



---

# MEMORANDUM

---

Date: October 16, 2000

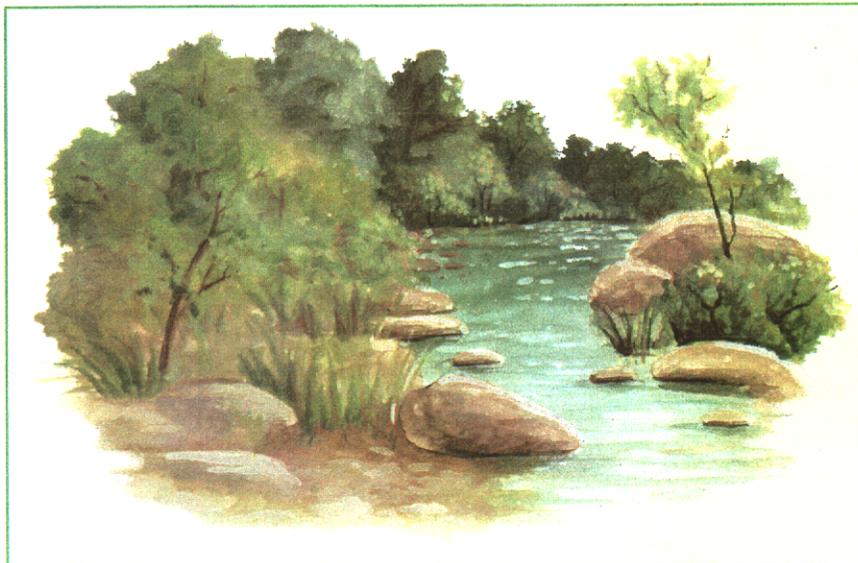
To: The Honorable Chair and Members  
Pima County Board of Supervisors

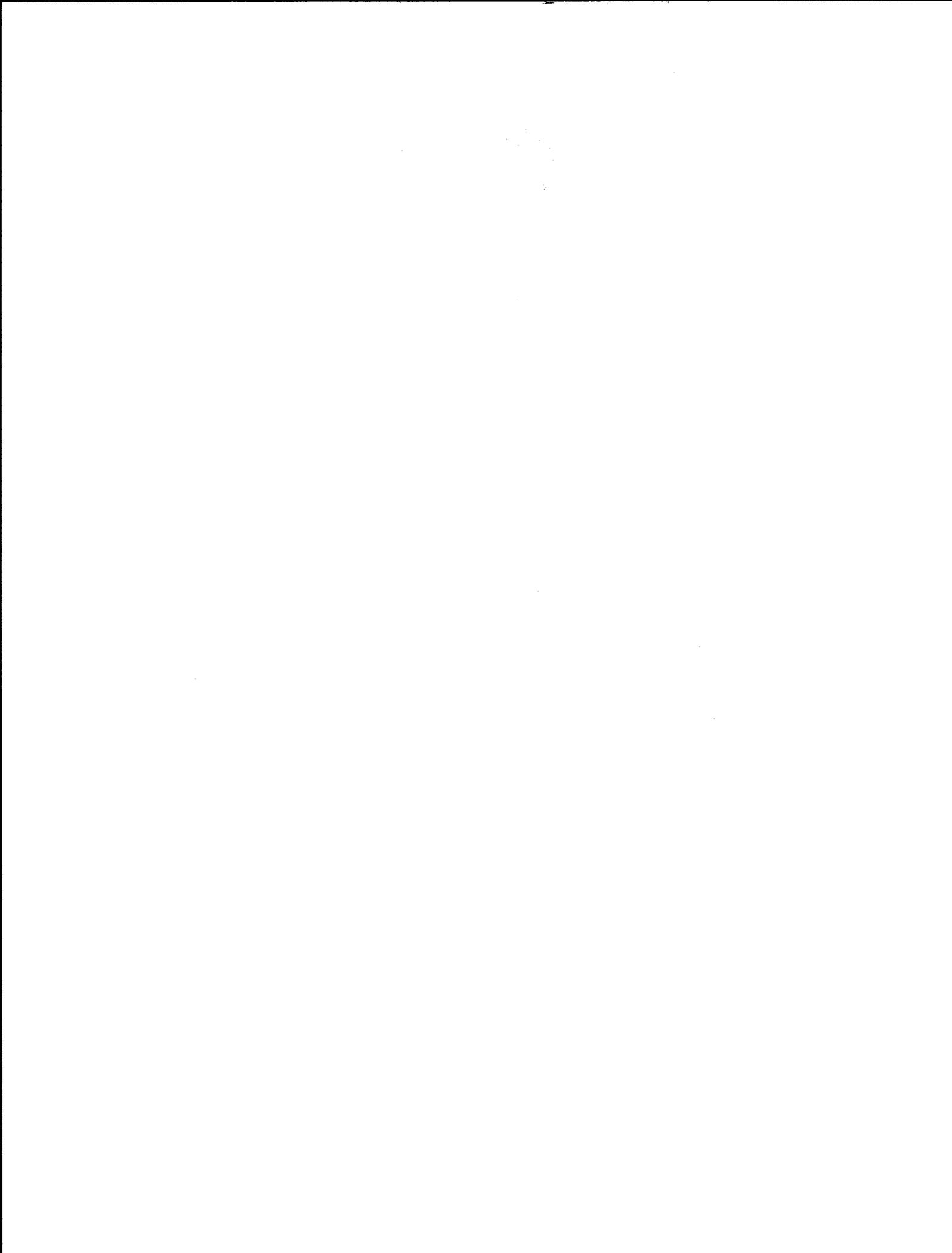
From: C.H. Huckelberry  
County Administrator 

Re: **Attached Overview of the Draft Preliminary Sonoran Desert Conservation Plan**

The attached report entitled *Overview of the Draft Preliminary Sonoran Desert Conservation Plan* is a review and explanation of aspects of the first two years of the planning process, written for the general public to describe in non-technical terms both the procedural and substantive aspects of the conservation planning effort. The author, Ms. Barbara Tellman of the University of Arizona Water Resources Research Center, has provided an assessment that will leave readers with a greater understanding of how the process has unfolded and how the major studies contribute to the *Draft Preliminary Sonoran Desert Conservation Plan*, which is now out for public comment.

Ms. Tellman's report is in one sense a concise encyclopedia of Sonoran Desert Conservation Plan information. In another way it places the current Pima County effort within the context of conservation and land use planning efforts throughout Tucson's history. And in yet another way this document provides a level of peer review that allows us to reflect on recent experience and invite comments from the Steering Committee and interested members of the community about how to build on and improve the next two years of the planning process as we move toward permit application and program implementation. Regardless of how the *Overview* is read, it is a welcome addition to the study series. It is a great privilege to be able to work with Ms. Tellman, and to forward the attached *Overview* to the Board and the community.





# EXECUTIVE SUMMARY

## The Origins of the Plan

Two years ago when the small endangered Cactus ferruginous pygmy-owl was the focus of major community controversy, the Pima County Board of Supervisors directed County staff to develop the Sonoran Desert Conservation Plan. The most significant component of the SDCP would be a Multi-species Habitat Conservation Plan (MHCP) which would satisfy federal requirements. The Board decided that a MHCP was far preferable to a site-by-site approach to deciding where development could and could not occur and under what conditions. It would benefit the vulnerable species by taking an area-wide approach to determining the best way to protect the species and their habitats as a whole. It would increase predictability for developers by clearly defining the process and the affected areas, and reducing the need for each developer to conduct surveys and apply for permits. The other jurisdictions that agreed to participate in the MHCP could offer a unified process and protected habitats.

County staff were directed to do several things and report back to the Board of Supervisors.

- Staff should gather the latest scientific information about the owl and other threatened and endangered species.

- Staff should use that information to determine the most effective way to protect the owl and its habitat and to meet federal regulations.

- Staff should develop a system whereby developers would have greater predictability in planning where to put new construction and simplify the permitting process.

- Staff should incorporate other elements for the benefit of Pima County residents, such as preservation of scenic values and recreational opportunities.

In order to do a thorough job, funds were needed and members of the Arizona congressional delegation, Representatives Kolbe and Pastor and Secretary of Interior Bruce Babbitt worked to obtain a federal appropriation. In fiscal year 2000 an initial appropriation of \$994,750 was provided. Pima County provided additional funding. A team of county employees worked to assure that the reports came out on time and local organizations such as the Arizona-Sonora Desert Museum and the Nature Conservancy contributed their expertise.

## How the Draft Preliminary Plan was Developed

County staff worked closely with the leading biological scientists in the region. A volunteer team of scientists (STAT) primarily from the university and government agencies met regularly to plan and oversee the scientific

information gathering. The group identified a list of "vulnerable" species for study. While the most extensive work focussed on the pygmy-owl, other threatened and endangered species were included as were species not currently on the federal list but in need of further protection, some of which will undoubtedly be listed in the future. Looking ahead today would prevent future surprises.

Staff working on the archaeological and historical studies assembled an expert team of professionals to develop the best information on those topics. Staff working on ranching issues worked with ranchers in the areas with the most significant unfragmented ranch holdings to assess the potential for open space conservation through cooperative efforts with private landowners. An expert Ranch Team was assembled, including interested ranchers and agency experts. Staff also worked with experts from various nonprofit groups to develop information on a variety of topics and regions. Staff was in regular contact with the U.S. Fish and Wildlife Service to assure that the completed work would satisfy federal requirements.

The Board also appointed a Steering Committee of more than 80 people representative of community interests to be part of the process. These people also met regularly to get information and progress reports and to provide advice on many aspects of the plan. All meetings were announced public meetings and attended by from 80 to 150 people. Any interested resident could have his/her name added to the mailing list, attend, and fully participate.

A list of members of the members of the various committee members is in Appendix C.

As the work proceeded, two things became clear:

- For really informed decision-making, much more information was needed than had been originally envisioned.

- There were many possibilities for additional benefits to the community than had originally been envisioned. Issues of social justice and tax equity became part of the thinking of staff, for example.

- Some things needed to happen even before the plan was finalized. One of those things was President Clinton's creation of the Ironwood National Monument. Another was application for protected status for State Trust Land in the Tortolita Mountains.

After two years of intensive work and more than 100 detailed reports on a variety of topics, the preliminary plan is now available for community and elected official review. Staff, with the help of local experts, will continue to produce reports as the community considers the preliminary plan. Additional information will contribute



*Cottonwood forests are important to many riparian species. but have declined in number since 1850 mostly because of loss of natural water supplies.*

to decision-making. Detailed species analyses are needed to complement work already done on the pygmy-owl, native fish and frogs, and the ironwood community. Scientific information will continue to be gathered to assure that the county has the latest information for decision-making.

### **The Draft Preliminary SDCP**

The preliminary plan should be viewed as a work in progress. Areas are identified where enough information is available for current action and areas where more information is needed for future action. The plan calls for continued research to further refine and clarify needed actions.

The plan has several aspects, all of which must be integrated to have a comprehensive plan for protection of vulnerable species and habitat, preservation of archaeological and historic resources, preservation of significant open space and scenic vistas, and provisions for orderly provision of housing and services for the public. The studies were conducted from two perspectives. The region was divided into subareas defined by watershed and each subarea was studied as a unit. The plan also designated elements of Wildlife Habitat and Corridors, Cultural Resources, Mountain Parks, Land Use and Fiscal Considerations, and Ranching. Each of those elements was studied for the entire region. The final plan integrates the subarea and subject matter studies into one comprehensive plan, probably the most ambitious such effort in the nation.

### **The Multi-species Habitat Conservation Plan**

The MHCP itself will be written in coming months in cooperation with the U.S. Fish and Wildlife Service and based on public input from official hearings and written comments. This plan will include designation of specific geographic areas where protection and recovery of threatened and endangered species will be emphasized. It will establish clear procedures for obtaining permits for some kinds of activities in those areas and for making trade-offs between activities in those areas and in areas less important for vulnerable species. The first step is a public hearing on the "Taking Permit" which allows limited activities in affected areas when mitigation will result in no overall loss or enhancement of the species.

The proposals below are discussed in more detail in the following chapters and in much greater details in various reports which are available for public review.

### **Creation of and Expansion of Reserves**

The preliminary plan defines large areas where reserves could be established. These are areas with minimally fragmented open space, roadless areas, and significant useful habitat for the vulnerable species. These areas are also connected to other similar areas to provide a connected system of federal, state, and local preserves.

The proposed new preserve is the Santa Rita Mountain Park in the northern foothills of the Santa Rita Mountains

The proposed new conservation areas are the Cerro Colorado and Sierrita Mountain Ranch in the Altar Valley.

The proposed expanded and enhanced reserves are:

Las Cienegas National Conservation Area in the Empire-Cienega Valley, which integrates existing BLM and County preserves through acquisition of additional land in Davidson Canyon and along Cienega Creek. Expansion of nearby Colossal Cave County Park will further integrate protection of the Rincon Mountain foothills.

Bingham-Cienega preserve along the San Pedro River, which integrates existing county and Nature Conservancy preserves through acquisition of addition land along watercourses. Land and water rights would also be acquired where threats to the water supply for the creek exist.

Expansion of Tortolita Mountain Park and Catalina State Park with the addition of State Trust Land in the Tortolita Mountains and along the Canada del Oro.

Expansion of Tucson Mountain Park to preserve scenic vistas and wildlife habitat in the vicinity of the park and Saguaro National Park.

The recently designated Ironwood National Monument in the northwest part of Avra Valley will be expanded when agreements with other agencies and landowners are completed.

Other land protection proposals include continuing to acquire floodprone land in order to reduce flood control costs, reduce flood damage, and preserve riparian habitat. The major opportunities are along lower Sabino Creek, Agua Caliente, Tanque Verde Creek, and Sutherland Wash.

### **Restoration and Reintroduction Proposals**

Restoration of natural riparian functions to watercourses that have the potential for such restoration would have priority, especially where there is relatively intact habitat. They also include reintroduction of native plant and animal species where appropriate. Priorities and criteria are proposed to determine which projects should be implemented.

Proposals include

Use of appropriate alternate water supplies to replenish stream flow or for nearby land uses.

Protection of shallow groundwater areas.

Replanting areas with native plant species where the water supply is adequate for them.

Introducing native fish and frogs into appropriate watercourses, including reduction of invasive nonnative species that compete with the natives.

### **Proposed Changes in Laws, Regulations and Procedures**

The preliminary plan identifies a number of areas where changes in laws, regulations, and procedures would help promote the goals of the plan. These are further described in Chapter Six.

New procedures to allow one-stop permitting for rezonings, including Section 404 Permits, Endangered Species Acts Permits, and others.

Strengthening zoning ordinances that deal with natural resources, including the Buffers Overlay Zone, Riparian Ordinance, Native Plant Ordinance, Grading Ordinance, and the Protected Peaks and Ridges Ordinances into a new Environmentally Sensitive Land Ordinance.

