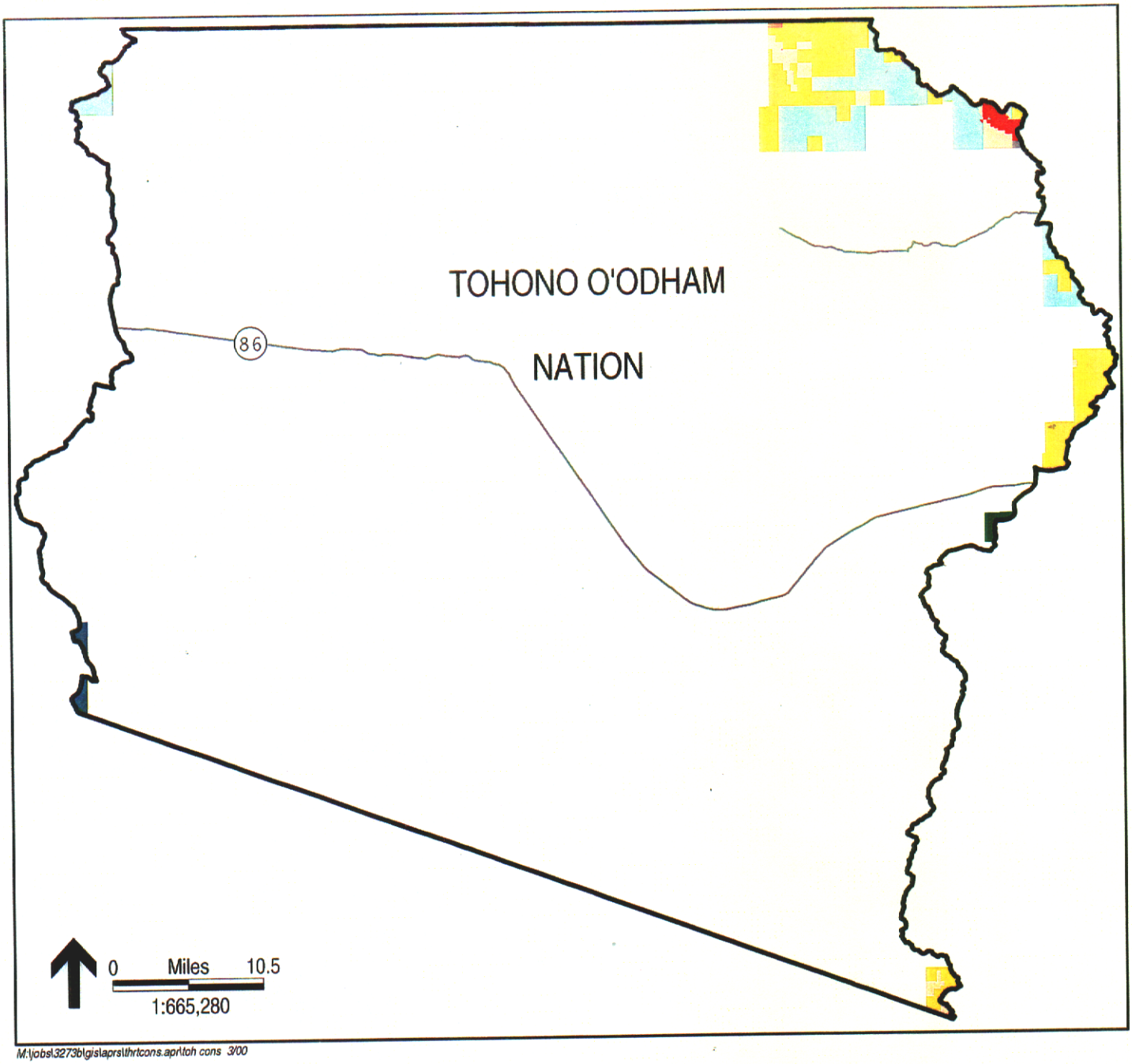
Vegetation Communities (BLP Classification)

- 122.41 Pinyon-Juniper
- 123.31 Encinal (Oak)
- 123.32 Oak-Pine
- 133.32 Manzanita
- 133.36 Mixed Evergreen Sclerophyll
- 143.15 Mixed Grass-Scrub
- 154.11 Creosote-Bursage
- 154.12 Paloverde-Mixed Cacti

Other Land Cover Types

- 999.0 Unclassified
- 999.1 Agriculture
- 999.2 Urban
- 999.3 Water

Figure 45



Level of Threat Represented by Conservation Status

in the Tohono O'Odham Subarea

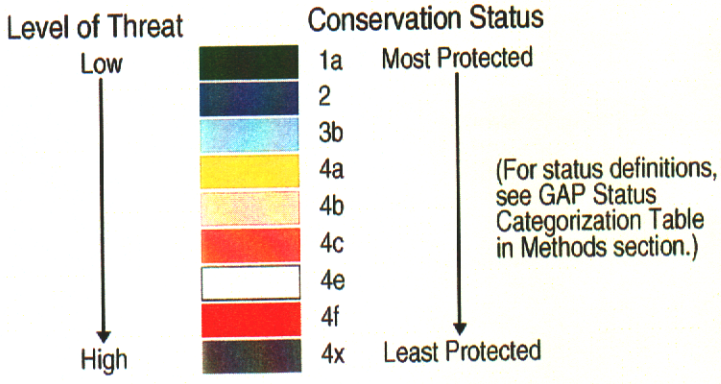


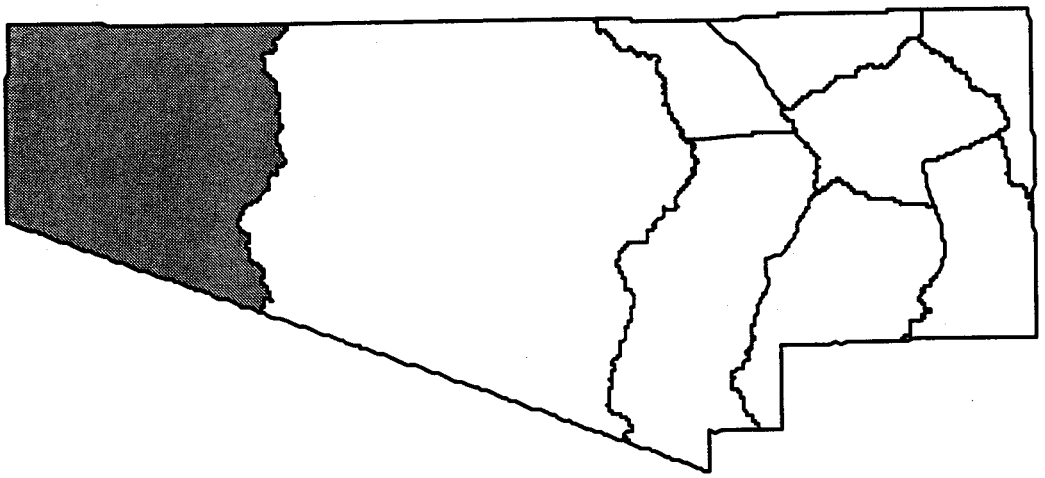
Figure 46

Western Pima County

Sub Area 8

XI. Western Pima County (Subarea 8)

This subarea occupies the western third of Pima County and is comprised of four watersheds: Rio Sonoyta (along the U.S./Mexico border), San Cristobal, Childs Valley (where the community of Ajo is located), and Midway (Figure 47). The uplands and mountainous areas are within the Arizona Upland Subdivision but much of the lower valley areas are within the Lower Colorado Subdivision. A few small areas of Semi-desert grassland also occur. The Lower Colorado River Subdivision is the driest subdivision of the Sonoran desert scrub biotic community. Although plant species are similar to those found in the Arizona Upland subdivision, the higher temperatures and lower precipitation result in more open and simple vegetative growth. Competition between species for scarce water resources is intense. Topographic relief is generally low, and sheet flow is common.

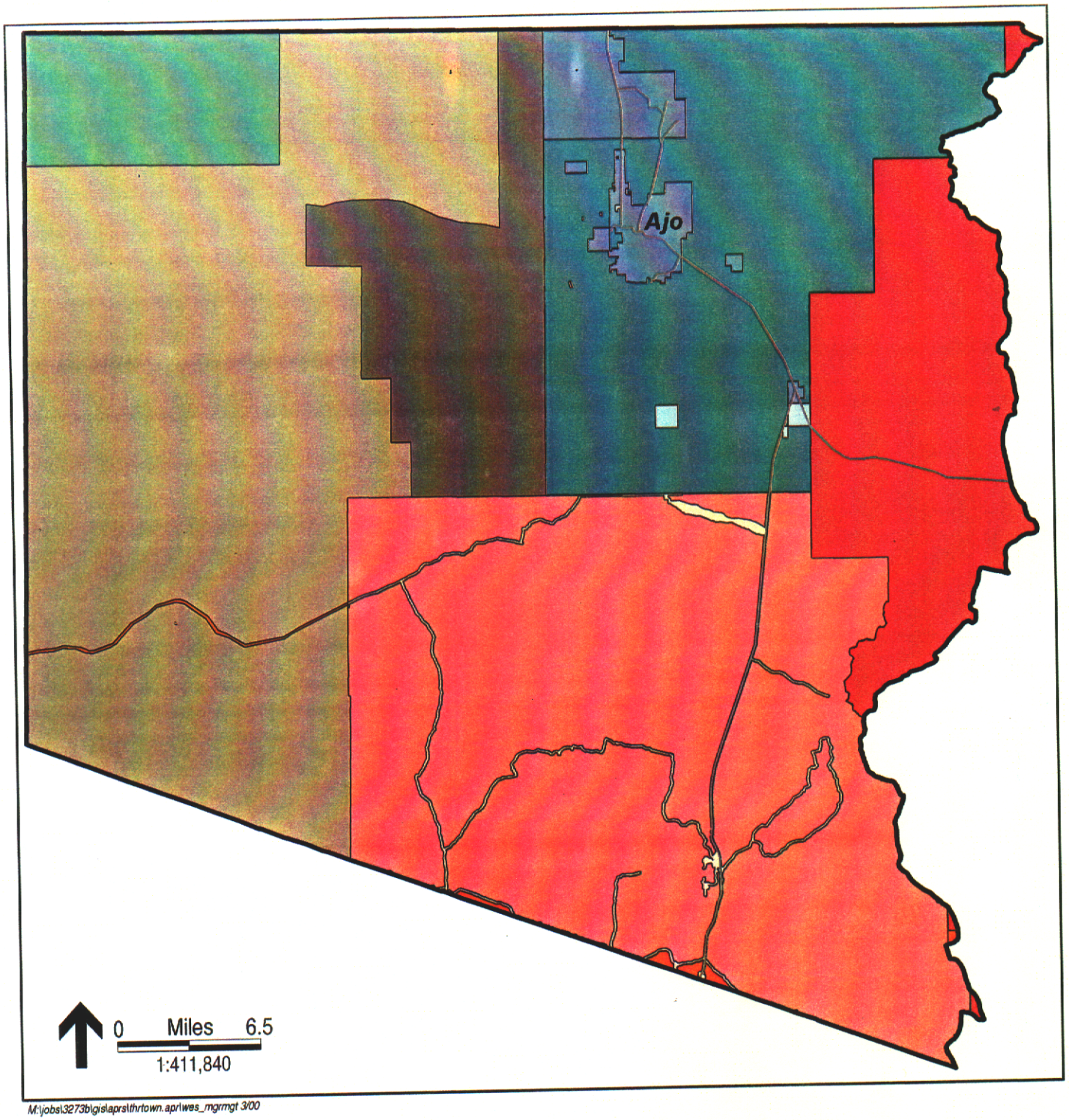


Western Pima County Subarea Location in Pima County
Figure 47

A. Potential Threats and Stressors

1. Land Use and Landscape Character

Private land in the subarea is limited to the communities of Ajo and Why so development is limited and the landscape is characterized by expanses of broad sweeping valleys punctuated by isolated rugged mountains and rock outcrops (Figure 48). Why is located at the western edge of the Tohono O'odham Nation, where SR-86 intersects with SR-85. Here there are a number of RV parks and facilities to serve visitors to Mexico, Organ Pipe Cactus National Monument, and Cabeza Prieta National Wildlife Refuge. The Nation operates a small casino just east of Why.