Changes to allow for better preservation of archaeological and historic resources in a proactive manner.

Changes in the rezoning procedure to incorporate considerations identified in the plan, such as preservation of floodplain functions and preservation of the most valuable habitat

Changes in the state water laws and rules to better protect perennial and intermittent streams and shallow groundwater areas.

Changes in state tax laws to provide incentives for land conservation.



*The Lesser long-nosed bat is a grey-red bat of medium size. It feeds on nectar and pollen. The bat migrates from Mexico and breeds in caves in Arizona in the summer. The largest colony in this area is in the Rincon Mountains.*

Changes in state laws to permit better regulation of wildcat development and road improvements to improve air quality in rural areas.

Changes in state law to permit downzoning in certain circumstances.

Changes in state law to increase the county's ability to levy impact fees and surcharges.

### **How the Plan Will Be Funded**

Potential local funding sources are identified, along with available state and federal funding. Local sources include bonds, impact fees, water conservation fees, mitigation fees and development surcharges. These are discussed in more detail in Chapter Six.

### **Education Programs**

Educational programs for adults and children are proposed, in cooperation with local nonprofit groups such as Tucson Botanical Garden, Tucson Audubon Society, Arizona-Sonora Desert Museum, Herpetological Society, and others. These programs will be aimed at helping the public understand the importance of preserving and enhancing native species, dealing with exotic species, and other topics.

### **Public Involvement**

The public will be an important part of the SDCP. These proposals are offered for community consideration. Many public meetings will be held in coming months to provide information and gain public input into these preliminary proposals. Pima County's SDCP Web Site will have continually updated information. Community groups are urged to invite the County to send speakers about SDCP. The official comment period for the SDCP lasts until January 1, 2001.



# TABLE OF CONTENTS

Preface ..... i

I. The Draft Sonoran Desert Conservation Plan ..... 1

II. Land Planning and Preservation over the Years ..... 5

III. Perspectives on the Resources ..... 13

IV. Perspectives from Various Parts of the County ..... 35

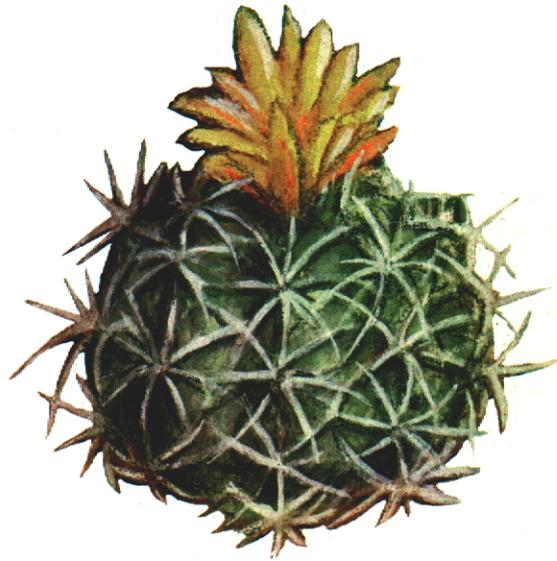
V. Optimizing Benefits for People and Wildlife ..... 73

VI. The Sonoran Desert Conservation Plan Draft Proposals ..... 83

Appendix A. Glossary ..... 97

Appendix B. The Sonoran Desert Conservation Plan Reports ..... 99

Appendix C. The Sonoran Desert Conservation Plan Committees ..... 101



*Pima pineapple cactus, one of  
Pima County's endangered species.*

# FIGURES

Executive Summary		Vulnerable Species in the Upper San Pedro Subarea ..	37
Cottonwood leaves .....	i	Beaver Dam at Bingham Cienega .....	38
Lesser long-nosed bat .....	ii	The Proposed Buehman-Bingham Preserve .....	38
<b>Chapter One</b>		The Cienega-Rincon Subarea .....	39
The Cactus Ferruginous Pygmy-owl .....	1	Land Ownership in the Cienega-Rincon Subarea .....	39
Abert's Towhee .....	2	Vulnerable Species in the Cienega-Rincon Subarea ...	40
The Lowland Leopard Frog .....	3	Existing and Proposed Preserves in the	
The Gila Topminnow .....	3	Cienega-Rincon Subarea .....	41
The Pima Pineapple Cactus .....	3	Pale Townsend's big-eared bat. ....	41
Designated Pygmy-owl Habitat .....	4	Land Ownership in the Upper Santa Cruz Subarea ....	42
		The Upper Santa Cruz Subarea .....	42
<b>Chapter Two</b>		The Elegant Trogon .....	43
Tucson Population per Square Mile .....	5	Floodplain Characteristics of the	
Pima County Population Growth .....	5	Upper Santa Cruz Subarea .....	43
Growth of the City of Tucson .....	6	The Historic Canoa Ranch .....	44
Main Street in Tucson 1895 .....	8	Vulnerable Species in the Upper Santa Cruz Subarea ..	44
Carillo Gardens in 1882 .....	9	The Middle Santa Cruz Subarea .....	45
		Land Ownership in the Middle Santa Cruz Subarea ...	45
<b>Chapter Three</b>		Burrowing owl .....	46
The Sonoran Desert .....	13	Proposed Expansion of Existing Preserves and	
Average Annual Precipitation In The Tucson Valley ..	14	Floodprone Land Acquisitions in the	
Climate Averages For Different Places In Pima County	14	Middle Santa Cruz Subarea .....	47
The Importance of the Desert Ironwood Tree .....	15	Vulnerable Species in the Middle Santa Cruz Subarea	46
Some Problem Non-native Species .....	16	Golf Courses in Eastern Pima County .....	48
Federally Protected Species in Pima County .....	17	The Tortolita Subarea .....	49
Some Species Extirpated from Pima County .....	17	Land Ownership in the Tortolita Subarea .....	49
Types of Vulnerable Species in Pima County .....	18	Vulnerable Species in the Tortolita Subarea .....	50
Classes of Vulnerable Species in Pima County .....	18	The Tortolita Subarea Watershed's	
Riparian Vegetation Communities .....	21	Floodplain Characteristics .....	51
Some Species in Pima County Riparian Areas .....	21	Honeybee Wash .....	51
Water Needs of Riparian Vegetation .....	21	Existing and Proposed Preserves	
Priority Restoration Projects in Pima County .....	22	in the Tortolita Subarea .....	52
Major Opportunities for Protection and Restoration ...	23	The Altar Valley Subarea .....	53
Perennial and Intermittent Streams,		Land Use in the Altar Valley Subarea (acres) .....	53
Springs and Shallow Groundwater Areas .....	24	Vulnerable Species in the Altar Valley Subarea .....	54
Cultural Resources and Threats to the Resources .....	27	Masked Bobwhite Quail .....	55
Population in Towns, Tohono O'odham Nation, and		Proposed Ranch Conservation Areas .....	55
Unincorporated Areas .....	28	Modern Ranch in the Altar Valley .....	56
Acres of Land in Towns, Tohono O'odham		The Altar Valley in 1897 .....	56
Nation and Unincorporated Areas .....	29	The Avra Valley Subarea .....	57
Land Ownership in the Subareas .....	30	Land Ownership in the Avra Valley Subarea .....	57
Some Voluntary Land Preservation Measures .....	31	Vulnerable Species in the Avra Valley Subarea .....	58
Ownership of Grazed Land in the Subareas .....	32	Nichol's Turk's Head Cactus. ....	58
Ownership of Grazed Land in Pima County .....	32	Floodplain Characteristics in the Avra Valley Subarea.	59
A Scene on the Chilton Ranch in the Altar Valley .....	34	The Western Pima County Subarea .....	60
		Land Ownership in the Western Pima County Subarea	60
<b>Chapter Four</b>		Vulnerable Species in the	
The Subareas of Pima County .....	35	Western Pima County Subarea .....	61
The Middle San Pedro Subarea .....	36	The Organ Pipe Shovelnose Snake .....	61
Land Ownership in the San Pedro Subarea .....	36	The Sonoran Pronghorn Antelope .....	62
Beaver .....	37		

## Chapter Five

Comparative Resources of the Subareas .....	63	Hohokam Excavation in Marana .....	74
Total Acreage of the Subareas .....	64	Natural Desert Wash .....	75
Land Ownership of Grazed Lands .....	64	Channelized urban wash .....	75
Grazed Land in Pima County .....	64	Pumping of Water in the Santa Cruz Basin from Headwaters to the Pinal County line. ....	77
Zoning on Vacant Land in Unincorporated Pima County .....	65	Schematic Representation of the Significant Floodplain Features in the Subareas. ....	76
Population of the Subareas .....	65	Drop in the Water Table in Selected Areas. ....	78
Significant Riparian Features in the Subareas .....	66	Water Supplies in the Subareas. ....	79
Types of Vulnerable Species in the Subareas .....	67	Urban Sprawl .....	80
Classes of Vulnerable Species in the Subareas. ....	68	Rancho Vistoso. ....	81
Number of Archaeological and Cultural Sites in the Subareas. ....	69	Chapter Six	
Potentially Developable Land in the .....	70	The Western Yellow-billed cuckoo .....	83
Private land in the Subareas .....	70	The Cerro Colorado Mountains .....	85
Archaeological Surveys and Sites in Eastern Pima County .....	71	Ironwood Habitat .....	86
County Property Tax Revenue per Acre on Private Land. ....	71	Vulnerable Species That Can Sometimes Be Found in ... Medium to High Density Urban Areas .....	87
Average Cash Value Per Acre of Private Land in the Subareas .....	71	Screwbean mesquite .....	88
Comparison of Significant Elements in the Subareas. 72		Vulnerable Species Found in Ranching Areas .....	88
Acres of Vegetation Converted to New Land uses in Pima County .....	73	Some Important Historic Sites .....	89
Percentages of Vegetation Types Converted to New Land Uses in Pima County .....	73	Burned Area .....	90
		Arivaca Cienega .....	91
		Agua Caliente Park .....	93
		Kearney's Bluestar .....	93
		Talus Snail .....	94

### ILLUSTRATION CREDITS

Photo on page 38 is from the Arizona Nature Conservancy.

Photo on page 81 is by Adriel Heisey.

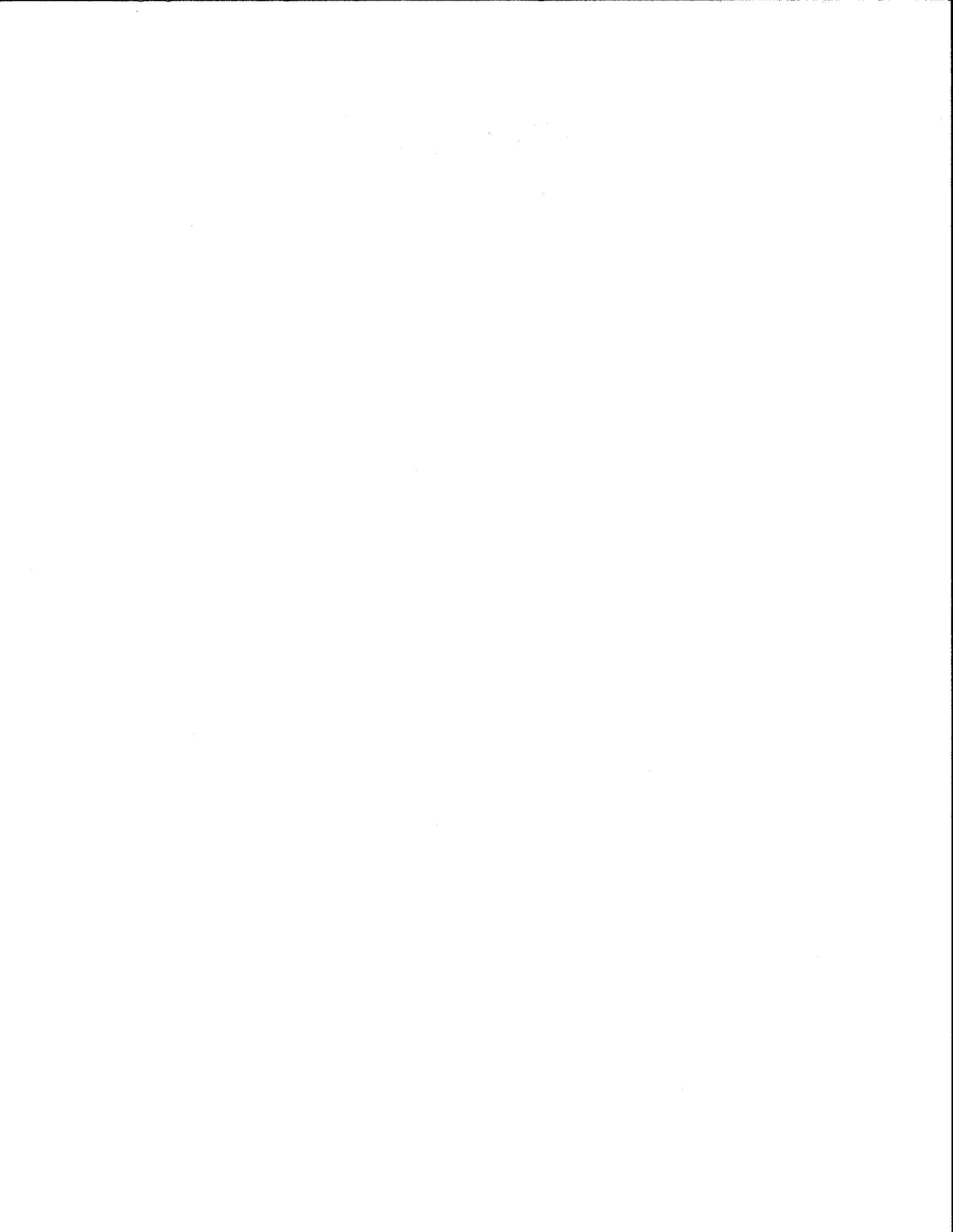
Photos on page 34 and 56 are by Linda Mayro.

Photos on page 8, 9, and 56 are by Leo Goldschmidt from a family photo album owned by Anita Scales and Janna-Neen Cunningham-Jones, descendants of the Goldschmidt family.

Photos on pages 46, 74-75, 80, and 90-93 are by Barbara Tellman.

Illustrations on pages 6 and 78 are from the Water Resources Research Center, University of Arizona.

The drawings, maps, and other illustrations are from the Pima County Graphic Design Division.



# I. THE DRAFT PRELIMINARY SONORAN DESERT CONSERVATION PLAN

The Draft Sonoran Desert Conservation Plan is a comprehensive attempt to solve related problems.

For many years there has been tension between elements of the community that want to preserve scenic views and wildlife habitat and those who wish to provide homes and businesses for an expanding population.

The presence of threatened and endangered species in the area means that we are subject to federal laws aimed at protecting those species and must protect them.