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Land Ownership and Land Management
in the Western Pima County Subarea

- BLM - Unreserved
- DOD - Barry M. Goldwater Range
- NPS - Organ Pipe Cactus NM Roads
- NPS - Organ Pipe Cactus NM Wilderness Area
- NPS - Organ Pipe Cactus National Monument
- Pima County Unreserved - Private Lands
- Pima County Unreserved - State Trust Lands
- Tohono O'Odham Nation - Unreserved
- USFWS - Cabeza Prieta National Wildlife Refuge
- USFWS - Cabeza Prieta Roads
- USFWS - Cabeza Prieta Wilderness Area
- Major Road or Highway

Figure 48

Ajo was founded as a mining town in 1855 (Arizona State Museum [ASM] 1999). The Arizona Mining and Trading Company arrived here in 1854, began mining copper and other ores and eventually merged with Phelps Dodge Corporation in 1931. Phelps

Dodge Mining Company (PDMC) operated the large "New Cornelia" open pit mine and smelting operation until depressed copper prices forced a shutdown in 1985 (Ajo 2000). This greatly affected the local economy as the town had always been primarily a "company town" with the mine as its mainstay. In May of 1997 PDMC decided to reopen the mine using more efficient and cost-effective extraction techniques. The operation will consist of a grinding mill and concentrator producing an estimated 135 million pounds of copper per year (Ajo 2000). PDMC plans to reuse the existing pit site, effectively neutralizing the hydrological and aesthetic objectives common to most mining proposals. The promised 600 mining jobs will boost employment to the community of Ajo by 30 percent (*Arizona Daily Star* 1997).

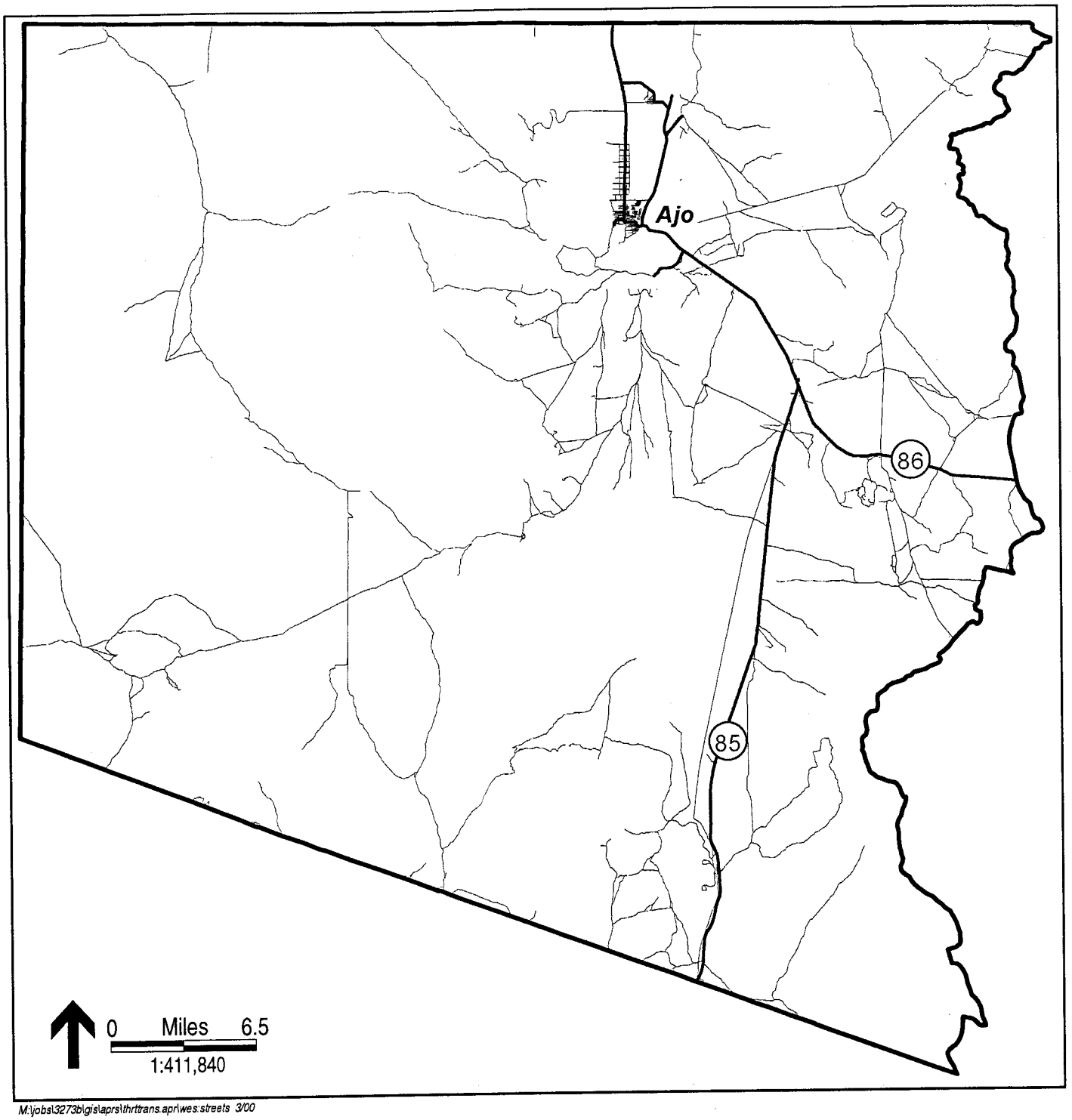
The potential for increased smaller scale mining activities exists in the BLM lands that surround Ajo. Biological stressors associated with increased mining include habitat loss, degradation, and fragmentation. These would be of particular concern to the managers of Cabeza Prieta National Wildlife Refuge (west of Ajo) and Organ Pipe Cactus National Monument. The PDMC mining activities could be reactivated to levels that might be of concern with respect to air and water pollution and atmospheric deposition. These are issues PDMC will need to resolve as part of their permitting process.

Ajo, like Why, also serves as a "jumping off" point for travelers to and from Mexico, recreationists and visitors to the region. When the mine closed the economic base shifted to tourism and there has been an increase in the number of RV parks and support facilities. Homes once owned by PDMC have been sold to new residents, mostly retirees. In 1992 homes sales to retirees constituted 99 percent of the available housing (USDI-USFWS 1998). The potential stress to biological resources that would be associated with the increasing urbanization of the Ajo area is somewhat limited due to the small amount of private property that exists. However, the secondary impacts of increased recreational use of adjacent areas and increased groundwater pumping are distinct sources of stress. BLM lands near Ajo allow for long-term camping. RV use in these areas is very high in the cooler months. This has resulted in moderate to severe habitat loss, alteration and degradation in an area that is habitat for Sonoran pronghorn and other wildlife. Often times vegetation is damaged or cut down, soils are compacted, sewage is disposed of and areas are left with little or no vegetative cover (USDI-NPS Rutman 2000.)

Livestock grazing is an allowed use in the BLM lands surrounding Ajo. Because sources of water are few and forage is very limited in this area, grazing can quickly degrade habitat, particularly in the vicinity of the water sources. Grazing is not permitted in Cabeza Prieta National Wildlife Refuge, Organ Pipe Cactus National Monument, or the Barry M. Goldwater Air Force Range.

2. Transportation

Arizona State Routes 86 and 85 are the primary roadways in the area (Figure 49). SR-85 extends south from SR-86 at Why to the border crossing at Lukeville, and north from Ajo to Interstate 8. Numerous other small roadways, many unpaved, exist throughout Ajo



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Road Network

in the Western Pima County Subarea

Highway or Major Road
Local Road

Figure 49

and the BLM lands that surround it. The Ajo Municipal Airport is located approximately 10 miles north of Ajo. It accommodates only small aircraft.

The international port-of-entry at Lukeville provides vehicular access between 6:00 A.M. until midnight each day. Most of the traffic is not attributed to monument visitors. Increased traffic along SR-85 is due to increased regional tourism and increased truck traffic resulting from NAFTA. The NPS and ADOT are working together to develop three interpretative pullouts along SR-85 through the Monument. Because the speed limit is 65 miles per hour, deceleration and acceleration lanes will be required for each pullout. Drainage improvements such as extended culverts and/or bridges will be required at wash crossings. This will result in habitat loss and fragmentation of habitat that support Sonoran pronghorn, CFPO, and lesser long-nosed bats. It will also make the roadway more of a barrier to wildlife movement (USDI-NPS Rutman 2000).

Other roadways in the subarea are found in the Cabeza Prieta National Wildlife Refuge and Organ Pipe Cactus National Monument. The two loop roads in the Monument are both unpaved. Several other unimproved dirt roads go further into the Monument backcountry. A Border Patrol road is located just north of the U.S./Mexico border; Mexico Highway 2 is located just south of the border, west of SR-85. There are also numerous other wildcat roads and trails in the area that have been created by UDAs and other persons. The traffic into the U.S. from Mexico has become a real problem. Vehicles as well as stock (burros, horses, and mules) cut fences and make their own paths bringing in drugs and UDAs. Resource damage includes habitat loss and degradation, disturbance of wildlife, increased potential for wildfires, and introduction of non-native species. Huge amounts of trash is left behind (USDI-NPS-Rutman 2000). Because the Monument is bisected by SR-85, concerns have been raised about how SR-85 serves as a barrier to wildlife movement, particularly the endangered Sonoran pronghorn, associated roadkill, and the potential for introduction and spread of invasive species (USDI-NPS 1997). NPS staff is working with ADOT, AG&FD, USFWS, and others to study the extent of traffic impacts on wildlife and measures to reduce negative impacts.

Roads within Cabeza Prieta are unpaved, unmaintained, and passable by four-wheel-drive vehicles by permit only. A 200-foot-wide corridor along the roads defines the non-wilderness area associated with the roads. There are no restrictions on where visitors may hike or camp with one exception: no camping is allowed within one-quarter mile of water developments. The management plan calls for the closure of approximately 30 miles of administrative trails and 139 miles of old trails (USDI-USFWS 1998).