SDCP is an innovative and far-reaching blueprint for preserving habitat so that a great variety of species of plants and animals can continue to survive in Pima County. The Plan is designed to maximize benefits both to plants and wildlife and to the residents of Pima County, as well as to preserve archaeological and historical sites and provide recreational opportunities. The plan also looks at a wealth of land use issues and impacts of various growth patterns. Costs and benefits are important elements of the draft plan.

The task is far more complex than just saving one type of land or one endangered species. It involves land throughout the county and more than 100 species of plants and animals. It involves new land acquisition, rehabilitation projects for riparian areas, reintroduction of native fish and frogs, and changes in local land use practices.



*The Cactus ferruginous pygmy-owl is one of the smallest owls and weighs at most about two and a half ounces. Historically it lived from Sonora to Central Arizona. Its range today has been greatly reduced because of loss of riparian and other habitat.*

*"The proposed Sonoran Desert Conservation Plan is really the most exciting event anywhere in the United States. I can't think of a higher priority." Secretary of Interior Bruce Babbitt, Congressional Committee Recommendation. February 24, 1999. Washington D.C.*

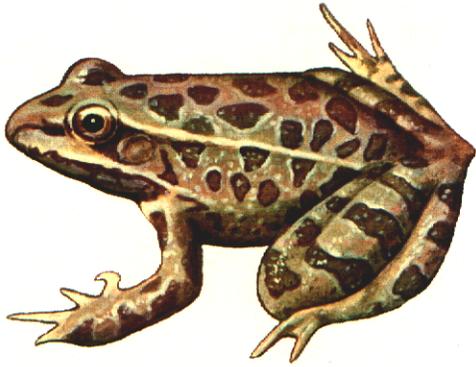
This is a draft plan submitted for community comment. Elected officials will make a series of decisions on the general blueprint as well as specific elements of the plan, based on community input and the need to meet federal requirements. In order for the plan to be truly effective in protecting species and their habitat, as well as offering predictability for homebuilders, all local jurisdictions should participate in the process.

## Basics of the Endangered Species Act (ESA)

In 1997, the Cactus ferruginous pygmy-owl was listed as an "endangered species." This occurred when population growth was expanding rapidly in the Tortolita area where the owl had been sighted. A great deal of land had already been approved for subdivisions in Oro Valley, Marana, and unincorporated Pima County. A new high school was planned to accommodate the projected growth. The school district that had purchased land long before the owl was even considered for designation faced major problems in satisfying new and evolving requirements for this endangered owl about which little was known. When critical habitat was designated, part was in that area and other parts of the county and new subdivisions in the designated area were delayed or halted.

The federal ESA, passed in 1977, protects designated species in several ways. A species is designated through a lengthy process that involves gathering scientific information on which a recommendation is made, put through a public process, possibly altered, and finally adopted. To be designated a species must be in decline and its numbers reaching levels beyond which the species would have difficulty surviving, at least in a regional area. Eighteen species have been designated as threatened, endangered, and five more listed as candidates for listing in Pima County. Nationally more than 1,100 species are designated.

Once a species is designated, some basic rules apply. The U.S. Fish and Wildlife Service (FWS) is responsible for deciding how to protect the species and, if possible, facilitate its recovery. It designates certain areas as "critical habitat" in which stricter rules apply. It develops recovery plans for conservation and survival of the species unless there is a finding that a plan will not



*The Lowland leopard frog lives near water and eats insects and occasionally small vertebrates. It lives only in the northern part of the Sonoran Desert along streams and springs. It is endangered because of loss of habitat.*

promote conservation. These plans are designed to protect individual species and no net loss of habitat is to occur.

Nobody may legally “take” a protected species, except for extraordinary circumstances such as self defense. The word “take” may have several meanings. On the most basic level, no one is allowed to kill a protected animal or uproot a plant. More generally, it applies to destroying places necessary for the species survival. In particular, it is forbidden to modify or build on your property or someone’s else’s land in a way that either results in the death of a listed species or injures it by interfering with its breeding, feeding, or nesting. This part of the law is much more difficult to interpret and implement.

### **Options for Protection**

If an applicant submits an “Adequate Conservation Plan,” incidental “take” is allowed. These permits are issued for specific projects and must show adequate measures for minimizing and mitigating impacts of the development. The plan must include a showing that the project will not appreciably reduce the likelihood of survival and recovery of the species. It must also include adequate funding to carry out the plan. This means that each time a project is proposed in areas that may be important to a designated species, the developer must apply for a permit, do studies, and go through what may be a lengthy approval process under public scrutiny. One form that mitigation may take is paying for purchase of land elsewhere where the species can be protected.

Another option is for the community to develop a Multi-Species Habitat Conservation Plan (MHCP). With a plan to protect and/or improve habitat for the threatened and endangered species as a whole, taking may be allowed under circumstances specified in the plan. The first step in Pima County’s application for are scoping meetings on the “Incidental Take Permit” part of the plan.

MHCPs must be as large and comprehensive as possible and address a wide range of activities and bring them under the umbrella of a general permit. This type of plan includes more than one protected species and may include species that are not protected as well. This type of plan looks at the big picture of a range of species and habitats. The average length of a permit under this approach is 25 years. The area covered by these plans ranges from half an acre to more than a million and a half acres, and range in complexity from very simple to highly complex. In all cases, the plan must include a strategy for funding the various aspects of the plan. It must include agreements from other significant affected jurisdictions.

### **The goals of Pima County’s Plan**

The Pima County Board of Supervisors, with the support of local governments and citizen groups, decided to develop a MHCP rather than continue to have specific plans done for specific projects for several reasons.

- The MHCP offers a chance to do community-wide planning, rather than satisfy the law through piecemeal approaches to specific projects.

- The MHCP offers a level of certainty to developers and makes it possible to predict where construction will and will not be permitted and under what conditions.

- The MHCP provides a vehicle for offering additional benefits to the community by incorporating other elements such as historic preservation into the plan.

- The MHCP provides a way to preserve large acreages for habitat protection and open space while targeting other areas for other land uses.

- A large-scale plan of this type makes it possible to attract funding for major projects.

In addition to the biological goals, Pima County opted to incorporate archaeological and historical preservation and incorporate recreational needs in a framework of maximizing benefits and keeping the costs as affordable as possible. The MHCP is a plan that must be approved by the U.S. Fish and Wildlife Service. The SDCP



*Abert’s towhee eats insects and seeds, especially caterpillars, beetles, and ants. It lives in the northern part of the Sonoran Desert in riparian woodlands with a dense understory. It has declined primarily because of loss of habitat.*

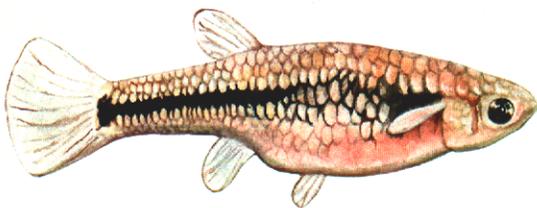
incorporates the MHCP but includes additional elements and the Board of Supervisors is responsible for approval of that plan.

### **How the Draft Plan was Developed**

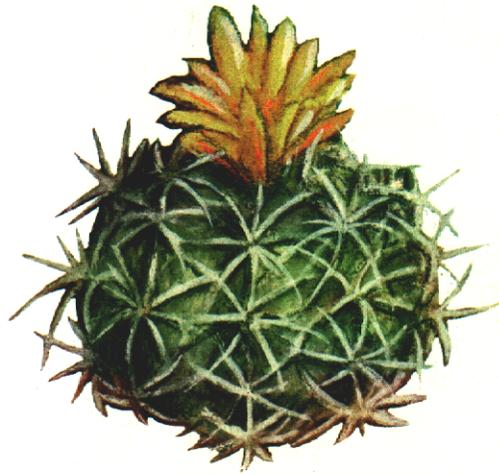
There are two major aspects to development of the plan. On the one hand, a great deal of basic factual information is being gathered. For the scientific information, Pima County assembled a team of top scientists, the Scientific Technical Advisory Team (STAT) to advise county staff and the consultants on what the study needs are, what methods should be used to collect and verify data, and to comment on the draft results of the studies. Studies on other topics such as land use, history, and archaeology, were conducted by county staff and private consultants. A total of more than 100 reports were issued through this process.

The County also worked hard to solicit public opinion from a great variety of community representatives. The County assembled a Steering Committee of more than 80 people representative of a broad range of community interests, who met on at least a monthly basis for more than a year to learn about the information gathered and comment on it. In addition, panels of people concerned about issues in specific areas met to discuss the information and recommendations relative to their area. In some cases, local residents also did their own studies which became part of the information available to everyone. The County's web site was a basic place where the public in general could get information about the developing plan.

The information and draft recommendations will be submitted for public scrutiny and elected officials will make their decisions based on all of this information and public input. Public meetings will be held in October and November 2000 and a comment period will last until January 1, 2001.



*The Gila topminnow seldom grows to more than two inches long. It was once the most common fish in Central Arizona but now there are only ten known populations of the fish because of loss of springs and perennial streams.*



*The Pima pineapple cactus grows to a maximum height of about 18 inches. It grows in northern Sonora and southern Arizona. There are only 64 records of the cactus in Pima County. It is highly threatened by land development.*

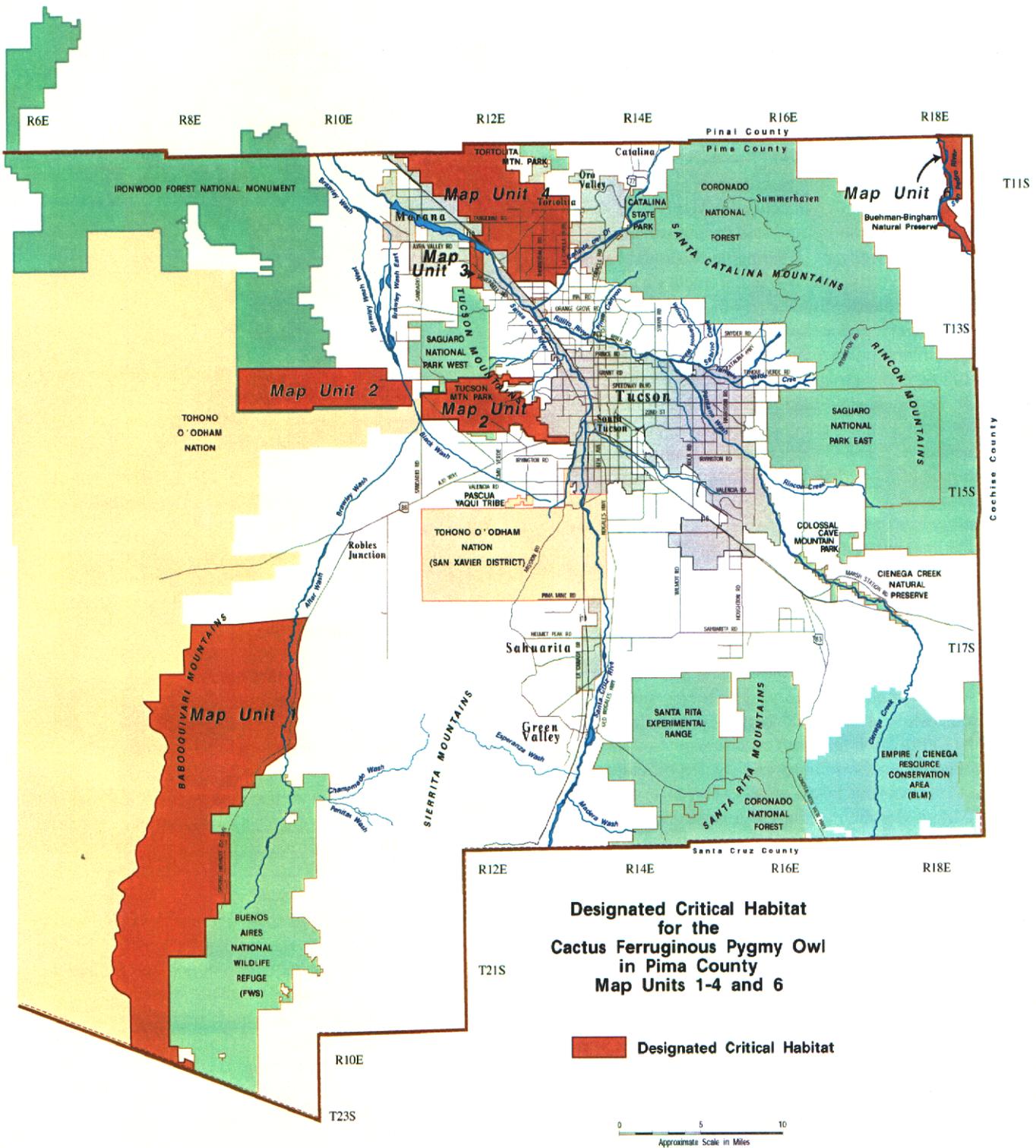
### **Major elements of the draft Sonoran Desert Conservation Plan**

The plan includes both elements that need to be part of the MHCP and extra elements to benefit the community.

1. New reserves to protect certain special areas that are now relatively pristine.
2. Expansion of existing reserves to consolidate areas and include land with important habitat.
3. Projects to preserve corridors between refuges to allow for movement of wildlife.
4. Projects to rehabilitate areas and reintroduce protected species.
5. Projects to protect archaeological historical and sites.
6. Projects to preserve open space in private ownership through voluntary programs.
7. Designs for continued provision of housing in areas where that is most appropriate.
8. Changes in local and state land use laws, and water law
9. Changes in management of county land for better species protection and control of invasive species.
10. Partnerships with community organizations
11. Funding mechanisms.

All of these elements are coordinated so that, for example, some preserved areas will have value for habitat, historic interest, and public recreation and community organizations will provide volunteer assistance to develop and monitor projects and produce educational materials.

Priority is placed on finding ways to maximize sources of funded and use the money to save the greatest number of the most important resources.



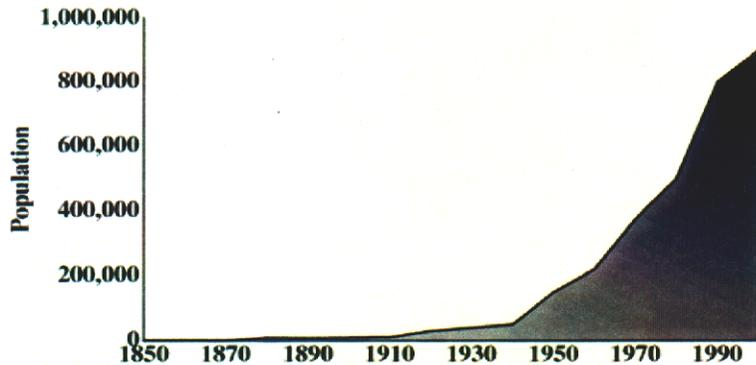
## II. LAND PLANNING AND PRESERVATION OVER THE YEARS

The Sonoran Desert Conservation Plan is the latest in more than a century of land preservation efforts in Pima County. Some of those efforts were successful, while others failed in face of continued population growth pressures.