3. Military Overflights and Activities at Cabeza Prieta National Wildlife Refuge

Airspace over 822,000 of the refuge's 860,010 acres is part of the Barry M. Goldwater Air Force Range (BMGR) (land area of which is located to the north of the refuge). Military flights are allowed at elevations of 1,500 feet and higher above ground level throughout the refuge (USDI-USFWS 1998). Although use of live fire is allowed, it is confined to air-to-air weaponry and is confined to altitudes of 5,000 feet. There are defined flight corridors that allow flights as low as 200 feet above ground level. A proposal to increase low-level flights over the Refuge is currently being reviewed. The USFWS determined that the proposal could cause harm to the endangered Sonoran pronghorn (Stand by Your Lands 2000).

Low-level overflights are also a concern within Organ Pipe Cactus National Monument, particularly in Sonoran pronghorn habitat areas where noise and wildlife disturbance are a source of stress. Helicopter overflights by Border Patrol and Customs agents are an additional source of noise and disturbance along the border (USDI-NPS-Rutman 2000).

Potential sources of biological stress associated with military activities include visual and noise disturbance, disturbance to wildlife behavior, wildlife shifting use areas due to military activities, aircraft collisions with wildlife, and impacts caused by live fire and military debris including live ordnance. A monitoring program has been established to study detectable wildlife population impacts at the conducted flight levels. The refuge manager has been working with the Air Force to remove large military debris from wilderness areas.

Since 1995 the Air Force demolished a radar surveillance station located at Childs Mountain, northwest of Ajo. A concrete structure and several towers remain. An upgraded FAA radar facility is planned for this location to serve multi-agency purposes. The USFWS is working towards an alternative that ensures compatibility with refuge purposes, possibly including a wildlife overlook interpretive site. The long-term strategy is to trade the land for other lands that would be better manages for wildlife purposes. A winding road leads to this area from SR-85.

4. Water Use

Water is a limited resource in this subarea (Table 28). Groundwater is the source of water for the New Cornelia mine and for the community of Ajo. There are four water companies and a community wastewater treatment facility (Tellman 2000). The wastewater facility is privately operated by a subsidiary of PDMC. It does not meet Pima County standards (Pima County-Wastewater 2000). Groundwater pumping will increase in the future in order to accommodate the mine operations and domestic water supplies for an influx of residents. If it increases to the extent of lowering groundwater levels it could negatively affect vegetative resources which are adapted to survive with the 9-inch or less of rainfall the area receives per year.

Within the Cabeza Prieta National Wildlife Refuge no perennial water bodies exist and surface water is scarce, varying with the seasons. There are 22 developed waters on the refuge. At certain times and locations water is hauled by truck to supplemental wildlife "drinkers." One research priority of the Refuge is to analyze the role of developed waters and how they affect desert bighorn sheep, Sonoran pronghorn, and other wildlife populations including predators and invasive species. Within the Pima County portion of the Refuge an area of shallow groundwater exists in the valley east of the Growler Mountains (west of Ajo). A few wells operated by windmills are located here. Other wells are located elsewhere within the refuge (USDI-USFWS 1998). The depth to groundwater could be affected if groundwater pumping continues to increase at Ajo and the New Cornelia mine.

Organ Pipe Cactus National Monument relies on several wells to supply water for staff, visitors, and campers. There are 11 springs, eight of which are located at the Quitobaquito area along the southwest boundary. A pond and dam were built at Quitobaquito in 1860 and an area of lush riparian vegetation surrounds it. It is the largest source of surface water in the monument and one of the largest oases in the Sonoran

TABLE 28

STREAM CHARACTERISTICS OF THE WESTERN PIMA COUNTY SUBAREA

Stream Name	Miles of Perennial Flow	Miles of Intermittent Flow	Acres of Hydro-mesoriparian Habitat	Acres of Class A Riparian Habitat	Acres of Shallow Groundwater	Pygmy-Owl Habitat	Fish Species	Leopard Frogs
Quitobaquito Pond	0.1	0	N/A	N/A	N/A	No	1	N/A
Quitobaquito Springs	0.1	0	N/A	N/A	N/A	No	N/A	N/A

N/A = not applicable.

Desert. Endangered desert pupfish are found here. Introduction of non-native fish has been a concern that Monument staff hope to mitigate with increased patrol time (USDI-USFWS 1998).

Increasing urban and agricultural needs for water in the Sonoyta Valley of Mexico have raised concerns regarding the water table. A moratorium on new well drilling has been imposed but the aquifer continues to be lowered by the current rate of use. The Monument staff continues to work with resource personnel in Mexico regarding this issue (USDI-USFWS 1998). If surface waters at the Quitobaquito area are reduced as a result of this overdraft it would directly affect the habitat of the desert pupfish population here, as well as the surrounding riparian woodland habitat.

5. Recreation

Recreational opportunities in the Western Pima County Subarea are found in the Organ Pipe Cactus National Monument and Cabeza Prieta National Wildlife Refuge. Visitor use to both areas continues to increase. The Monument has developed trails and a campground, with plans for expansion and addition of new camping spaces. Recreational use of the Refuge is much more primitive and allowed by permit only. Hunting of bighorn sheep is allowed within the Refuge.

Because of the few trails within the Monument many miles of "social" trails have appeared. These serve to degrade and fragment habitat. Uncontrolled use of trails into the Quitobaquito area is being curtailed. Visitors have facilitated the spread of invasive species here and Monument staff perform weekly inspections of the area, looking for nonnative species.

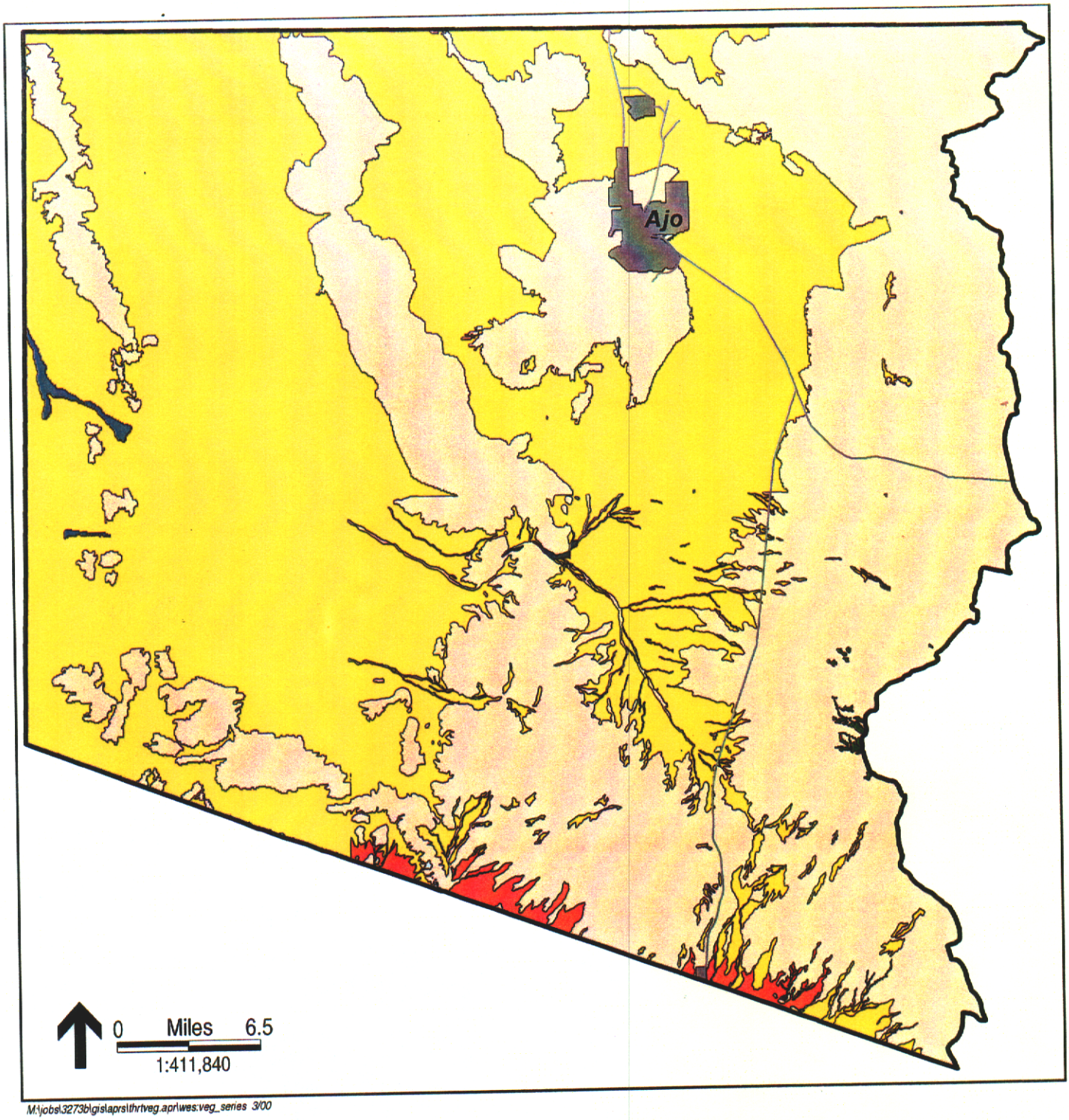
While the NPS is not proposing to expand visitation to the Monument, it anticipates that visitation will continue to increase. Some expansion of existing use areas is planned. Actions at the Monument that could further increase visitation include expanded visitor services, increased number of trails, and increased campsites at Alamo Canyon and Twin Peaks.

The expansion of the campground at Alamo Canyon will be evaluated by Monument staff with regard to the mine adit at Copper Mountain that exists nearby. The adit and surrounding foraging habitat are home to the largest known maternity colony of the lesser long-nosed bat in the U.S. The adit are inspected every two weeks from April through September. The mine adit is closed to all visitor use and human visitation in the area does not appear to be impacting the bats. Removal of columnar cacti resulting from adding new campsites would be a potential source of stress to the bat colony (USDI-NPS-Rutman 2000).

B. Biological Resources

1. Vegetation and Land Cover

Habitat within the Western Pima County Subarea consists primarily of creosote-bursage and palo verde-mixed cacti communities (Figure 50). Areas of saltbrush occupy the southern edge of the subarea and near these is a small stand of cattail. Urban development has occurred on the southern edge and the central portion of the subarea.



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Vegetation and Land Cover
in the Western Pima County Subarea

Vegetation Communities (BLP Classification)

- 122.41 Pinyon-Juniper
- 123.31 Encinal (Oak)
- 124.71 Mesquite
- 133.36 Mixed-Evergreen Sclerophyll
- 154.11 Creosote-Bursage
- 154.12 Paloverde-Mixed Cacti
- 154.17 Saltbush
- 244.71 Cattail
- 244.75 Saltgrass

Other Land Cover Types

- 999.0 Unclassified
- 999.1 Agriculture
- 999.2 Urban
- 999.3 Water
- 999.4 Bare Ground
- Major Road or Highway

Figure 50

Small areas of pinyon-juniper are located on the eastern edge of the subarea and small stands of mesquite grow in centrally located drainages. Permanent water is located in two places on the western edge of the subarea and these may support riparian vegetation.