The pioneers were surrounded by open space that they were hoping to conquer, but they also appreciated special places like Sabino Canyon. Although population and economic growth were important goals, many community leaders throughout the years have also tried to assure that important scenic areas were protected. The zeal for environmental preservation has at times led people in the Phoenix area to consider Tucsonans rather odd and has often led Tucsonans to consider themselves somewhat more progressive than their neighbors to the north. In the 1970s, for example, there was a tongue-in-cheek movement for Tucson to secede from Arizona and form its own state, Baja, Arizona. For several years people celebrated Tucson's quiriness in the Rillito River Regatta with boat races in the dry riverbed.

### The Early Community

The boundary of the town in Spanish times was the presidio, a military encampment. Another population center was at San Xavier around the mission. The rest of the area was sparsely occupied by Tohono O'odham and Apaches. In the early Anglo days, the city boundary was defined by the city wall where it was relatively safe for Europeans to live without concerns about Apache attacks. By the time the population had outgrown these



Pima County Population Growth

boundaries after the end of the American Civil War, the Anglo army had conquered the Apaches and Anglos began to move outward. Some people homesteaded on ranches in the vicinity and opened up mines, but the main population center remained the original city and its immediate vicinity.

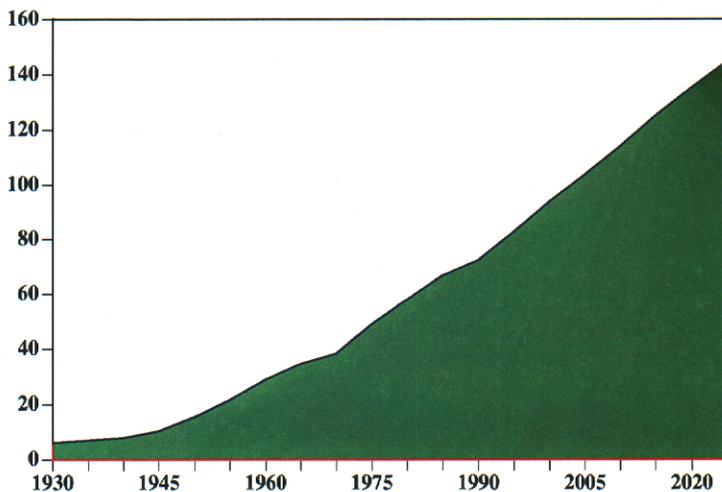
### The Growth of Eastern Pima County

As the city expanded over the years, most of the people still lived in areas adjacent to the historic town. When the University was built in the 1800s, the area between town and the distant University began to fill up with buildings. A streetcar ran between the campus and downtown for many years. An arroyo restricted growth to the north of Speedway for some time and what is now Country Club Road was considered "way out in the country."

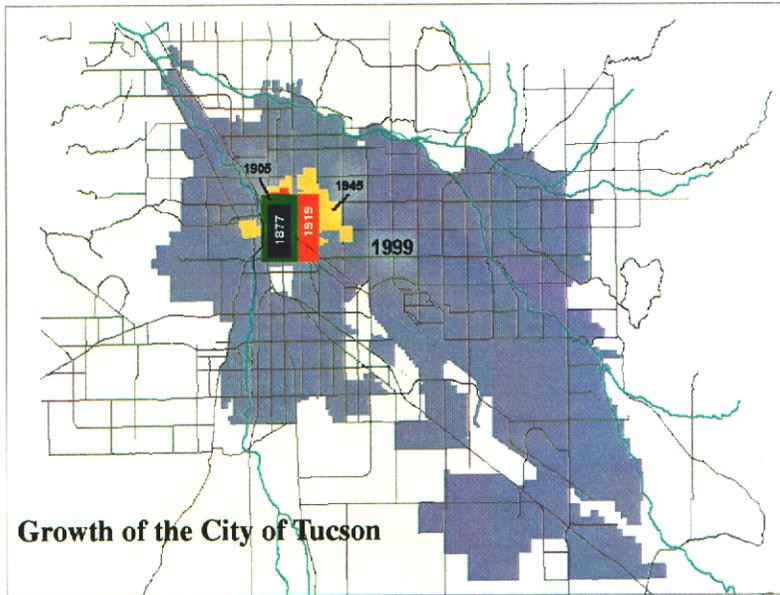
In the 1920s some residents began to worry about haphazard growth and started calling for city planning. While the town was not large by modern standards, it had begun to outgrow the roads, water lines, and sewers of the old city. People were calling for better street lighting and for improved amenities such as parks and schools. The town had changed from a predominantly Hispanic populace to a predominately Anglo one and was mostly segregated into white, Hispanic, and black areas with separate facilities for the minorities.

### The Beginnings of City Planning

Gertrude Mason had a vision of what the community should become and worked actively through the Business and Professional Women's Group to achieve that vision. She wrote in 1930 "As we see it, a city plan guides the city's growth; it benefits both the present and the future generations. ... We remember the Tucson of the past, when the Spanish atmosphere was much



Tucson Population per Square Mile



**Growth of the City of Tucson**

more apparent, when modern progress had not given us so many conveniences and taken away so much of the city's charm. We hope it is not too late to save some of the things that have made Tucson different." She went on to recommend that all utility wires run underground and be installed prior to paving. She wanted the outlines of the city to be evened up [no what we would call leap frog development] and kept uniform to facilitate installation of sewers, etc. which would "save thousands of dollars." She spoke for parks, public rest rooms, restoration of historic Spanish buildings going to ruin, and for noise and sign ordinances. She said "No future subdivisions allowed in city limits without suitable provisions for parks and schools." Finally she wanted vistas of the mountains and desert preserved.

Gertrude was successful in persuading the city to move ahead with planning and in 1930 she was appointed to the newly formed Tucson Planning Commission where she served for many years. This was possible because of the work of Gertrude and others who persuaded the State Legislature to enact enabling legislation for cities in 1925. It was not until 1949 that counties were also given that authority.

### **City of Tucson Land Use Planning**

The city adopted a zoning ordinance and began work on regional planning. The first efforts were guided by the "Tucson Regional Plan," a group which actively worked for good planning in the face of increased population growth, especially during and after World War II when population growth mushroomed.

### **Comprehensive Planning in City and County**

The plans and zoning ordinances were continually altered over the years. Pima County had its first Planning zoning ordinance in place.

During the 1950s and 1960s, the League of Women Voters took up the cause of better land use planning. Alene Dunbar Smith was another farsighted woman who advocated for better land use in order to make the city more livable, to preserve historical and natural resources, and to control the costs of providing services. Alene worked tirelessly through the League of Women Voters to make citizens aware of the need for the kind of land use that would make provision of mass transit feasible. When the County began a Comprehensive Planning Process, the League launched a major campaign to support the process and can be given much of the credit for passage of the new plan.

One of the aspects of the new approach was development of neighborhood plans. In 1928 John Murphey had acquired 7,000 acres of Catalina Foothills property north of

River Road, part of which became Catalina Estates. An area plan was developed for this which included commercial "bullseyes" one of which was at the intersection of Sabino Canyon road and River Road. Other plans such as the Rincon Area Plan were developed in later years. One such plan, the Posta Quemada Area Plan, in the Rincon Mountain Foothills near Saguaro National Park was approved in 1959, but although it was never developed it remains in effect to this day.

Another Comprehensive Planning Process took place in the 1960s. Controlled-growth advocates had elected representatives to the City Council and Board of Supervisors and the call for controlled growth was growing along with opposition to this on the part of some business people especially homebuilders and their employees. As the League of Women Voters, the Tucson Mountains Association and others called for better planning, opposition bumper stickers began to appear with slogans such as "Growth feeds my family." The controversy became acrimonious and by the mid 1960s whether or not Tucson should contract for water from the

The attitude of some citizens was reflected by a "typical greater Tucson citizen" who wrote a letter to the editor in the Star in fall 1943.

*"If planning is for all of us, as I've found out it is, then I am interested. But if planning is just to increase the number of people living here, I'm against it because I hate big cities like Los Angeles. If planning is to bring in great industries, then I'm against it because I live in Tucson for its charm, its comfort, its friendliness, its light, air, space, and sunshine. But I guess I am for planning just to protect all those things that to me are the Tucson region."*

*"... The river banks through the city have many beautiful trees. We understand the city owns a small part of the west bank close to Speedway, perhaps other parts close to W Congress and Parker Park, which is now in terrible condition, although trees were once planted there, we hear. We suggest that the rubbish and refuse that has been dumped there might well be used to form a permanent levee or breakwater for the river, that a drive be formed there, that the sides of the levee to the river bottom be planted to Arizona growth of some sort, and that all the land owned in Parker Park be made into a real park, kept clean and available for the use of the people who cannot get away into the country. We feel that part of it, at least, should be made into a playground for the Mexican children, to give them some place to play besides on the streets; and some provision should be made for the colored population to have some part to resort to. ... We feel that Dr. Mathewson's recommendations of a city-owned drive and strip of park all along the river would add much to the beauty and comfort of the city. ... We feel that the amount of rubbish, etc., dumped on Parker Park and in its vicinity would form a breakwater for the river channel pretty well through town, that the city and county (if this be possible) might well put their prisoners to work thereon, and this would, when completed, be used in averting the disastrous floods which come so unexpectedly down the river..."* Gertrude Mason for the Business and Professional Women. 1930.

Central Arizona Project became part of the dispute. It was at this time, too, that differences between city and county on various matters came to a head. An attempt to consolidate the city and county water and sewer systems, for example, began with a joint managing agency and ended with an agreement that the city would continue to provide water, and the county would manage all the wastewater facilities, but that the city would retain ownership of the wastewater - a decision which rankled for many years until a new agreement was reached in 2000.

In 1973 the County began a third Comprehensive Planning Process which included planning for housing, transportation and infrastructure. The process was extensive and included hiring of outside consultants as well as public participation. Once again the League was a central player. One consultant's report studied the financial impacts of sprawl and came to the conclusion that planned growth would cost far less than continued sprawl, in terms of the costs of providing roads, sewers and various services. There were major differences of opinion between groups such as the Chamber of Commerce and several environmental groups. Some of the public referred to the plan as an "elitist manifesto" while others called it "one of the finest examples of its kind." The plan was dropped and the planned-growth anti-CAP elected officials lost their elections (including a city recall election ostensibly about water rates).

In the 1980s growth had accelerated and a new planning process began. Studies were made and outside consultants brought in. Pima County adopted a new Comprehensive Land Use Plan in 1992 after many public meetings where strong differences of opinion were expressed.

### **Citizens Resort to Referendum Votes**

No matter what the plan, there were always requests to change that plan and the existing zoning. Over the years rezonings have been fraught with controversy, especially large rezonings that changed the character of an area. Three cases in the late 1980s and early 1990s mobilized

large numbers of people on both sides. Rezoning of the Rocking K area, near the Saguaro National Monument, was one of the most bitter battles of modern times. The landowner requested that a large scenic area be rezoned to allow for a town "the size of Prescott." Neighborhood and environmental advocates protested on the grounds that views of Saguaro National Monument would be destroyed, wildlife and vegetation seriously damaged, air pollution and traffic problems increased, water problems exacerbated and that this kind of sprawl would make it very expensive for the community to provide services. When the County approved the rezoning, citizens collected enough signatures for a referendum, but the Arizona Supreme Court denied the issue a place on the ballot because of technicalities. About the same time two other major rezonings were protested and signatures collected - the Sabino Springs development near Sabino Canyon and the Desert Springs resort and shopping center near the entrance to Catalina State Park. Again more than enough signatures were collected, but the Supreme Court denied the Sabino Springs referendum a place on the ballot, again for technical reasons. The Desert Springs referendum not only survived the Supreme Court challenge, but won by a landslide all over the county and the rezoning was overturned.

Pima County and the towns of Tucson, Oro Valley, Sahuarita, and Marana all have planning and zoning processes, and all continually have requests to make changes in those plans and zoning requirements and protests against those changes.

In retrospect, the pendulum has swung back and forth over the years. At some times the desire to keep growth in check and protect natural areas has prevailed while at other times population growth and sprawl have accelerated. Throughout the years, however, there has always been a core of community leaders working to keep Tucson as a special area, rather than follow the path of its neighbor to the north or of Los Angeles to the west. There has also always been a group of people working diligently for population growth and economic growth.



**Main Street in Tucson 1895.** Photo: Leo Goldschmidt

### **Historic Preservation**

Tucson and Pima County have both demonstrated a concern for preserving historic places since the early 1970s. The Tucson Urban Renewal Project leveled large parts of the old historic downtown and this prompted the passage of two historic ordinances in 1972, one by the City of Tucson and the other by Pima County. These laws created a means of designating historic properties as special overlay zones so that their historic character can be maintained. In 1974, the city and county created a joint Tucson Pima County Historical Commission to give preservation a voice in the city and county governments. In 1983, Pima County adopted a resolution requiring that its own public works projects be reviewed for potential impacts to archaeological and historic sites prior to construction, and that where needed, studies be done to recover important historic information. In 1985, these same requirements were extended to private development by making them a part of the way that Pima County reviews and approves development. Later, the citizens of Pima County approved more than \$6 million in bond money for historic preservation projects. So the citizens of both Tucson and Pima County have been supportive of the need to preserve their heritage.

### **A Tucson Land Preservation Tradition**

Local efforts to set aside lands as "public lands" have made Tucson one of the few American cities almost entirely surrounded by such land - Coronado National Forest, Saguaro National Park, Catalina State Park, Tucson Mountain Park, Buenos Aires National Wildlife Refuge, and other smaller preserves. Some lands became public lands through federal and state actions early in the twentieth century, most notably Bureau of Land Management and State Trust Lands. Some lands were set aside for military purposes. The Tohono O'odham Nation on the west forms a large open space area between Tucson and the Saguaro National Park to the east and Organ Pipe National Monument and the Cabeza Prieta Wildlife

Refuge. Even lands owned by the Department of Defense in that area have been important in preserving parts of the Sonoran Desert. These areas today provide important recreation areas for local residents, major tourist attractions for people from elsewhere, and refuges for wildlife.

Who were the people who worked to preserve these lands for the public? In most cases they were local people who cared about the area where they lived. In some cases they were national figures, such as Presidents Theodore Roosevelt and Herbert Hoover, or Arizona residents who achieved conservation goals from their elected positions in Washington D.C., such as Morris and Stewart Udall, Barry Goldwater, and Isabella Greenway.

### **Lakes, Public Gardens, and Beautification**

Silver Lake was the first recreational lake in the Tucson area where people could boat and fish and enjoy refreshments in a resort on the shore. Solomon Warner built the lake in the 1860s to provide power for his flour mill at the foot of Sentinel Peak ("A" Mountain) and welcomed the people who wanted a place for relaxation. The lake was washed out in the 1892 flood and was never rebuilt.

On the other side of the Santa Cruz River, Leopold Carillo built a beautiful garden in the 1880s where people could go to enjoy baths in a wooded area with water gushing from the springs. The garden had roses, weeping willows and a multitude of plants imported from Mexico. The gardens were so popular that express horse-and-buggies ran regularly from downtown to the gardens on Meyer Street south of today's Community Center where Carillo Elementary School now stands. After Carillo's death, Manuel Drachman turned the garden into an amusement park called Elysian Grove with a skating rink and baseball diamond. The springs dried up because of groundwater pumping and the gardens disappeared. About this time community leaders realized that most of the trees in the area had been cut down for firewood and lumber and decided to replant trees in town, making Arbor Day a popular annual event.

### **Coronado National Forest**

On the national level, people began to realize that throughout the West forested watersheds were being seriously damaged by overgrazing and too much timber harvesting. It was important to preserve the watersheds in order to make sure that water supplies for people in the lower areas would not be damaged. President Harrison created six forest reserves in 1891 in later years more were added, including what became the Coronado National Forest in 1902. President Theodore Roosevelt was highly committed to making the forest preserves real places where important resources could be used without too much long term damage to the forests and water supplies.

The first foresters were intrepid types who had to be ready for anything. The new regulations were irksome to cattlemen and others accustomed to unlimited use of the land. Because of the timber resources on the mountains and the value of the watershed, the Coronado had to be managed well. Fred Winn was the first Ranger on the Coronado and was prepared to guard thousands of acres of forest whether it involved fire fighting, dealing with cattlemen, bears, miners, building and maintaining trails and roads and many other tasks.

Sabino Canyon was a popular area within the national forest. On and off for decades people had sought a way to dam the creek and divert its water for use at Fort Lowell or for agriculture. The big dam schemes came to naught, but during the Depression, CCC workers not only built an recreational dam, but also built picnic sites, roads, bridges and restrooms. The area was set aside as a special recreation area and became so popular that restrictions on traffic had to be put in place in the 1970s.

#### **“A Mountain” and Tumamoc Hill are preserved**

Sentinel Peak (“A” Mountain) had been important to the local Indian population and to the Spanish settlers for centuries and in the late 1800s Anglos mined the area for its rock for their buildings. The area then became neglected, but in the 1920s the City Council realized that the land was in private hands and would probably soon be used commercially. At a public hearing in 1925 many of the city’s leading citizens spoke on behalf of turning the area into a public park. People pointed to its historic importance and its enormous value to the people of the area for hiking, picnics and recreation. Daughters of the American Revolution, the Saturday Morning Musical Club, the University, and many others came to the Peak’s defense. Some residents bought land at the top and trail easements which they donated to the City. Later the City acquired most of the rest of the mountain.

The Smithsonian Institution chose Tumamoc Hill west of “A” Mountain for a unique laboratory because of the large number of plant species to be found there, including many unique to the Sonoran Desert, especially the saguaro. The goal was to preserve the area and conduct long term studies of how the vegetation and wildlife changed over time. The University of Arizona now owns Tumamoc Hill and in spite of pressures at times to sell the property, the University supported keeping the area under protection. The lower part of the hill belongs to the State Land Department which also had pressure to sell the land for development. Because of public support for keeping the hill free of homes and commercial structures, the State Land Department has agreed to treat it as an area in need of protection, pending resolution of issues concerning an old landfill site there. Sentinel Hill and Tumamoc Peak remain in public hands with their slopes largely free of

structures that would damage the view, a situation most Tucsonans take for granted.

#### **Saguaro National Park East**

On the other side of the valley a magnificent saguaro forest covered the foothills of the Rincon Mountains. Ranching began in the area in the late 1800s, but it was not until the early 1920s that so many homesteaders started showing interest in the area that people felt that survival of the forest was in doubt. The Natural History Club tried hard to raise enough money to buy the land, or to interest government in buying the land, but did not succeed. Things looked bleak for the saguaros until University President Homer Shantz persuaded the Board of Regents to spend \$50,000 on 6,400 acres of the prime saguaro habitat. The plan was to create a desert botanical laboratory similar to the one on Tumamoc Hill. This site had the added bonus of having a perfect site for telescopes, since the Steward Observatory on campus was being degraded by city lights. Shantz at one point announced that part of the area had been designated a State Park, but since there is no record of this in the State Park archives, it appears that he was overly optimistic.

Homesteaders were thus prevented from destroying the best part of the saguaro forest, but the rest of the area was still in the path of development. Local residents continued to work to preserve many more acres and in 1933, Herbert Hoover declared the area a National Monument. President Shantz resigned under pressure, partly over this dispute. The Democratic Party newsletter was contemptuous of the way the University was, in their view, now “run by Phelps Dodge.”

Boundary questions continued for years. Part of the reserve was on Forest Service land and people argued over whether the Forest Service should manage the upper elevation areas where there were no saguaros and continue to allow grazing or whether the Park Service should manage the whole watershed. Most of the time the two agencies worked together, but at times there was real



**Carillo Gardens in 1882. Photo: Leo Goldschmidt**

One of the early forest rangers, Garvin Smith, described his adventures persuading a stockman named Fussy that he had to get several hundred cattle out of the forest. *"I don't mind admitting that I was scared. Fussy mean business. I was unarmed, but I stepped off my horse on the far side and tried to reason with them without backing down an inch on government regulations. That gun barrel looked as big as a saucepan. The stockman's camp cook came out, with an axe, but he took my side, argued with his employer that I was right. We counted that stock through the gate and that night I bedded down with that hostile crowd. They fed me, but no one but the cook would speak to me."* (Arizona Daily Star, July 8 1940)

conflict. In April 1949 the Daily Star warned that the loss of the National Monument was looming unless the Park Service and Forest Service cooperated to eliminate grazing and unless the University would sell its part of the land. The Tucson Chamber of Commerce was adamant that all the problems get solved so the Monument could be preserved, since it was contributing so much to tourism and the economy. Many people were influential in finally getting the disputes resolved, expanding the boundaries of the monument, and changing its status to a National Park.

#### **Saguaro National Park West and Tucson Mountain Park**

Valuable saguaro forests also occurred in the Tucson Mountains. Parts of these were even closer to town than the ones on the east side and also vulnerable to homesteading, mining, and grazing. Sentinel Peak and Tumamoc Hill were preserved, but the rest of the mountain range was not. The area had been prospected for many years and mining continued to loom in the future of the Tucson Mountains. As recently as 1981 oil drilling was proposed, but residents were incensed and Pima County successfully opposed that effort. Tucsonans have vigorously opposed any attempts to change the character of the park, including a proposal in the 1980s to build a large reservoir in Starr Valley for Central Arizona Project water.

How was the land saved in the first place? By 1925 many Tucsonans were alarmed at the rate of expansion of homesteading as well as mining in the mountains. In 1929 C.B. Brown and others petitioned Congress to set aside the area which would not be open to mining or homesteading. The Tucson Protective Game Association joined with community leaders and Senator Carl Hayden. The result was that in 1929 60,000 acres on the western slope of the mountains were set aside as areas not open to mining or homesteading. This area and the later addition of 30,000 acres became Pima County's Tucson Mountain Park. The timing was right for development of park facilities when the CCC crews arrived in 1933 and built erosion control structures, picnic areas, roads and other park facilities. Pima County obtained a lease on 15,787 acres of that land

for park purposes. C.B. Brown became the first park superintendent and managed the park well for many years. W.B. Taylor, President of the Tucson Natural History Society lauded the foresight of the Board of Supervisors in making this the only park of its kind in the entire world.

In 1959 the Department of Interior proposed restoring 7,600 acres to mining, including the Picture Rocks area. There was so much local opposition that this proposal died, but the threat launched various efforts to make sure the area would never be open to mining. Various bills were introduced and in 1961 President Kennedy proclaimed that Saguaro National Monument would be enlarged by adding 15,360 acres in the Tucson Mountains. More land was added later both to the Monument and the Park, and the result is a continuous park area part of which is Tucson Mountain Park and part of which is Saguaro National Monument's (now Saguaro National Park's) East Unit.

#### **Organ Pipe Cactus National Monument**

The area that is now Organ Pipe Cactus National Monument was so remote that few Tucsonans knew about it. President Theodore Roosevelt set aside Lukeville as a border station in 1907 and in 1923 President Coolidge proclaimed forty acres around Quitobaquito Spring as a "Public Water Reserve." It was President Franklin Roosevelt who set aside a large area as a National Monument in 1937 to protect "objects of historic and scientific interest." Even in this very dry part of the county, settlement of grazing rights was a major issue. One of the major controversies was a long-standing grazing right at Quitobaquito Spring which was finally settled by land condemnation in 1957.

Isabella Greenway, widow of mining entrepreneur, John Greenway, played a major role in the proclamation, as she did in assuring protection of areas such as Saguaro National Monument. The Greenways lived in Ajo and played a major role in the development of the town, including the Plaza, school, churches, homes, etc. When John died, he left an inheritance to the mine workers in Ajo. Isabella, who was a close friend of Eleanor Roosevelt, eventually went to Washington as Arizona's representative in Congress and influenced land preservation to a much greater extent than the freshman Congressman could usually accomplish.

#### **Catalina State Park**

In the 1970s a real possibility of massive land development loomed on the western slopes of the Catalina

*"As a boy I have climbed to the top of the [Sentinel] peak many times, with companions, and one who has never seen the view from this point cannot imagine its magnificence. Vast expanses of mountains, mesas and valleys are brought to view, and at night when the lights are burning the view from the Peak is really impressive." Moses Drachman 1925.*

Mountains south of Catalina. Many Tucsonans were angered at the thought of their views of the mountains being destroyed by a large master planned community. The newspaper warned that denial of a rezoning was not sufficient to protect the land from development. Environmental groups organized to find alternatives. Eventually a land swap was arranged involving private land, State Trust Land, and some federal lands. In 1973 Pima County voters overwhelmingly approved a \$4.5 million bond issue for open space protection some of which was used in the complex land swap. In 1981 Governor Babbitt proclaimed the area as a state park.

### **Buenos Aires National Wildlife Refuge**

In 1985 the U.S. Fish and Wildlife Service bought many acres of grazing land in the Altar Valley to preserve and improve habitat for the endangered banded bobwhite quail and other species. The area was expanded in later years to include the Arivaca Cienega and Brown Canyon in the Baboquivari Mountains. It was the first Pima County preserve specifically to enhance habitat for an endangered species.

### **Wilderness Areas**

The 1980s were years when environmental groups made strong efforts throughout the nation to have some federal public lands declared "wilderness areas." This designation would further protect the areas from human encroachment, such as roads. The Arizona Wilderness Coalition was a statewide group with many of its core members in Tucson. The group proposed that Congress declare thousands of acres in Arizona as wilderness. Pima County now has wilderness areas in the Baboquivaris, Catalinas, Rincons, and other areas. The Pusch Ridge Wilderness Area is one of the few wilderness areas in the United States close to a large urban area.

### **City and County Parks**

Tucson Mountain Park, described above, is the largest of the county parks in the area, but by no means the only one. Parks have been integral to the community from the beginning. In 1930 Gertrude Mason and the Business and Professional Women's Club urged in 1930 that "no future subdivisions be allowed within city limits without suitable provisions for parks and schools." They also urged access to areas such as Sabino Canyon and Mt. Lemmon, preservation of ancient ruins, parks near schools, and unimpeded thoroughfares with views of the mountains.

In 1925 480 acres of land were available for sale by the federal government and when the city could not afford to buy them, W.E. Barnum did, and gave them to the city for a park. In 1927 the golf course was completed at Randolph Park (now Reid Park) so that people could play "the old Scottish game" and the next year the Star urged that it become a recreation area. CCC crews worked on the park during the 1930s, but it was not until 1954 that the park as we know it today began to develop and the zoo, originally a petting zoo, was begun. Gene Reid took over as supervisor of the city parks in 1947 and built the park

*"The national forests are for the use and benefit of all the people and the administrative principle which is the incentive back of all this can be summed up as 'the greatest good for the greatest number.' Sometimes individuals or groups who seek to exploit or control the national property for personal aggrandizement object to this incentive. The would-be homesteader on a national forest tract which might have enormously high value for recreational purposes as a breathing space in the outdoors for hundreds of people is naturally unable to understand why his homestead ideas cannot be considered because the land he seeks to secure contains a value much higher than for any probable homestead." Fred Winn. 1912*

system which by then included Himmel Park and four others.

Pima County also developed a park system and in 1986 bought land for another natural park in the Tortolita Mountains. Pima County Flood Control District got into land preservation in the 1980s when it started acquiring land along watercourses for flood control purposes. Some of these lands, most notably Cienega Creek and Bingham Cienega, also became important habitat preservation and recreation areas.

### **Conservation Groups**

The Tucson Natural History Society, founded in 1923, was a group of scientists and residents interested in all branches of natural science. The group had monthly lectures on topics of scientific interest and took outings to many sites to study birds, plants and geology. These outings at times gave members the motivation to work to preserve places threatened by human activities. One of its first conservation activities was to back the movement to establish the Chiricahua National Monument in Cochise County. They were instrumental in having the Forest Service set aside 4,464 acres in the Catalina Mountains as a Natural Area, the first such designation in the United States. By 1930 the group had more than 100 members and was deeply involved in the Saguaro National Monument cause.

The Arizona Protective Game Association (AGPA) also became deeply involved in land and wildlife preservation. The state chapter was closely affiliated with the Game and Fish Department and was involved in wildlife management issues. Members were hunters and fishermen who realized the importance of preserving habitat in order to benefit hunting and fishing. C.B. Brown was the Tucson Chapter President in 1929 when the membership reached 300 local residents. Brown and the APGA were instrumental in persuading Arizona Senator Hayden to get the Department of Interior to withdraw some 30,000 acres of land in the Tucson Mountains from mining and homesteading, the beginning of Tucson Mountain Park and Saguaro National Monument West..

### **The Civilian Conservation Corps (CCC)**

*In October 1933, with the Depression at its peak, a crew of workers came to Pima County and began work on a broad range of public works projects on salaries paid by the federal government. Over the next seven years CCC workers built 3,962 small rock dams in washes in the Tucson and Catalina Mountains to control erosion, built roads, bridges and picnic areas in Sabino Canyon and Madera Canyon, installed fences, repaired historic walls at Ft. Lowell, cleared old mine shafts and rubbish piles in Saguaro National Monument and did many other tasks important for preservation and restoration of natural areas and creation of recreational facilities.*

Many other conservation groups followed in later years including the Arizona Native Plant Society, Nature Conservancy, Sierra Club, the Southern Arizona Hiking Club, Tucson Audubon Society, and many others. At times other types of groups joined in the Conservation Cause. The Business and Professional Women worked for urban planning and parks in the 1930s as did the League of Women Voters in later years.