2. Critical Habitat

Although the CFPO is known to occur in the subarea, no areas of Critical Habitat have been designated.

3. Incidental Take Permit

The USFWS Biological Opinion on the management plan for Organ Pipe Cactus National Monument identified areas of Incidental Take for the lesser long-nosed bat, the Sonoran pronghorn and CFPO. Take is expected to occur if unauthorized human disturbance of the bat roost occurs or if one or more Sonoran pronghorn is injured or killed as a result of traffic on SR-85. USFWS anticipates 15 instances of incidental take of CFPO through harassment of individuals nesting or foraging in the area. The USFWS determined that levels of anticipated Take are not likely to result in jeopardy to the species (a "no jeopardy" opinion.)

4. Species at Risk

A total of 12 Status 1 and 2 Vulnerable Species occur within the subarea (Table 29).

C. Existing and Proposed Preserves

Organ Pipe Cactus National Monument, Cabeza Prieta National Wildlife Refuge, and the BMGR, as described above are the preserves within the Subarea. The Air Force has primary jurisdiction over the land of the BMGR. Although the BMGR is excluded from this study, the appropriateness of the Department of Defense managing land that functions as a wildlife refuge has been hotly debated. The USFWS and many conservation groups have voiced concern about the impact of Air Force training activities within the BMGR and the Refuge on endangered Sonoran pronghorn, bighorn sheep, other wildlife and plant communities (Stand 2000).

Organ Pipe Cactus National Monument has been included in an area designated by UNESCO as a Biosphere. This places a greater emphasis on the protection and study of biological and other resources.

Recent efforts by a citizen group have suggested that the Monument, the Wildlife Refuge, and portions of the BMGR be combined into a National Park. The Sonoran Desert National Park would be under the management of the NPS. Under this proposal, the Air Force would continue training activities at BMGR, but the land would be managed by NPS (*Arizona Daily Star* 1999).

D. Summary of Potential Stressors to Biological Resources

Primary stressors to biological resources within the Western Pima County Subarea include habitat alteration and degradation, habitat fragmentation, human use and

TABLE 29
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN THE WESTERN PIMA COUNTY SUBAREA

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
Agave schottii var. *treleasei* Trelease Agave	1	S1	FSC FSS HS	Narrow endemic. Direct impacts by road or recreational facility construction may impact local populations.	Mount Ajo quad 1989 NPS.	Occurs in an isolated, relatively secure location in Organ Pipe Cactus National Monument.
Antilocapra americana sonoriensis Sonoran Pronghorn	1	S1	LE WSC	Loss of habitat (historic); drought; drying of major rivers; historic overgrazing. Population has not recovered, despite three large public land withdrawals, and the removal of cattle. 1980's (AGFD 1986). In Mexico, it is believed that economic exploitation of habitat (grazing and agriculture) and poaching are still causing population and habitat losses. Military activities have been alleged to be a threat in a current lawsuit. Border patrol and illegal alien and smuggling activities may also be a threat. Present knowledge presents no clear means to increase either population densities or range	Growler Peak quad 1968-1980 FWS Granite Mountains South quad 1968-1980 FWS Chico Shunie quad 1994 BLM Agua Dulce Mountains quad 1991 FWS West of Lukeville quad 1980 NPS Diaz Peak quad 1980 NPS	Cabeza Prieta National Wildlife Refuge, Organ Pipe Cactus National Monument, Luke Air Force Barry M. Goldwater Gunnery Range, and possibly Tohono O'odham Indian Reservation. In Mexico: northwest part of the state of Sonora
Chionactis palorostris organica Organ pipe shovelnosed snake	1	S2	FSS	Drought. Grazing, arroyo cutting. Collecting. Road kill.	Ajo South quad 2 sites 1945, 1950 BLM Armenta Well quad 4 sites 1993-1994 NPS, BLM	Most, if not all, of the range of this species is within Organ Pipe Cactus National Monument.

TABLE 29
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN IN THE WESTERN PIMA COUNTY SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
					Tillotson Peak quad 5 sites 1993 NPS Mount Ajo quad 1971 NPS Lukeville quad 3 sites, 1 1956 Private, 2 1977, 1996 NPS	
Cnemidophorus burti xanthonotus Red-backed whiptail lizard	1		FSC	Limited distribution. Climate change?	Lukeville quad 1968 NPS Quitobaquito Springs quad 1968 NPS Mount Ajo quad 2 sites 1939, 1968 NPS	
Cyprinodon macularius eremus Quitobaquito desert pupfish	1	S1	LE WSC	Narrow endemic. All in one pond, which is not in pristine condition. Non-native predators, parasites, diseases. Lowered groundwater resulting from pumping in Mexico. Illegal activities, e.g. dumping a load of illicit drugs to evade arrest, could harm the environment.	Quitobaquito Springs quad 1995 NPS	There are at least two artificially maintained refugia populations. Six reintroduction sites were tried, 5 in Organ Pipe Cactus NM, 1 in Salt River near Tempe. All have failed.
Echinomastus erectocentrus var. *acunensis* Acuña cactus	1	S1	FC HS	Limited range, requirements not clearly understood. Poaching and military activity may affect this	West of Lukeville quad 1952 NPS Tillotson Peak quad 1980	May be more common and widespread than is currently known—very difficult to find.

TABLE 29
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN IN THE WESTERN PIMA COUNTY SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
				species..	NPS Kino Peak quad 1955 NPS Coffeepot Mountain quad 1982 BLM	
Glaucidium brasilianum cactorum Cactus ferruginous pygmy-owl	1	S1	FE FSS WSC	Habitat destruction and alteration, historic and present. Groundwater pumping, channelization, urbanization, historic livestock grazing? Farming and agricultural uses? Wood cutting. Disturbance by bird watchers. Small population subject to stochastic events. Possibility of disease, including emerging diseases, and loss of viable food supply as a result of drought and/or climate change.	Bates Well quad 1998 NPS Armenta Well quad 1999 NPS Gunsight quad 1999 2 sites NPS Kino Peak quad 1972 NPS Mount Ajo quad 1992, 1995, 1996 NPS Lukeville quad 1981, 1996 (2), 1997 NPS Diaz Peak quad 1996 NPS	Subarea is not included in Critical Habitat. This species has been known to be present in Organ Pipe Cactus NM since 1948, but is not in the same places every year.
Kinosternon sonoriense longifemorale Sonoyta mud turtle	1	S1	FC FSS	Very limited range. Possible groundwater pumping in Mexico. Water quality. Poor recruitment. Collecting. Disease, malnutrition? Competition with pupfish (*Cyprinodon*	Quitobaquito Springs quad Quitobaquito pond 1993 NPS	This is the only known location for this subspecies.

TABLE 29
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN IN THE WESTERN PIMA COUNTY SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
				macularis eremicus?) (Phil Rosen, personal communication, 03-04-99).		
Perityle ajoensis Ajo rock daisy	1	S1	SR	Limited range. Little knowledge. Recently described species.	Mount Ajo quad 3 sites 1972, 1988 (2) all NPS	The only known locations are in Organ Pipe Cactus NM, in the Ajo Mountains, in rocky canyons.
Tryonia quitobaquitae Quitobaquito tryonia (snail)	1	S1	WSC FSS?	Very limited range. Possible habitat loss by groundwater pumping in Mexico. Water quality.	Wutiobaquito Springs quad, two springs 1985, 1995 NPS	
Leptonycteris curasoae yerbabuenae Lesser long-nosed bat	2	S2	FE WSC	Alleged to be related to reduction of numbers of maternity colonies and decline in size of remaining maternity colonies in Arizona and Sonora due to exclusion and disturbance. Additionally, thought to be negatively affected by large reductions in acreage of native agaves over large areas of northern Mexico due to excessive harvesting for local manufacture of mescal and tequila. Excessive browsing by livestock on newly emergent flower stalks of *Agaves* has also been suggested as	Bates Well quad 2 sites 1989, 1992 NPS O'Neill Hills quad 1989 FWS Agua Dulce Mountains quad 1968-1989 FWS Pozo Nuevo Well quad 1979 NPS Kino Peak quad 1979 NPS Tillotson Peak quad 1989 NPS Mounta Ajo quad	A major maternity roost of thousands of bats is in Organ Pipe Cactus NM and has been studied for many years.

TABLE 29
STATUS 1 AND 2 VULNERABLE SPECIES OCCURRING IN IN THE WESTERN PIMA COUNTY SUBAREA
(continued)

Scientific Name/Common Name	Pima County Status	State Rank	Listing Status	Potential Threats and Stressors	HDMS Records	Notes
				possibly decreasing foraging opportunities and thus contributing to declines among these bats.	1979, 1982 NPS	
Tumamoca macdougalii Tumamoc globeberry	2	S3	FSS SR	Threats include urbanization, farming, overgrazing, recreation, habitat conversion, javelina (eating tubers), off-road vehicle use, pesticides.	Kino Peak quad 1951 NPS	

NOTE: Most of the records from this subarea are from Organ Pipe Cactus National Monument and the Cabeza Prieta National Wildlife Refuge. Some species on the category 1 and 2 list are present in this area, but there are no HDMS records for them. For example, Bell's Vireo, and Townsend' big-eared bat (only 3 records in years of surveys), Merriam's mouse (1 record in many years of surveys).

Quads: Aguila Mtns. SE, Okie Well, East Pass, Midway SW, Deadman Gap, Hat Mountain SW, Tom Thumb, Granite Mts. North, West of Growler Peak, Growler Peak, Childs Mtn., Ajo North, Burro Gap, Coffeepot Mtn., Granite Mts. South, Saguaro Gap Well, Temporal Pass, Chico Shunie, Ajo South, Sikort Chuapo, Gakolik Mtns., Antelope Hills, North of Agua Dulce Mts., Palo Verde Camp, Bates Well, Armenta Well, Gunsight, Hotason Vo, O'Neill Hills, Agua Dulce Mts., Pozo Nuevo Well, Kino Peak, Tillotson Peak, Mount Ajo, Gu Vo, West of Quitobaquito Springs, Quitobaquito Springs, West of Lukeville, Lukeville, Diaz Peak, Pia Oik, South of Lukeville, Blankenship Well, Menagers Lake.

overuse, decline in groundwater levels, and competition and predation by invasive species. The current ownership and management pattern within the Western Pima County Subarea is primarily conservation status 1a and 1b, with most of the remainder in status 3b (Figure 51), limited areas of intensive uses occur, primarily associated with Ajo and Why.

Activities contributing to biological stress are summarized in Table 30. These can be mostly attributed to the effects of a history of large and small-scale mining in the area, livestock grazing in a very arid region, increasing tourism and recreational use of the preserves and groundwater pumping to support agricultural uses directly south in Mexico.

The population of Ajo will increase somewhat in response to the New Cornelia mine reopening and an influx of jobs and residents. Increasing tourism and the appeal of the area to retirees is also bringing new people into the area. The primary consequence of this will be an increase in groundwater pumping.

Continued, increased, or intensified military training activities in the BMGR and Cabeza Prieta Wildlife Refuge raise concerns for plant and wildlife species there, particularly the Sonoran pronghorn and bighorn sheep.