### **State Laws Protect Cactus and Wildlife**

Many of the same Tucsonans who worked to preserve land were also important in developing laws to protect native plants in the 1920s. Because of the uniqueness of Sonoran desert cactus, they were prime targets for thieves, either to use themselves or more often to sell around the world. In 1929 many of the same conservation-minded people who worked to preserve land in Pima County were instrumental in getting the Arizona Legislature to pass the first native plant protection law in the nation. This law was designed to prevent theft of cactus which was the main problem at the time. Enforcement, however, was difficult because of the vast open spaces where the cacti grew. Since the prime cactus-producing areas were often on public land, cactus theft was less of a problem where those areas were beginning to be managed for protection purposes.

While the law prohibited cactus theft, it did not prevent destruction of cactus by land owners. After World War II the population boom and the development of large-scale subdivision led to mass destruction of native plants on private land. Because of the anti-theft provisions of the law it was easier to destroy plants than for people to salvage

them. By the 1980s this problem became even more severe as people began to appreciate and use low water use plants in landscaping. The law was then changed to make legal plant salvage much easier and more profitable and destruction a little more difficult. Even today, however, implementation is difficult as funding has been cut for staff in the Department of Agriculture which administers the law.

The need to preserve wildlife was clear by the time of Statehood in 1912. Wildlife was so plentiful in the early Territorial days that there seemed no limit to the wild turkeys or deer. The state constitution had provisions for a state game warden and this office led quickly to what is now the Arizona Game and Fish Department. In the early days the primary aims were to improve hunting and fishing through limiting the number of animals that could be taken and by stocking streams with sport fish and even bullfrogs. It was not until the 1970s that the devastation wrought by these nonnative species was evident to scientists and the Game and Fish Department began efforts to control the nonnatives.

It became clear at an early date that habitat preservation was essential also and the hunting and fishing clubs became important spokesmen for that. Many members were mainly interested in increasing hunting and fishing potential, but became strong advocates for habitat protection in general. By the 1970s Game and Fish also recognized the importance of other creatures and developed a branch devoted to non-game species as well as education programs. Tucsonans, led by the Arizona Nature Conservancy, initiated a referendum which resulted in passage of the Heritage Act in the 1990s to provide a steady source of funds for study and preservation of wildlife and habitat and for recreation. The Conservancy was later active in establishing the Arizona Water Protection Fund Act which provides funds for riparian area restoration.

Now in the year 2000 the community has another opportunity to reexamine land use planning and to decide whether to preserve additional lands. Some important things that still await community action are preserving additional valuable habitat and recreational areas, establishing corridors between the preserves, preserving the remaining riparian areas and rehabilitating those that can be repaired preserving archaeological, historic, and cultural sites, and preserving unimpeded views of the landscape. These and other options are discussed in the following sections

### III. PERSPECTIVES ON THE RESOURCES

Pima County is a large county with a great wealth of diverse landscapes, wildlife habitats, and human history. Elevations range from close to sea level in the western part of the county to almost 10,000 feet in the Catalina Mountains. The area's human history goes back at least 12,000 years and encompasses prehistoric hunting cultures, prehistoric agricultural cultures, Native American, European, Mexican, African and Oriental cultures.

Pima County has plants that only occur naturally in the Sonoran Desert, mountain plants that are the same as those in more northern climates and a great variety in between the two extremes.

The wildlife, too, is special to this area. On the mountains are species that retreated upwards as the land warmed up after the last Ice Age and in the desert are species adapted to a low-water hot desert. Along the riparian areas are species that depend on the thin ribbons of water that pass through the region. In the mountains are caves that contain species of life only found in those limited areas.

This region is also on the migratory route for birds, insects, and bats that move between Mexico and places as far north as Canada.

The region also has mineral resources, especially in the copper belt region that runs from Mexico to Central Arizona.

These features, the climate, and good land for agriculture and ranching have attracted millions of people to visit the area and hundreds of thousands to remain.

This rapid population growth has severely impacted many of the resources we value. Riparian areas have dried up or otherwise been affected. Some species of plants and animals are no longer found here. Large areas with ancient saguaros or ironwoods that are home to a community of wildlife have fallen to the bulldozer.

The region is fortunate to have a high percentage of its land in public ownership which provides recreation as well as relatively safe places for much of the wildlife. The private lands, however, have been affected by urbanization. The urban core has been much more affected than the outlying areas, but even those areas are facing urban pressures as the population reaches one million.

At this time we have an unusual opportunity to try to protect what is left for the benefit of many species as well as the humans. We now have an great deal of information

about the needs of wildlife as well as information about the most economically feasible way of protecting areas while still providing places for people to live and work.

This chapter looks at the resources, the threats to the resources, and some opportunities for preservation and rehabilitation.

#### The Physical Setting

##### Pima County's Land

Pima's County's 5,880,000 acres of land encompass a great variety of landscapes and habitats. The low desert on the eastern border of the county is close to sea level and receives less than 3 inches of annual precipitation on the average. The area seldom if ever gets frost and is home to species such as the Organ Pipe Cactus that cannot tolerate

too cold temperatures. The saguaro-dominated type desert occurs in the lower parts of the rest of the county. On the northeast side of Pima County are mountains that get ten times as much annual precipitation and usually get snow in the winter. Another significant vegetation type is the hilly grassland with trees such as oak and juniper. The Sonoran Desert has two rainy seasons - winter and summer, both of which are important to the kinds of vegetation that grows within it. The Chihuahuan Desert to the east has only a dependable summer rainy season while the Mohave Desert to the west has only a dependable winter rainy season.

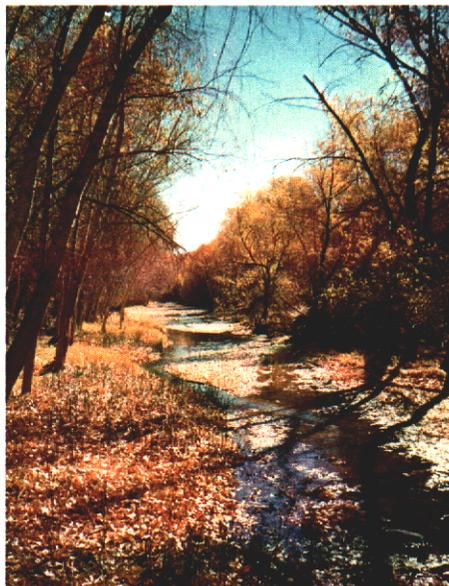
Most of Pima County is within the Sonoran Desert which also extends south into Mexico, north to

Maricopa County, west slightly into California and the Mohave Desert, and on the east side ends right about at the Pima County line not far from where the Chihuahuan Desert begins.

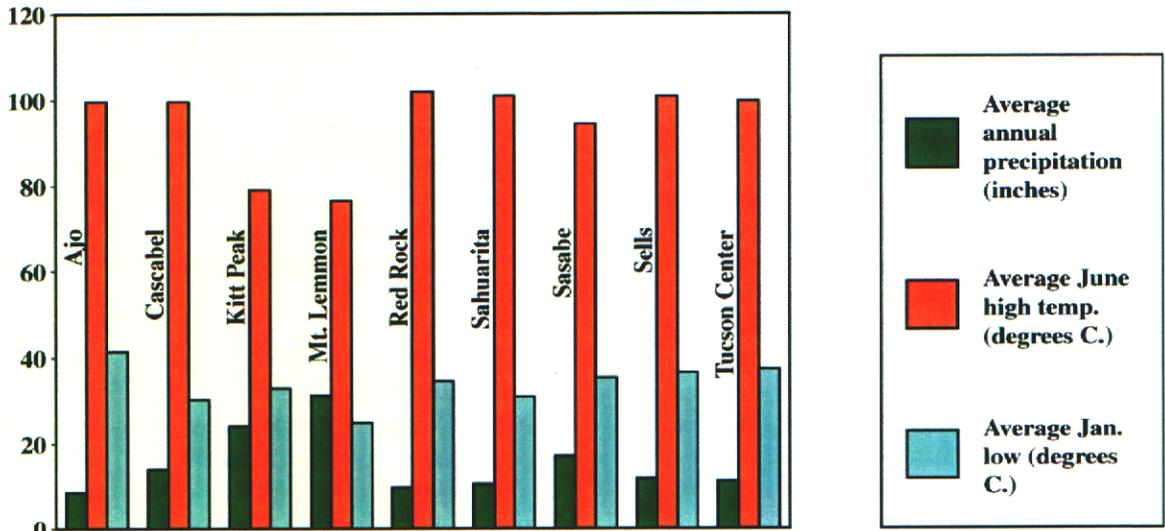
This location means that Pima County has a wide variety of vegetation and wildlife ranging from low desert to high mountain species. Pima County is the edge of the northern range of some Mexican species such as the jaguar, coppery tailed trogon, and masked bobwhite quail. Saguaro cactus is native only to the Sonoran Desert.

##### The Watercourses

Although much of Pima County is desert that receives less than eleven inches of rain per year, it has a few watercourses which have rich riparian habitat, largely because much of their water originates high in the nearby mountains. The Tucson Valley is nearly surrounded by



The Sonoran Desert



**Climate Averages For Different Places In Pima County**

mountains which are an important part of the watershed of the Santa Cruz River. This river originates in the mountains and the San Rafael Valley east of Nogales. It swings down into Mexico and then reenters the United States and heads north, adding flows from Sonoita Creek and many small creeks, and heads towards the Gila River which flows towards the Colorado River.

The Santa Cruz River has many tributaries that make up the river system. The Rillito River, too, starts in the Santa Rita Mountains as Cienega Creek. Cienega Creeks joins Rincon Creek, to become Pantano Wash which then joins the Tanque Verde Wash at Craycroft Road to become the Rillito. Sabino Creek is a major tributary of Tanque Verde Wash. It begins high in the Catalina Mountains and flows perennially all the way to the valley.

Many small creeks in the mountains are also part of the Santa Cruz watershed as are the many dry washes throughout the valley, including those in the Tucson Mountains and the Tortolita Mountains.

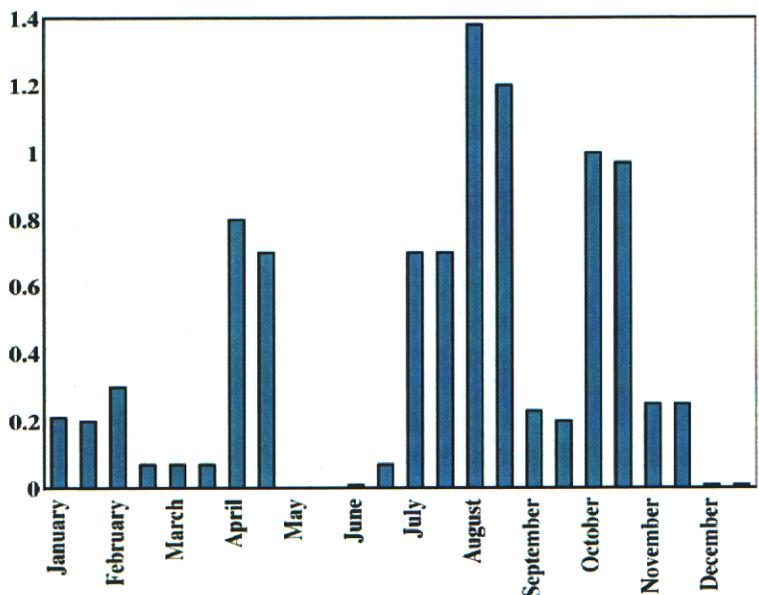
Prior to the arrival of a large Anglo population, the Santa Cruz River flowed perennially in places, had numerous cienegas, and, although usually dry in other places, had a high enough water table to support riparian trees. The Cienega-Pantano-Rillito river, too, flowed for much of its length and was home to beaver and muskrat. Irrigated agriculture was practiced for many years using water diverted from both the Santa Cruz and the Rillito rivers. There were springs at San Xavier and in the downtown Tucson area. Groundwater pumping in the past hundred years took water that used to feed the rivers and springs, causing the Santa Cruz and Rillito Rivers to dry up except at flood time.

Western Pima County is much drier and has no perennial streams, partly because there are no high mountain ranges to provide water for the lowlands. Just south of the Mexican border,

however, Sonoita Creek flows intermittently and provides water for irrigated agriculture in Sonora.

Many of the watercourses in Eastern Pima County have been modified by urbanization. Construction of roads, bridges, houses, commercial buildings, and flood control structures have all changed the watercourses.

The riparian areas cover a very small percentage of the land area of Pima County, but provide important habitat for much of the wildlife which depend on riparian areas for at least a part of their life cycle. These include insects, native fish, frogs, birds, and mammals. Even the dry washes play an important role in providing shelter, food, nesting areas, and corridors for movement between areas.



**Average Annual Precipitation In The Tucson Valley.**

## Ecological Perspectives

For more than a year, a group of Pima County's leading biological scientists have met regularly to assess the current state of various species and their habitats and to help guide the SDCP process. This group, the Scientific Technical Advisory Committee (STAT) has played a major role in identifying issues that need study and recommend guidelines, priorities, and ways of protecting vulnerable species.

Consultants did the major studies and reviewed their work with the STAT. County staff worked closely with both groups. An enormous amount of information came out of this collaboration.

The consultants and the STAT agreed upon basic principles for the project. The studies were directed toward providing the necessary information for meeting those goals. STAT also cautioned that there were many gaps in the available information that made complete scientific certainly impossible.

Monitoring and management plans will be developed with provisions to monitor the status of the species and adapt management and protection strategies in the interest of protecting species and promoting their recovery in response to changes in available habitat, ecosystem conditions, or knowledge about the species.

### Biological Goals

The biological goal of the Sonoran Desert Conservation Plan is "to ensure the long-term survival of the full

spectrum of plants and animals that are indigenous to Pima County through maintaining or improving the habitat conditions and ecosystem functions necessary for their survival.

Inherent within this broad goal are several objectives.

- . Promote recovery of federally listed and candidate species to the point where their continued existence is not longer at risk.
- . Where feasible and appropriate, reintroduce and recover species that have been extirpated from this region.
- . Maintain or improve the status of unlisted species whose existence in Pima County is vulnerable.
- . Identify biological threats to the region's biodiversity posed by exotic and native species of plants and animals and develop strategies to reduce these threats and avoid additional invasive exotics in the future.
- . Identify compromises to ecosystem functions within target plant communities selected for their biological significance and develop strategies to mitigate them.
- . Promote long-term viability for species, environments and biotic communities that have special significance to people in this region because of their aesthetic or cultural values, regional uniqueness, or economic significance.