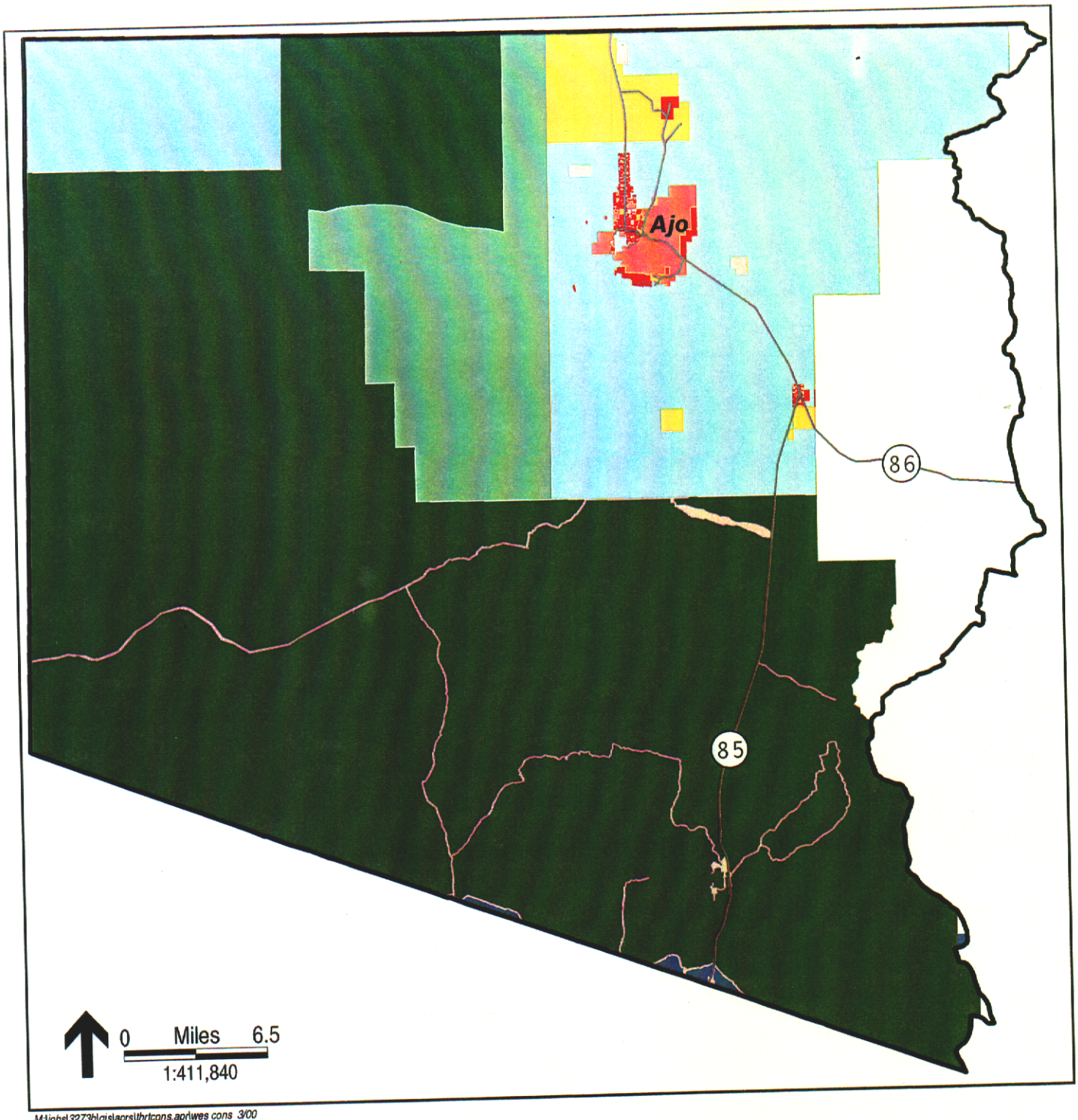
Expansion of the campground at Alamo Canyon Campground and increased use of trails in the vicinity are potential source of stress to the population of lesser long-nosed bats and desert pupfish. Precautions are being taken by the NPS to avoid impacting these species. Trapping by non-native fish will continue as an ongoing effort. Access to the bats' roost adit is restricted and the adit is carefully monitored for indication of human disturbance or presence of predatory barn owls.

Potential exists for the transfer of land from public (BLM) to private ownership, and the expansion of the Ajo community. The subsequent conversion of native vegetated lands, albeit grazed, to higher intensity urbanized areas dependent upon groundwater pumping raises concern for groundwater availability. This is a particular concern where these public lands are located adjacent to the existing preserves. The high impact of dispersed and long-term camping on BLM lands is a stressor to vegetation and wildlife in the area around Ajo.

The reopening of the New Cornelia mine is not expected to impact land areas not already disturbed. However, increased groundwater pumping, water pollution, and atmospheric deposition are concerns that Phelps Dodge will have to address as part of their permitting process.

The potential for increased smaller-scale mining exists. The BLM land surrounding Ajo permits mining. Increased mining in this area would result in habitat loss, alteration, degradation, and fragmentation.

One subarea habitat that appears to be most vulnerable to stress is the small riparian and wetland area surrounding the Quitobaquito spring and pond. Although NPS is taking precautions to protect and minimize visitor impacts to the area, increasing groundwater pumping and declining groundwater levels in the agricultural areas to the south in Mexico could affect the available surface water here. This is a potential stressor to the



Level of Threat Represented by Conservation Status
in the Western Pima County Subarea

Level of Threat
Low

Conservation Status
Most Protected

- 1a
- 1b
- 2
- 3b
- 4a

(For status definitions, see GAP Status Categorization Table in Methods section.)

Level of Threat
High

Conservation Status
Least Protected

- 4b
- 4c
- 4e
- 4f
- 4x

Figure 51

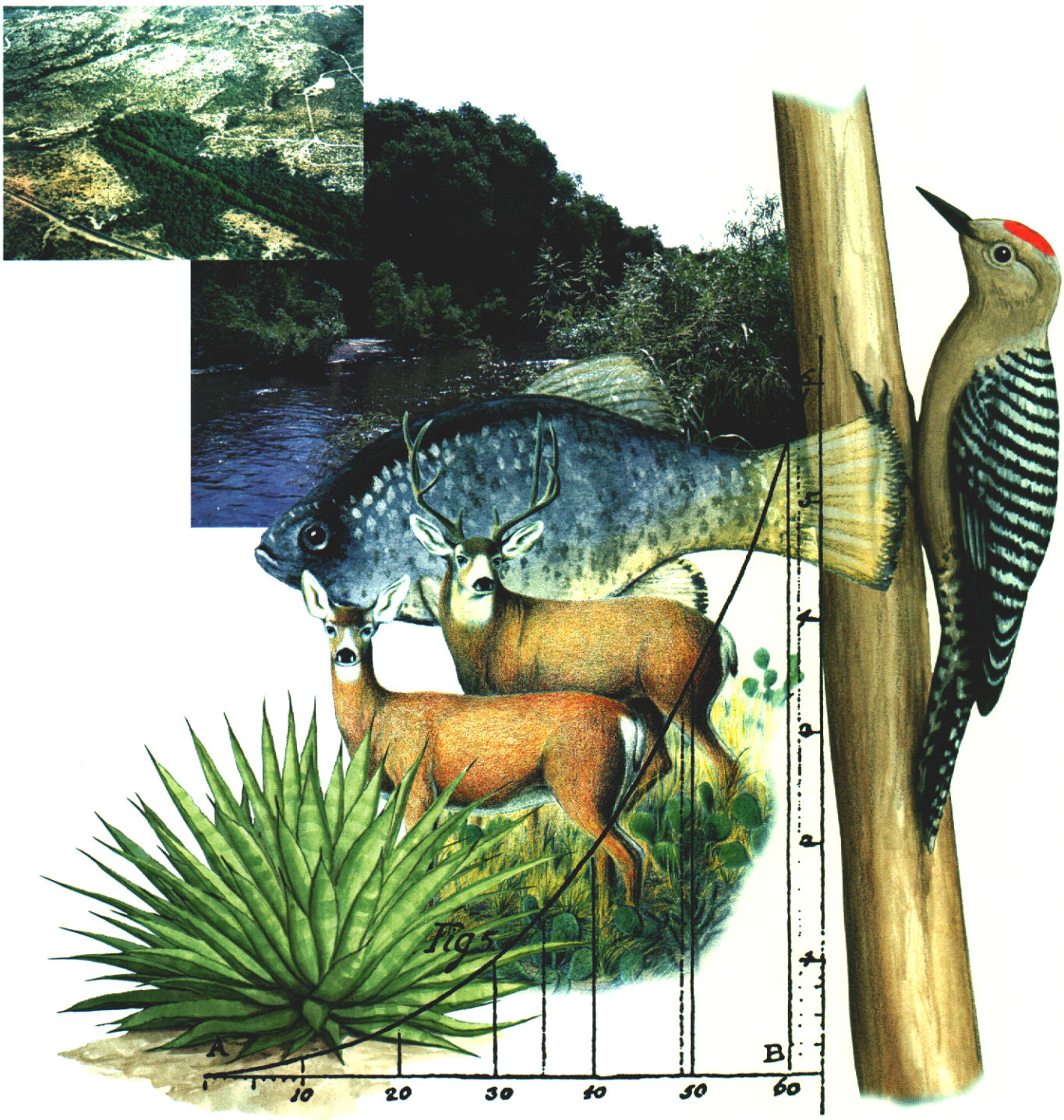
TABLE 30
LAND USE ACTIVITIES WITHIN LAND OWNERSHIP/MANAGEMENT CATEGORIES OF THE WESTERN PIMA COUNTY SUBAREA

Ownership or Management Category	Land Uses and Activities									
	Conversion of Vegetative Cover	Competition/Predation by Invasive Species	Lot-Splitting & Urbanization	Groundwater Pumping	Water Diversion & Impoundments	Recreational Uses	Mining	Roadways	Livestock Grazing	Removal of Plants
Cabeza Prieta Wildlife Refuge (76,990 acres)	-	x	-	x	x	x	✪	x	✪	✪
Cabeza Prieta Roads (1,231 acres)										
Cabeza Prieta Wilderness (322,145 acres)										
Organ Pipe National Monument (1,628 acres)	-	x	-	x	*	x	✪	x	✪	✪
Organ Pipe NM Roads (10,451 acres)										
Organ Pipe NM Wilderness (316,789 acres)										
BLM Lands (174,813 acres)	x	x	*	x	x	x	x	x	x	x
Tohono O'Odham Nation Unreserved (104,959 acres)										
DOD Barry M. Goldwater Range (44,258 acres)										
State Land (1,396 acres)	x	x	*	x	x	x	x	x	x	x
Private Lands (27,472 acres)	x	x	x	x	x	x	x	x	x	x

x = occurs
- = does not occur
* = potential to occur
✪ = historic but not present occurrence

endangered pupfish. Primary sources of stress affecting habitats all along the border include the illegal traffic from Mexico, introduction and spread of invasive species such as buffel grass, fountain grass, and red brome, and the illegal collection of desert plants. Invasive grasses have changed the fire regime. Lower elevation plant communities of legumes and cacti are not resistant to the higher temperatures of grass fires and are damaged or killed by wildfires.

Summary, Conclusions, and Recomendations



XII. Summary, Conclusions, and Recommendations

A. Summary

There is fairly high public knowledge of some of the potential threats and stressors identified by this assessment (e.g., urbanization, highway and road construction, groundwater overdraft, declining stream flows, loss of riparian habitat). Other issues discussed here are not as well known to many in our community.

- The laws regulating the use of State Lands have tremendous overriding implications to the Sonoran Desert Conservation Plan, since they comprise so much of the land already identified for potential future conservation.

- Resource damage related to the huge numbers of illegal border crossings is a seemingly never-ending, unstoppable reality for private land owners and public land managers all along the border.

- The dramatic transformation of the region's grasslands to desert scrub habitat in the early 1900s is something we are still impacted by in terms of erosion, spread of invasive grasses, fire regime changes, and conversion of habitats.

- The presence of non-native grasses and other invasive plant and wildlife species is a big concern in all of the subareas, particularly those with aquatic habitats and native grasslands.

- The presence of many areas of medium to high levels of mineral resource potential presents serious concerns when overlaid with areas of critical biological concern.

- These are all issues and factors that must be considered in the design of a preserve system that protects our biological resources and ecosystem functions.

Tables 31-39 summarize the analysis of each subarea, including areas and habitats of concern, listed or threatened species and primary or potential sources of stress.

B. Conclusions

The analysis presented here has specific limitations. The information available for this report does not provide an all inclusive picture of all projects, but rather offers an initial overview of current and potential threats and stressors within each subarea. Time constraints limited the amount of input received from subarea panels that are only now beginning to be formed. Future information that is developed as a result of the subarea reports being prepared by others have not been incorporated, since they are in their initial phase of development.

Conservation status, assigned to management categories, summarizes the patterns of existing biodiversity protection and shows opportunities for establishing future protection within a reserve design. Based on the distribution of potential general levels of potential threats and stressors (as depicted by the pattern and amount of land in each conservation status category, Figure 52 and Table 40), certain general conclusions emerge:

TABLE 31
SUMMARY OF STRESS ANALYSIS OF MIDDLE SAN PEDRO (SUBAREA 1)

Areas and Habitats of Concern	Federally Endangered or Threatened Species	Primary or Potential Sources of Stress
• Perennial stream flows in the San Pedro River and the associated aquatic and cottonwood-willow riparian woodlands • Designated Critical Habitat for the CFPO and proposed Critical Habitat for the Spikedace and Loach minnow • The Bingham Cienega marsh habitat • Remaining areas of sacaton grass • Tributary canyon connections to the Catalina and Rincon mountains (The Bingham Cienega Preserve and TNC's Buehman Canyon holdings preserve some of these but are currently separated from each other by State and private lands)	• Gila topminnow • CFPO • Southwest willow flycatcher • Mexican spotted owl • Western yellow-billed cuckoo (under consideration for listing)	• Growth and development pressure resulting in the conversion of ranches and other large agricultural properties into smaller properties, each with groundwater needs • The presence of surface flows in the River jeopardized by increased groundwater pumping and water diversion for residents and agricultural fields • The presence of developable private and/or State Lands along the River and adjacent to preserve areas • Areas of medium to high mineral resources in the east flank of the mountains and the existing mining operations in Buehman Canyon • Indiscriminate ORV and other recreational uses in the Redington Pass area that degrade habitat • Invasive species (e.g., non-native grasses, bullfrogs, non-native fish, feral hogs) that compete with and prey upon native species of concern and limit the potential for reintroduction of native species such as beaver and native fish

TABLE 32
SUMMARY OF STRESS ANALYSIS OF CIENEGA-RINCON (SUBAREA 2)

Areas and Habitats of Concern	Federally Endangered or Threatened Species	Primary or Potential Sources of Stress
• Perennial stream flows and shallow groundwater along the Cienega, Agua Verde and Rincon Creeks and Davidson Canyon, and the associated aquatic and cottonwood-willow riparian woodlands and cienega marshlands; grasslands, including crinkle-awn and areas of sacaton grass • Cave habitats and limestone dependent plant communities • Tributary connections to the Saguaro National Park, Rincon Mountains, and Santa Rita Mountains (The proposed Las Cienegas National Conservation Area would protect many of these areas while still allowing ranching and other private uses.)	• Gila topminnow • Huachuca water umbel • CFPO • Mexican spotted owl • Lesser long-nosed bat • Pima pineapple cactus • Western yellow-billed cuckoo (under consideration for listing)	• Growth and development pressure in the Tucson basin is shifting to the southeast, resulting in large Specific Plan developments, concentrations of unregulated lot-splitting and the conversion of ranches into smaller properties, each with growing groundwater needs • The shallow groundwater along Rincon Creek and perennial flows in the Cienega Creek could be jeopardized by increased groundwater pumping and water diversion for residents and golf courses in the Rincon Valley- also a concern for Empirita Ranch • Increased lot-splitting in the Pistol Hill area near Colossal Cave impacts limy soils and the species they support (agaves and lesser long-nosed bat) • The existing zoning plan for Vail-Posta Quemada that allows high density development in the vicinity of the Cienega Creek Preserve • Excavation of the Pantano Wash for sand and gravel purposes • The presence of developable private and/or State Lands along the Cienega Creek and Davidson Canyon and adjacent to sensitive preserve areas

TABLE 32
SUMMARY OF STRESS ANALYSIS OF CIENEGA-RINCON (SUBAREA 2)
(continued)

Areas and Habitats of Concern	Federally Endangered or Threatened Species	Primary or Potential Sources of Stress
		• Areas of medium to high mineral resources in the Santa Rita mountains and the proposed mining operations at Rosemont Ranch • Indiscriminate ORV and other recreational uses in Gardner Canyon and other areas degrade riparian and other habitat and put cave habitats at risk • Invasive species (e.g., non-native grasses, bullfrogs, non-native fish) that compete with and prey upon native species of concern and can limit the potential for reintroduction of native fish species

TABLE 33
SUMMARY OF STRESS ANALYSIS OF UPPER SANTA CRUZ (SUBAREA 3)

Areas and Habitats of Concern	Federally Endangered or Threatened Species	Primary or Potential Sources of Stress
• Areas of shallow groundwater along the Sopori Wash • Mixed riparian woodlands and xeroriparian communities associated with the Santa Cruz River and its tributaries • Palo verde mixed scrub associations in upland areas • Undeveloped low elevation valley lands along the Santa Cruz River • Semi-desert grasslands • Pecan groves providing habitat for the Western yellow-billed cuckoo • Pima pineapple cactus habitat	• Pima pineapple cactus • Gila topminnow • Mexican spotted owl • lesser long-nosed bat • San Xavier Talussnail • Western yellow-billed cuckoo (under consideration for listing)	• Growth and development along the I-19-Santa Cruz River corridor that creates a swath of urbanization extending into the Sahuarita area • Concentrations of unregulated lot-splitting in the Sahuarita, Sopori, and Sierrita foothills area • The extension and widening of Sahuarita Road could facilitate unregulated growth • Conversion of agricultural lands to residential development • Conversion of ranches into smaller properties, each with growing groundwater needs • The presence of shallow groundwater along the Sopori Wash area that could be jeopardized by increased groundwater pumping for residents • Growing interest in areas of medium to high mineral resources in the Santa Rita mountains • Habitat loss from the existing mining operations at Helvetia and in Green Valley • Invasive species, particularly non-native grasses, that compete with native grass species of concern (within the Santa Rita Experimental Range and elsewhere) • Continued increase in ground water pumping to support mines, agriculture and urban uses. (The proposal to extend the CAP line south to serve the mines, FICO, and Green Valley that could greatly reduce dependency on ground water pumping)

TABLE 34
SUMMARY OF STRESS ANALYSIS OF MIDDLE SANTA CRUZ (SUBAREA 4)

Areas and Habitats of Concern	Federally Endangered or Threatened Species	Primary or Potential Sources of Stress
• Shallow groundwater and areas of perennial flow along the Tanque Verde Wash, Agua Caliente Creek, Sabino Creek and Lemmon Creek and the aquatic and riparian habitats they support • Effluent-dominated stream flow along the Santa Cruz River and the riparian habitat it supports • Remaining segments of xeroriparian habitat and their extensions to preserve areas • Critical Habitat for the CFPO and ironwood plant communities and palo verde mixed scrub associations in upland areas	• Gila topminnow • CFPO • Mexican spotted owl • lesser long-nosed bat • Western yellow-billed cuckoo (under consideration for listing)	• Continuing growth and development within the Tucson basin • Groundwater pumping that has resulted in overdraft and contributed to the significant decline in riparian vegetation • Unregulated lot-splitting in outlying areas • Increasing pumping of ground water in the Mt. Lemmon area of upper Sabino Creek • Invasive species (e.g., non-native grasses, saltcedar and other plants, bullfrogs, crayfish, non-native fish) that compete with and prey upon native species of concern and limit the potential for successful riparian restoration projects and the reintroduction of native fish species • Problem with mosquitoes carrying encephalitis at the wetlands created at Sweetwater • Increasing recreational use of public lands that degrades habitat and disturbs wildlife • Indiscriminate ORV and other recreational uses of the Redington Pass area • High use of the Pusch Ridge Wilderness area as a factor in declining bighorn sheep population

TABLE 34
SUMMARY OF STRESS ANALYSIS OF MIDDLE SANTA CRUZ (SUBAREA 4)
(continued

Areas and Habitats of Concern	Federally Endangered or Threatened Species	Primary or Potential Sources of Stress
		• Presence of developable private and State lands adjacent to preserves and/or within proposed expansion boundaries • Increased utilization of effluent water that could reduce the amount available for discharge into the Santa Cruz River, impacting the effluent-dependent riparian vegetation established there

TABLE 35
SUMMARY OF STRESS ANALYSIS OF TORTOLITA FAN (SUBAREA 5)

Areas and Habitats of Concern	Federally Endangered or Threatened Species	Primary or Potential Sources of Stress
• Undeveloped areas of Critical Habitat for the CFPO, ironwood plant communities and palo verde mixed scrub associations in upland areas • Areas of perennial flow in the Honeybee, Rueleas, and Romero Canyons and the aquatic and cottonwood-willow riparian vegetation they support • Effluent-dominated stream flow along the Santa Cruz River and the riparian habitat it supports • Remaining segments of xeroriparian habitat and their extensions to preserve areas	• Gila topminnow • CFPO • Mexican spotted owl • Lesser long-nosed bat	• Rapid growth and development coupled with increasing groundwater pumping and declining water table • Unregulated lot-splitting in the communities of Catalina and Tortolita • Possible storage basin and extension of CAP line east through CFPO habitat (While the CAP line would result in habitat loss and would likely facilitate increased growth by providing a new source of water, it would significantly reduce this area's dependency on ground water) • Conversion of agricultural to residential subdivisions lands in Marana area • Increased erosion of heavily dissected bajadas as the result of vegetation clearing and channelization • The presence of developable private and/or State Lands adjacent to sensitive preserve areas of Tortolita Mountain Park and Catalina State Park