### Pima's County's Habitats

Pima County's has a great variety of habitats. Some are large and general in nature, such as riparian areas, while others are smaller and very specific, such as limestone

### The Importance of the Desert Ironwood Tree

The Arizona Sonora Desert Museum conducted a study of the ironwood tree (*Olneya tesota*) and the community of life dependent on it. Ironwood is a slow-growing and long-lived species with a limited range in the Sonoran desert regions of northern Mexico and Arizona. It is a keystone species and a nurse plant vital to 500 other desert species. It provides safe sites for seed dispersal, seedling protection from extreme heat and cold, shade for saplings, as refuges for hunted animals, and enriches the soil with nitrogen. It is often the tallest tree in the area and is used by birds who roost in the branches and generate a literal "rain" of seeds and whole fruit. The presence of ironwood can increase the number of bird species in desert scrub habitat by 63 percent. Saguaro, organ pipe and senita cactus all benefit from the cover of ironwood and other desert legume trees in their early years..

Ironwood has long been valued for its cultural value. Its extremely hard wood is used for many purposes and various parts of it are used for food, medicines, implements, food, and ritual purposes. The dense wood burns extremely hot, making it the preferred fuel wood for many in northern Mexico, where dead wood is gathered.

Ironwoods are threatened by grazing, exotic species that spread fire, and by land clearing for urban uses in the U.S. It is a major component of much of the charcoal that is exported to the United States, although ironwood harvesting for charcoal is illegal in Mexico. Although it is not listed as endangered in the U.S., it has "special protection status" in Mexico. Its numbers on both sides of the border have been drastically reduced



caves. Each is important to one or more species. Many species breed or feed in only one type of habitat. Some bats, for example, require certain kinds of caves and must be undisturbed during the time they are raising their young in the cave.

Defining specific habitats requirements of some species is not always easy. Cycles of drought and plenty are basic to the desert and species may spread into less favorable habitat during some years while in other years they can forage in a lush region. Many species require different habitats at different times of year. This is especially obvious for migrating birds. Some species may move to higher elevations at some times and come down to lower elevations at others. Bighorn sheep, for example, used to forage in present day Oro Valley in the winter time and retreat to the mountains in the heat of summer.

Habitats are defined by a number of factors, including elevation, slope, availability of water, type of vegetation, underlying soil or rock, and direction that the area faces.

In the high mountain areas, for example, the north-facing slope receives less heat than the south-facing slope and different vegetation may grow in the two places.

Since many species have very specific habitat requirements, it is often possible to predict where certain species are liable to be found based on their habitat needs, or conversely, where they are not liable to be found.

#### **Varieties of Vegetation and Wildlife**

Pima County has a great variety of wildlife. Because of the County's location in the northern part of the Sonoran Desert but close to the Mohave and Chihuahuan Deserts, and close to the subtropical regions of Mexico, the area has many species of native plants and animals. The

<b>Some Problem Non-native Species</b>	
<b>Species</b>	<b>Problem</b>
Bullfrog	Eats native fish and frogs
Buffelgrass, Red brome grass	Displaces native grasses, increases fire danger for plants such as saguaros
Saltcedar	Displaces native riparian species with less valuable habitat
Green sunfish	Eats native fish
Feral cat	Eats native birds and lizards

variety is also high because of the variety of habitats from the alpine zone in the Catalina Mountains to the low desert areas of western Pima County. The Smithsonian Institution located their laboratory on Tumamoc Hill early in the twentieth century because there was such a unusually great range of plant and animal life in the region.

Thousands of nonnative species have been Some of these species coexist satisfactorily with humans and even in urban areas. Most native plants can be grown in urban landscapes and landscapes designed for wildlife can often attract native birds, lizards, rabbits or butterflies. But many wildlife species cannot coexist with urban areas because humans view them as dangerous (e.g., rattlesnakes), because they have lost habitat and food necessary to their survival (e.g., native fish), or because life is too dangerous for them when they move about, when crossing roads, for example. In general, there has been a major decline of native animals and plants in the urbanized areas which means a decline throughout the region as their is not enough space or food to feed both the creatures already in the more unpopulated areas and those expelled from the urban areas.

Another major threat to native plants and wildlife is the spread of nonnative species. Thousands of such species have been brought to the area accidentally or on purpose as landscape plants, forage for cattle, for sport. Not all the nonnative species actually cause problems, but many have the potential to do so even if they have not done so yet. The Africanized killer bees are probably the most publicized invasion of problem nonnatives. Many others are less obvious. Foreign grasses have invaded desert areas unadapted to fire. When fires start they can spread quickly through areas with saguaro and barrel cactus, killing these slow-growing plants. Bullfrogs can quickly invade a wetland or riparian area, killing native frogs and fish and competing with them for food. Saltcedar trees can drive out native trees in disturbed riparian areas.

#### **Cactus Ferruginous Pygmy-Owl Studies**

When the owl was first proposed for listing in the early 1990s, little was known about its present or historic distribution or habitat needs. In the past three years scientists from Arizona Game and Fish and the U.S. Fish and Wildlife Service have discovered much more. In 1999 25 occupied territories were confirmed with 11 active nests. From those nests 32 young owls fledged and 16 were known to have left the nest successfully, although the success rate was higher in the preceding years.

The largest concentration of territories was in the Altar Valley. Another group occupies ironwood forests in northwest Tucson from Tortolita to the Ironwood National Monument. There are four distinct populations in Pima County and seemingly little interchange among those groups. When the young leave the nest and disperse, they do best in areas where there are a succession of trees, such as riparian areas. They generally choose not to go through high density residential developments. They require a good food supply of lizards, rodents and insects and protection from predators. In a drought year when the food supply is low, fledgling success is also low. Much more is yet to be discovered, such as whether there are connections among the Arizona, Texas and Mexican populations.

**Vulnerable Species**

There are 123 species of plants and animals which the STAT considers vulnerable for various reasons. The list includes plants, mammals, fish, amphibians, reptiles, and invertebrates. Some of them have very specific habitats needs and some can survive in several different types of habitats. All, however, are in danger because of human activities.

The listing of recommended species for conservation under the SDCP is a dynamic process. The list provided here should be considered as another draft, and not as the final list. STAT will continue to review and revise the list of species as more scientific information becomes available up until the final draft of the MHCP.

**Threatened and Endangered Species**

There are 25 plants and animals in Pima County that are federally recognized as threatened, endangered or candidates for this listing. In order to be put on the federal list, the species must be greatly reduced in numbers from what it was previously and in danger of further loss unless action is taken. The U.S. Fish and Wildlife Service goes through an extensive process to add a species to the list or to remove a species that is listed. This involves extensive scientific studies to support the proposal, notice in the Federal Register, and an opportunity for public comment. Although there is a legal distinction between "threatened" and "endangered" in practice both designations are treated similarly. Similarly, species that are not yet listed but are under consideration for listing are usually treated in practice as if they will probably be listed in the future.

**Extirpated Species**

Twelve species have been extirpated in Pima County. This means that although they once lived here and live in some area, they have not been found in Pima County in recent years.

**Species of Concern**

There are 49 additional species that the local scientists identified as species of concern. These include twelve species that are in jeopardy in Pima County and are

**Federally Protected Species in Pima County**

Species	Habitat
<b>Threatened and endangered</b>	
American Peregrine Falcon	Grasslands/Desert
Bald Eagle	Multiple
Cactus Ferruginous Pygmy-Owl	Desert/Riparian
Desert Pupfish	Aquatic
Gila Topminnow	Aquatic
Huachuca Water Umbel	Aquatic
Jaguar	Multiple
Jaguarundi	Multiple
Kearney's Blue Star	Riparian
Lesser Long-nosed Bat	Caves/mines
Masked Bobwhite Quail	Grasslands
Mexican Gray Wolf	Multiple
Mexican Spotted Owl	Forest
Nichol's Turk's Head Cactus	Desert slope
Ocelot	Multiple
Pima Pineapple Cactus	Desert/grassland
Sonoran Pronghorn Antelope	Grassland
Southwest Willow Flycatcher	Riparian
<b>Proposed</b>	
Acuna Cactus	
Chiricahua Leopard Frog	Riparian
Gila Chub	Aquatic
Mountain Plover	Mountain forest
Sonoyta Mud Turtle	Aquatic
<b>Petitioned</b>	
Yellow-billed Cuckoo	Riparian/grassland

species for whom the Pima County habitat is crucial for their overall existence (Class A). Another 18 species are in jeopardy in Pima County and generally declining throughout their range (Class B). Another 13 species are in jeopardy in Pima County, but not elsewhere (Class C) and 6 species are not currently at risk, but should be protected because of their ecological or social significance (Class D).

**The Endangered Species Act (ESA)**

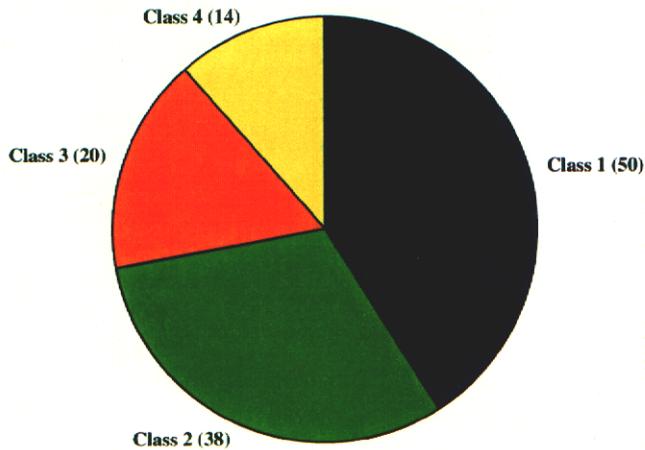
Congress passed this federal law in 1977 with the intent of preventing the extinction of any more species and to improve the status of species in trouble. When species are identified as threatened or endangered through a scientific process and extensive public input they receive additional levels of protection and in appropriate cases recovery plans are designed to increase their numbers.

**The Major Threats**

The major threats to species are:  
 . Loss of habitat, whether it be a perennial stream, a section of saguaro-studded

**Some Species Extirpated in Pima County**

Species	Reasons for Extirpation
Grizzly bear	Hunting, loss of habitat
Mexican grey wolf	Hunting, loss of habitat
Wild turkey	Hunting, loss of habitat
Muskrat	Hunting, Loss of water supply/habitat
Tarahumara frog	Loss of water supply/habitat, exotic species
Speckled dace	Loss of water supply/ habitat, exotic species
Malaxis orchid	Loss of habitat
Aravaipa sage	Loss of habitat



**Classes of Vulnerable Species in Pima County**

desert, or a cave. This means that animals may not have a place to feed, nest, or drink.

- . Loss of food supply. Some species are dependent on a specific type of food supply, such as butterflies depends on a specific plant for nectar.

- . Competition from nonnative species which occupy the niches formerly occupied by native species, often not providing the same type of food supply or nesting area.

- . Killing accidentally (e.g., by a car) or intentionally (e.g., predator control or bulldozing).

- . Disruption of breeding or nesting activities which can mean that reproduction is not successful.

- . Fire in non-fire adapted areas which can destroy plants such as cactus that take a long time to reproduce and mature.

- . Loss of corridors for movement between areas leading to too small a population for good reproduction, and reduction of food supply especially seasonal variety.

Constraints on conservation include a lack of adequate scientific information, conflicting needs of vulnerable species, cost of land and information gathering, adverse land management practices and mandates, funding and staffing shortfalls, and most significant of all the continual pressures for new land uses that will impact the species.

### Opportunities for Preservation and Restoration

Specific proposals are discussed in Chapter Six and riparian protection proposals discussed in the section that follows in this chapter. Some general guidelines for developing reserves are offered here.

Guidelines for specific reserves

- . A range of species should be addressed

- . Larger reserves are better than small ones. Large blocks of habitat with large populations of the vulnerable species are preferable to small ones with small populations.

- . Blocks of habitat adjacent or close to one

another are better than isolated ones. Habitat should be contiguous.

- . Reserves should be linked with corridors connecting similar habitats.

Guidelines for the Reserve System as a Whole

- . Reserves should be diverse and represent a variety of physical and environmental conditions;

- . Areas that are not under siege from invasive species have a higher level of system function and a better chance of success.

- . Fragmentation of the system should be minimal with as few roads as possible.

- . Areas should be prioritized that have the most vulnerable components and represent a high number of vulnerable species (areas with "species richness").

- . Opportunities to build on the existing reserve system should be sought where conditions are conducive to self-sustaining ecosystems.

- . The process should take into consideration land use constraints such as existing and proposed land uses, land values, parcel size as well as the mandates of the land managers.

### Conservation Options

Reserves can be developed in a wide range of ways ranging from land purchase to voluntary agreements with landowners.

- . Maintain and manage the existing reserve system.

- . Expand and enhance the existing reserve system, include purchase of land on park boundaries.

- . Create new reserves such as the Ironwood National Monument.

- . Purchase sensitive lands from willing sellers.

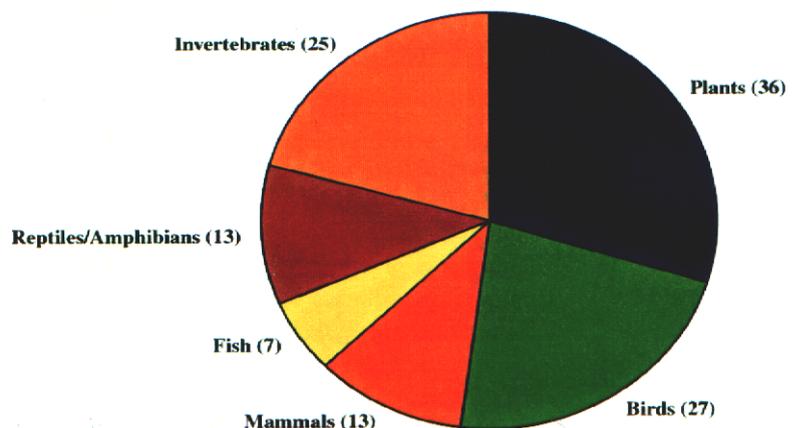
- . Purchase development rights from willing sellers.

- . Purchase or retire water rights from willing sellers.

- . Encourage conservation easements on private land.

- . Extend State Trust Land leases for longer than the usual five-year period.

- . Design appropriate management strategies.



**Types of Vulnerable Species in Pima**

## Riparian Perspectives

The word “riparian” originates from a Latin word meaning “along the river.” In the semiarid West, this includes areas associated with arroyos, seeps, ponds and any place with more water than the surrounding area. The riparian area includes the entire community of the watercourse including its wildlife, vegetation, soils, and water.

Riparian areas are important in many ways. From the perspective of a migrating bird, a riparian area offers a place to stop in a sheltered location, find some food, and rest before continuing on. From the perspective of a frog or toad, the riparian area may be where it spends its entire life, or may just be the place where it lays its eggs so they can develop into tadpoles. The fish can not leave the security of the water for long and also depends on the riparian area to produce insects or plants to eat. The mammal may see the riparian area as a place for a den, a source of food, or a place to get a drink. The cottonwood and willow trees can only thrive in a riparian area with plenty of water at or near the surface and floodwater in the spring to produce new trees. Cattails and rushes need to be in the water most of the time. Humans may view riparian areas as refreshing places to hike or picnic while looking for wildlife.