TABLE 36
SUMMARY OF STRESS ANALYSIS OF ALTAR VALLEY (SUBAREA 6A)

Areas and Habitats of Concern	Federally Endangered or Threatened Species	Primary or Potential Sources of Stress
• Perennial stream flows and shallow groundwater along the Arivaca Creek, Lake and cienega, and the associated cottonwood-willow riparian woodlands, aquatic habitat and cienega marshland; Sonoran and semi-desert grasslands, including areas of sacaton grass • Critical Habitat for the CFPO, ironwood plant communities, and palo verde mixed scrub associations in upland areas; undeveloped low elevation valley lands along the Brawley and Black Washes	• Gila topminnow • CFPO • masked bobwhite • jaguar • Pima pineapple cactus • Western yellow-billed cuckoo (under consideration for listing)	• Concentrations of unregulated lot-splitting and the conversion of ranches into smaller properties, each with groundwater needs • Impacts of historic range degradation, including the continued downcutting and erosion along the Brawley Wash • Groundwater pumping that could jeopardize the perennial surface flows in Arivaca Creek • Water quality at Arivaca Lake (mercury contamination of fish) • The presence of developable private and/or State Lands around Arivaca and the Sierrita and Cerro Colorado Mountains • Areas of medium to high mineral resources along the Arivaca Creek and the potential for water contamination due to past mining activities in the upper watershed • Invasive species (e.g., non-native grasses, bullfrogs, non-native fish) that compete with native grassland vegetation and prey upon aquatic species of concern in the Arivaca watershed • The possible future extension of San Joaquin loop road through the valley that could impact CFPO Critical Habitat and areas of ironwood plant communities

TABLE 37
SUMMARY OF STRESS ANALYSIS OF AVRA VALLEY (SUBAREA 6B)

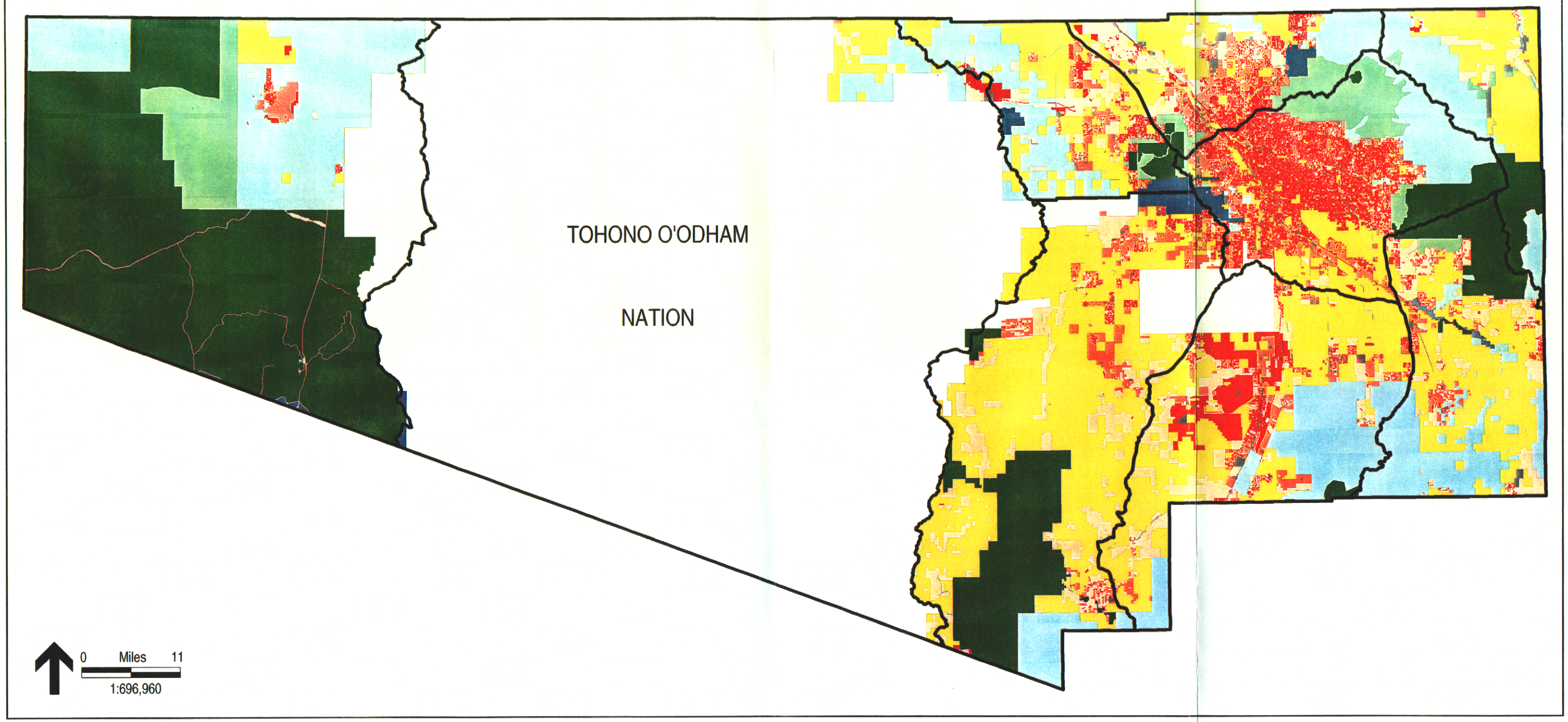
Areas and Habitats of Concern	Federally Endangered or Threatened Species	Primary or Potential Sources of Stress
• Small area of shallow groundwater east and down gradient from the Silver Bell mine • Ironwood plant communities and palo verde mixed scrub associations in upland areas, particularly in the Silverbell Mountains which support bighorn sheep • Undeveloped low elevation valley lands along the Brawley and Blanco Washes. The proposed Ironwood Preserve in the Silverbell Mountains, possibly extending south to the Waterman and Roskruge Mountains would protect significant areas of ironwood communities and xeroriparian habitat	• CFPO • Nichol's Turk's head cactus • Pima pineapple cactus	• Concentrations of unregulated lot-splitting west of Marana and in the Picture Rocks area abutting Saguaro National Park • The conversion of ranches into smaller properties • The conversion of agricultural lands to subdivisions and commercial developments • Increased ground water pumping and declining water table; retired agricultural lands that host invasive grass and other plant species • Potential for expanded mining in the Silver Bell Mountains; and the presence of developable private and/or State Lands, particularly in areas of high density ironwood plant communities • The possible future extension of Tangerine/San Joaquin loop road through the valley, potentially impacting CFPO Critical Habitat and areas of ironwood plant communities and facilitating growth and development of the valley • Resource damage and wildlife disturbance all along the U.S./Mexico border due to increasing rates of illegal crossing and stepped up Border Patrol activities

TABLE 38
SUMMARY OF STRESS ANALYSIS OF TOHONO O'ODHAM NATION (SUBAREA 7)

Issues of Concern
• Although not included in the scope of this study, activities within the Nation's boundaries affect abutting lands (and visa versa). The Nation is implementing plans to cultivate and irrigate over 2,500 acres of fields in the "Garcia Strip" of the Schuk Toak District using a portion of their CAP allotment. This area is directly south and west of an area of designated CFPO Critical Habitat, Map Unit 2. This represents direct loss of habitat of similar vegetative character and resource value as nearby Critical Habitat areas.
• Other planned uses of the Nation's CAP allotment include the direct release of water into the Santa Cruz River and tributaries for riparian and xeroriparian enhancement and restoration with a recreation component. A farmland rehabilitation project may also be included in the area north of San Xavier Mission. This would tie into the southern extent of the Paseo de las Iglesias, the County's conceptual plan for riparian restoration along the Santa Cruz River.
• The Nation's planned casino at I-19 and Pima Farms Road has the potential to turn this interchange into a major commercial center. This would be increased greatly if this interchange is used for the future connection of the Sahuarita Road corridor.
• Within the Tohono O'odham Sub-area are three watersheds: the San Simon Valley, the Santa Rosa Valley and the Aguirre Valley. The Aguirre Valley is one of the largest watersheds in Pima County and represents one of the largest areas of relatively undisturbed desert landscape that remains. The presence of unmodified low elevation desert soils and vegetation across the valley floor make this area unique and significant.
• As in the Altar Valley and Western Pima County Sub-areas, resource damage and wildlife disturbance occurs all along the U.S./Mexico border due to increasing rates of illegal crossing and stepped up Border Patrol activities.

TABLE 39
SUMMARY OF STRESS ANALYSIS OF WESTERN PIMA COUNTY (SUBAREA 8)

Areas and Habitats of Concern	Federally Endangered or Threatened Species	Primary or Potential Sources of Stress
• Areas of shallow groundwater along Growler Wash (west of Ajo) and elsewhere within the Subarea • Riparian and xeroriparian habitat; aquatic and riparian habitat at Quitobaquito and Aguajita Springs • Mine adit at Alamo Canyon/Copper Mountain (home to largest maternity colony of lesser long-nosed bat) • Large areas of Organ pipe cactus, ironwood plant communities and palo verde mixed scrub associations	• CFPO • Lesser long-nosed bat • Sonoran pronghorn • Quitobaquito desert pupfish	• Military overflights and Border Patrol Helicopter surveillance flights that disturb the sensitive Sonoran pronghorn, bighorn sheep and other wildlife species • Livestock grazing and human (recreational) overuse of BLM lands outside of Ajo that degrade and remove vegetation and habitat • The planned expansion of the New Cornelia open pit mine in Ajo • Increased ground water pumping to support the residents and future mine operations • Planned roadway improvements and possible future widening of SR 85 through Organ Pipe National Monument increase habitat fragmentation and the potential for roadkill • Invasive species (e.g., non-native grasses, bullfrogs, non-native fish) that compete with native grassland vegetation and prey upon aquatic species of concern at the Quitobaquito Springs • Resource damage and wildlife disturbance all along the U.S./Mexico border due to increasing rates of illegal crossing and stepped up Border Patrol activities, exacerbated at Organ Pipe National Monument where the Mexican Highway 2 parallels the border near the Quitobaquito Spring. Numerous wildcat roads and trails are created and used illegally by people, mules, horses, and vehicles, and by Border Patrol agents.



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Subarea Boundaries

Level of Threat

Low

High

Conservation Status

1a Most Protected
1b
2
3a
3b
4a
4b
4c
4e
4f
4x Least Protected

(For status definitions, see GAP Status Categorization Table in Methods section.)

Summary of Conservation Status for Pima County

Figure 52

TABLE 40
DISTRIBUTION OF CONSERVATION STATUS CATEGORIES IN EACH SUBAREA IN PIMA COUNTY

GAP Status	Altar Valley	Avra Valley	Cienega-Rincon	Middle Santa Cruz	San Pedro	Tohono O'odham	Tortolita	Upper Santa Cruz	Western Pima County	Total
1a	127,062	9,209	43,779	28,702	26,202	1,839	2,985	3,677	638,933	882,391
1b		4,219	4,247	46,889	3,922		19,865		76,990	156,134
2	9,090	8,489		6,465		1,933	5,453		1,628	33,057
3a			2,643		180					2,823
3b	30,425	69,565	82,568	53,499	57,016	33,982	32,778	94,912	219,071	673,895
4a	352,122	78,641	125,668	56,110	73,083	40,259	49,557	179,017	17,926	972,418
4b	69,718	21,850	37,035	11,984	10,227	6,882	34,442	56,288	12,725	261,154
4c	34,030	14,641	15,419	40,595	1,055	314	26,670	27,587	6,819	167,131
4e	75,068	882	36	3,859	6	2,266,844		31,689	104,957	2,483,344
4f	11,294	10,789	4,485	84,191	407	2,289	21,467	48,143	2,580	185,646
4x*	4,880	3,085	2,611	29,508	2,159	244	10,275	8,294	504	61,562
TOTAL	713,690	221,371	318,491	361,802	174,258	2,354,586	203,492	449,608	1,082,132	5,879,556

*No parcel data.

Eastern Pima County has a well-defined set of core conservation areas, primarily centered on higher elevation areas.

- Because of the existing level of threats and stressors and the limited opportunities for increasing the amount of conserved lands within the Tucson metropolitan area, conservation planning should focus on protection of key resources (e.g., riparian and aquatic habitats, CFPO habitat) and provision of corridors and connections between more appropriate and feasible conservation areas.

- Conservation planning outside of the Tucson metropolitan area should focus on augmentation of existing reserve core areas to provide for coverage of additional conservation targets, increase the coverage of underrepresented conservation targets, and landscape connections between the existing reserve core areas.

- Fragmentation and degradation as the result of urbanization, roads and highways, and other linear infrastructural elements represents a significant threat to conservation throughout Pima County.

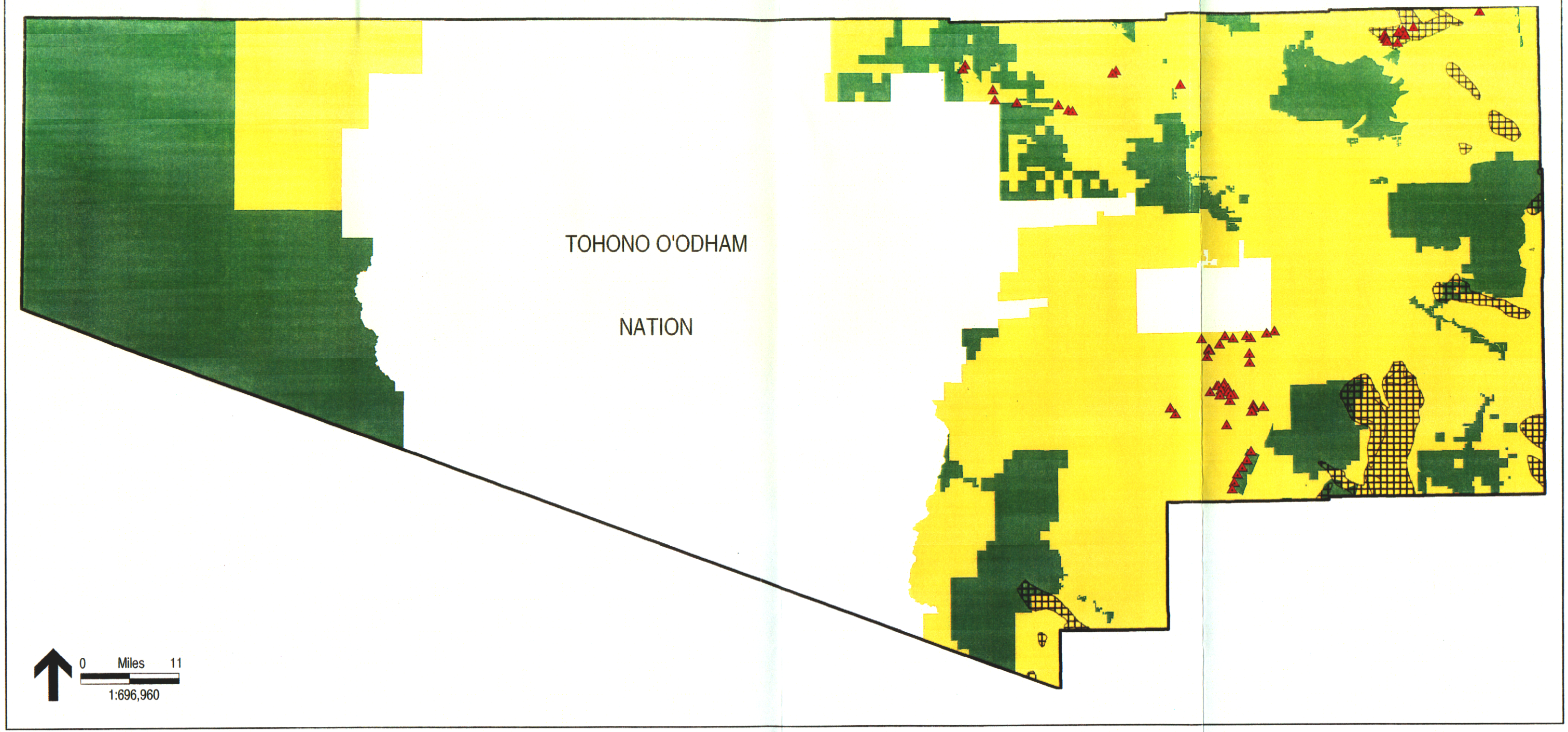
- The opportunity for development of meaningful reserve design alternatives, as represented by conservation status 4a and 3b lands, is substantial. More than 1.65 million acres or 28 percent of the County or 48 percent of the County exclusive of the Tohono O'odam lands is in this category, which although not currently managed for conservation, is also not committed to more intensive uses.

Individual land uses and permitted activities may also be associated with management categories in order to map where these stressors have the potential to occur. For example, mining is permitted in certain existing reserves and assumed to be permitted in the remaining conservation categories, resulting in the identification of mining as a potential threat throughout much of Pima County (Figure 53). Mining has the potential to result in land disturbance, fragmentation by roads, indirect effects of noise, dust, and vibration, air and water quality issues, and potential toxicity issues. However, active mines and potential mineral resources (from USFS data) are more limited in their distribution. Refinement of the data on the real and potential distribution and quality of mining resources would allow for a more effective assessment of the actual threats to biological resources posed by mining.

C. Recommendations

Based on the analyses of specific threats and stressors summarized in this assessment, the following recommendations focus on some of the primary policy level and general data collection issues identified:

- The County could consider its role and establish a dialogue with private parties, land managers (Buenos Aires & Cabeza Prieta National Wildlife Refuges, Organ Pipe National Park, Coronado National Forest, Tohono O'odham Nation), Border Patrol, and IBWC, as to potential measures to address the problems of resource damage associated with the flow of illegal entrants along the border (also: introduction of parasites, or fungi into wetlands, oil and fuel spills into wetlands, spread of exotic species, threats to endangered fish, etc.). The Border Patrol is under increasing pressure to keep its efforts in conformance with the Endangered Species Act, and a



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Pima County Boundary

Not Part of Study

Active Mine

Mineral Resource Potential Area

(Note: Active Mines and Mineral Resource Potential Areas have been digitized only for USFS lands in eastern Pima County. Active mine locations and mineral resource potential shown are therefore not representative of the entire county.)

Mining Permitted

Mining Not Permitted

Mining Threat in Pima County

Figure 53

potential measure, increasing barriers along the border, could have a negative effect on wildlife movement. This is an issue that affects the Sonoran Desert Conservation Plan but cannot be solved.

- The County should seek out other information on mining and mineral resources (other than the information from the Coronado National Forest) to aid in reserve design decision making. The County has initiated a Mineral Resources study which should be of great help, particularly in addressing concerns for the proposed preserve at the Silver Bell Mountains. The potential for mining operations, including sand and gravel extraction could result in establishment of a preserve system that is vulnerable to mining activities.

- The County should reevaluate its policies on permitting sand and gravel operations, especially within wash areas, in the context of the development of the conservation alternatives for the Sonoran Desert Conservation Plan. These are activities that have upstream and downstream impacts and could be counterproductive to the extensive riparian restoration program that is planned.

- The County should initiate a dialogue with the Department of Agriculture to discuss problems associated with invasive and pest species that "hitchhike" into our state. This issue affects most if not every existing and potential conservation area in Pima County, although the issue cannot be addressed solely by the Sonoran Desert Conservation Plan.

- The County should develop a strategy for addressing the issue of groundwater pumping in the context of the development of conservation alternatives for the Sonoran Desert Conservation Plan, including consideration of what actions would be appropriate in negotiating with such water users. An initial step in this process will be the PAG report identifying water companies or users pumping groundwater within one mile of perennial streams, intermittent streams, and areas of shallow groundwater. This will identify locations of groundwater withdrawal "hotspots" in sensitive habitats. The strategy could include trading for CAP water, purchase of groundwater rights, or acquisition of surface water rights to support endangered species habitats if they are present.

- Because of the amount and distribution of State Lands in Pima County, some resolution will have to be achieved to make the reserves work, since such a high percentage of these lands are found within potential conservation areas and in other sensitive areas.

The GIS analyses conducted for this work program have highlighted both data gaps and some avenues for future analyses. As reported in the methods section, there are many inconsistencies in the ownership, management, and land use coverages. While "sliver" errors are not critical for county-wide or subarea-wide analyses, they become more important at local and especially parcel-level analyses. Accurate boundary delineation and classification is especially important when management data is being analyzed together with limited species distributions. Land use information in the parcel database is also important for classifying level 4 category lands. This data is missing for 60,000 acres, primarily in the Tucson metropolitan area. To the extent possible, ownership, management, land use, and conservation status attribute data should be assigned to the

most accurate polygon boundaries delineating these areas. The parcel base may provide the most accurate management boundary delineation, but lacks attribute data that makes it useful for conservation analysis. Parcel use codes could be summarized and used to assign ownership, management, and conservation status; however, this is a very large task since the parcel base consists of over 300,000 polygons. Alternatively, the composite management coverage developed for this work program could be reviewed and revised against the parcel base to correct errors in boundary delineation and classification for areas prioritized from most to least critical.

GIS analyses conducted for the threats report also points to some areas of future analysis. The matrices of land uses/activities that occur or are permitted in each conservation management category can be applied to the GIS coverage of management in order to visually and quantitatively assess patterns of activities on the landscape. The level of threat for each of these activities can also be evaluated by intersecting these coverages with coverages delineating known and potential occurrence for each threat. Data showing distribution of individual threats need to be developed. These level of threats maps can then be overlaid with the distributions of vulnerable species in order to understand patterns of critical threats to individual species.

The following general recommendations are primarily focused on improvement of the underlying GIS database developed in this assessment:

- Identify and incorporate into the GIS database input from subarea panel members and other community experts, once they are assembled;

- Incorporate into the GIS database review comments of land managers and owners on ownership boundaries and classification;

- Develop and incorporate into the GIS database more comprehensive data on the distribution of mining resources;

- Incorporate into the GIS database review comments on the assignment of conservation threat status to various land uses;

- Incorporate into the GIS database recent changes in conservation status; and

- Develop a protocol for identification and incorporation of future changes in conservation status into the GIS database.

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