The watercourses are also important in conveying water from uphill areas to downhill areas. An intact natural watercourse generally includes a broad floodplain where the water can spread out during floods and soak gradually into the ground. These areas are also important for mitigating water quality problems when the vegetation takes up nutrients and even some pollutants.

### Ecological Analysis of Conservation Priorities

In April 2000 the Nature Conservancy issued a major study of the Sonoran Desert Ecoregion. Their scientists identified ecoregions, biodiversity targets, and needed data. The identified 100 landscape level conservation sites in the Mexican and U.S. portions of the Sonoran Desert, including the Pinacate-Organ Pipe-Goldwater Range, Altar Valley, Baboquivari Mountains, Santa Rita Mountains, Tucson Mountains, Cienega Creek, Middle San Pedro River, Sawtooth-Silverbell Mountains, Tortolita Mountains, and several other smaller sites in Pima County. Criteria included maintaining viable native fish populations, maintaining viable occurrences of vulnerable species and habitats, and conserving features such as migratory bird concentration areas, bat roosts, estuaries, springs, and invertebrate concentration areas. An Ecological Analysis of Conservation Priorities in the Sonoran Desert Ecoregion. April 2000. Tucson.

### Riparian Ecosystem Goals

The overall biological goals of the Sonoran Desert Conservation Plan are listed above. Within those broad goals are the following specific riparian ecosystem function goals.

- . To the extent possible, maintain or restore the connection between interdependent components of river systems: channel, overland floodplain, distributary flow zones, riparian vegetation and connected shallow groundwater.
  - a. maintain or restore natural flooding and sediment balance.
  - b. preserve or reestablish connection between channels and their floodplains, and channels and their distributary flow zones.
  - c. maintain or reestablish hydrologic connections between riparian and aquatic ecosystems and shallow groundwater zones.
- . Manage uplands as appropriate to protect the functioning of riparian and aquatic ecosystems within the watershed.
- . Manage point-source and non-point source pollution to maintain water quality at a level needed to support the SDCP biological goals.
- . Insure sufficient instream flows to achieve and protect natural functions of riparian and aquatic ecosystems.

### Riparian vegetation communities

Riparian areas can support a wide range of vegetation, depending on elevation and water supply. Some species need water right at the surface, while others can send their roots as deep as fifty feet to get water. To produce new plants, however, cottonwood and willow trees need water at the surface at the time the seeds are germinating and starting to grow. This condition does not occur every year, but is dependent on good flood flows at the time the seeds are ready for them. These flows then recede so the trees grow on dry ground alongside the stream with their roots in the water.

### Non-native Species

Many of the riparian areas have been invaded by species from other areas. The most problematic plants in Pima County are tamarisk (saltcedar) and a variety of grasses, especially bermuda grass, red brome, and buffelgrass. Saltcedar provides very poor habitat for most native species and tends to outcompete the native plants, especially in disturbed areas. It produces seedlings for a much longer period than the cottonwood and willow and can grow in conditions that would be adverse for those species. Grasses that grow in desert areas where grass did not grow in the past can cause fires that are devastating to desert plants such as saguaro or barrel cactus that did not

## Riparian Vegetation Communities

Type of area	Kind of stream	Typical vegetation	Example
Xeroriparian	Ephemeral streams	Mesquite and acacia	Alamo Wash
Mesoriparian	Intermittent streams	Mesquite, sycamore, ash	Tanque Verde
Hydroriparian	Perennial streams	Cottonwood, willow, rush	Cienega Creek
Marshland	Shallow groundwater	Cattail, watercress, sedge	Bingham Cienega
Sacaton grassland	Perennial/intermittent	Sacaton grass, shrubs	Arivaca Creek floodplain

evolve with fire. The most problematic animal species is the bullfrog which eats native fish and frogs and can come to dominate some riparian areas and ponds.

Non-native species are introduced intentionally and accidentally. The Arizona Game and Fish Department, for example, introduced bullfrogs and game fish for sport and food purposes. Many plants were introduced as forage for cattle after overgrazing led to the decline of native grasses. Fountain grass was introduced as a landscape plant. The U.S. Fish and Wildlife Service is concerned that use of CAP water in surface streams or ponds might introduce nonnative fish and other species that could be harmful to the native ones.

The most significant actions that can be taken to prevent nonnative species from becoming invasive are

1. To restore or mimic the natural functions of the watercourses so that conditions favor the natives such as cottonwood trees and leopard frogs.
2. To prevent new invasions of nonnative species such as bullfrogs or saltcedar in areas where they are not prevalent.
3. To remove invasions of nonnative species where they are starting to establish.

### Riparian-dependent vulnerable species

Native fish are the most riparian-dependent species. Twenty streams still have native fish in the area and four have native leopard frogs. Many species of wildlife depend on riparian areas and ponds for some part of their life cycle. The table below lists the species that once

existed in the area but are not longer found here (extirpated) as well as the species which are in decline and highly vulnerable.

### Perennial and intermittent streams

A perennial stream is one that has continuous flow.

An intermittent stream is one that flows only at certain times of year.

An ephemeral stream has a channel above the water table and flows only in direct response to precipitation.

The Pima Association of Governments (PAG) identified perennial and intermittent streams in Pima County, as shown on the map. Most of these streams are located at higher elevations within the National Forest, but some are located in the valley. The most notable perennial low-elevation perennial streams are Sabino Creek and Cienega Creek.

### Shallow groundwater zones

PAG also delineated areas of shallow groundwater as shown on the map. For this study, "shallow groundwater zone is an area where the water table is within fifty feet of the land surface. This depth was chosen as the maximum depth at which mesquite bosques can survive. In these areas additional groundwater pumping is liable to affect the riparian vegetation and thus wildlife as it has already affected so many of our streams.

### Springs

Springs are places where groundwater comes to the surface because of a high water table and/or an underlying geological formation which helps force the water to the surface. One hundred years ago there were many more springs in the area than there are today, because of changes in the water supply. PAG identified more than 250 springs in the county, most of which are on National Forest land. At least 27 of these springs flow perennially. Agua Caliente spring is the largest known perennial spring in Pima County.

### Some Species in Pima County Riparian Areas

Natives	Nonnatives
Fremont cottonwood	Saltcedar, tamarisk
Goodding willow	African sumac
Arizona ash	Bermuda grass
Sacaton grass	Red brome grass
Sedge	Johnson grass
Lowland leopard frog	Bullfrog
Gila topminnow	Crayfish
Raccoon	Green sunfish
Dragonfly	Honey bees
Southwest willow flycatcher	
Yellow-billed cuckoo	

## Floodplain Characteristics

### Overbank storage

An overbank storage area is the land along the watercourse over which water can flow during flood times. This allows the flood waters to spread out, slowing down the force of the flood waters and minimizing erosion. Some of the water returns slowly to the stream and some recharges the aquifer.

Almost all undisturbed watercourses have some overbank storage areas, but many of our watercourses have been modified by urban uses and flood and erosion control structures so that the overbank storage has been lost in much of the metropolitan area. The major reason that Pima County purchased the Cienega Creek Preserve was to maintain the overbank storage potential in the floodplain to reduce downstream flood damage and the need for costly flood control structures.

### Distributary flow areas

These are areas where the watercourses are ill-defined and frequently change with each new flow event. The floodplain shifts around and in these areas there is often xeroriparian vegetation over a larger area than is the case with defined channels. A large portion of the Tortolita area, the southern Avra Valley and northern Altar Valley have this type of flow. It is expensive and rather difficult to design flood control structures in these areas without exacerbating flood problems elsewhere in the area. To deal with this type of problem Pima County bought land with distributary flow characteristics along Black Wash in the Altar Valley. The U.S. Army Corps of Engineers conducted a study of the same type of problem in the

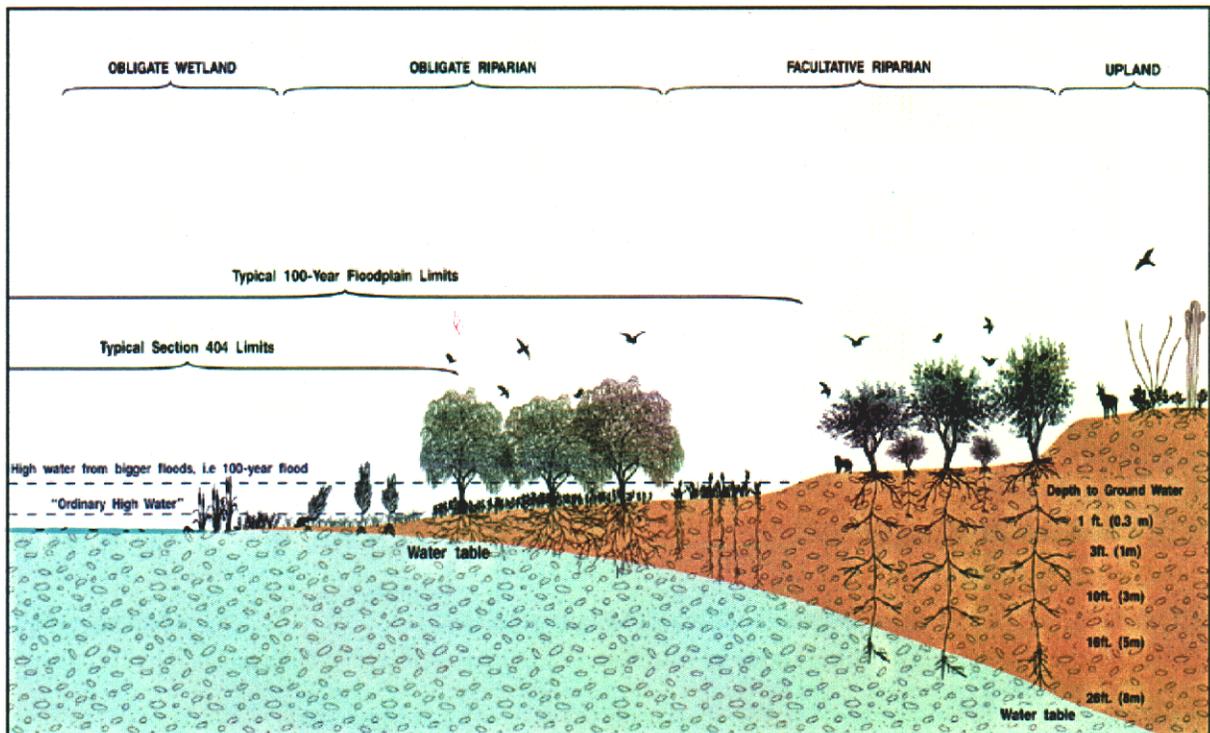
Tortolita area and determined that the costs of channelizing distributary flows to allow for more development would far outweigh the benefits

### Upland watersheds

The condition of the watershed is about as important as the condition of the watercourse itself. When the watersheds are paved, built upon, overgrazed or cleared of vegetation, the water that falls on them tends to flow much faster to the watercourses, increasing erosion and flood damage and further changing the watercourse itself. If construction in the watershed is not carefully done, landowners downstream may experience flood problems as the water flows faster towards them and may bring sediment with it.

### Threats to Riparian Areas

The major threats to riparian areas are groundwater pumping in vulnerable shallow groundwater areas, construction in the floodplain, introduction of Full page perennial, intermittent, springs, shallow groundwater map additional exotic species, and further damage to watersheds. The most imperiled systems are Sabino Canyon outside the National Forest, Arivaca Creek, Cienega Creek and Davidson Canyon. In Sabino Canyon groundwater pumping impairs streamflow, habitat losses are high, and exotic species are a problem. In Rincon Creek groundwater pumping for the planned Rocking K development may deplete a local aquifer which supports streamflow and gravel mining may increase channel downcutting. At Arivaca Creek, groundwater pumping, surface water diversion, water quality and exotic species



The Water Needs of Riparian Vegetation

impair natural riparian functions. At Cienega Creek future groundwater pumping could deplete streamflow, water quality could be impaired if train derailments occurred, and nonnative species imperil the largest remaining Gila topminnow population. Davidson Canyon is threatened principally by groundwater pumping and habitat loss. New mining in the watershed could impair water quality

**Opportunities for Protection, Restoration or Reintroduction**

Certain watercourses have priority because they have a high natural availability of water and possess relatively unimpaired water quality and are not currently within reserves. These watercourses have a good potential for preserving and augmenting the native fish and frog populations. The priority watercourses in the various subareas are listed below.

Few watercourses in the area are undisturbed by human activity. Many of these would be impossible or very difficult to rehabilitate, but some have high potential for restoring their natural riparian functions and for reintroducing species that no longer live in them.

**Water Supply Issues**

A dependable water supply is essential for riparian protection and rehabilitation, but just having water is not an assurance of protection. Possible water supplies in Pima County are surface water, groundwater, wastewater, and Central Arizona Project water.

Natural surface water is the ideal water source, but is extremely rare except in the higher elevations. This water comes from rain and snowmelt and seldom reaches the lower elevations. If it does, it is usually diverted for some use. Other than removing diversions, downstream of Cienega Creek, for example, there is little additional surface water for restoration purposes.

Groundwater is necessary to sustain a high water table and connected surface flows. This, too, has become an increasingly scarce commodity for riparian purposes.

Pumping has lowered the water table throughout much of the basin and additional pumping threatens areas such as Arivaca Cienega and the Tanque Verde. Cutbacks in pumping by providing alternate sources or eliminating some land uses may help in a few areas, but is not really feasible in most of the region.

Wastewater is a water supply that increases as the population grows. Wastewater can either be used directly for riparian uses or indirectly, when wastewater reduces the need to pump water for a use such as a golf course. Tucson's Sweetwater wetlands is an example of a man-made wetland that uses water to create a new wetland habitat. The Santa Cruz River downstream of the Pima County wastewater treatment plants is an example where the release of wastewater has created a riparian area incidental to the discharge. In some places this riparian area has native vegetation and is useful to wildlife, although there are water quality considerations. This water also replenishes the groundwater supply and is later pumped out for use.

About ten percent of Pima County's wastewater is currently treated and used on facilities such as golf courses and cemeteries to water the grass. This reduces the need to pump groundwater. Additional reuse could further reduce the need to pump groundwater. This would be especially useful for riparian areas if it reduced pumping in shallow groundwater areas, such as Tanque Verde Wash.

The Central Arizona Project is the largest renewable water supply in the area and has great potential for riparian areas, especially in the early years when the population is not large enough to use the entire supply. There are, however, important cautions concerning its use. Water from another basin brings with it nonnative species that may cause problems for the native species. These nonnative species include fish, frogs, clams, insects, plants, and microscopic elements which can introduce diseases into the native populations. If the water is treated, virtually all of these are eliminated and there is no

**Major Opportunities for Protection and Restoration**

<b>San Pedro Subarea</b>	San Pedro River, Buehman Creek, Espiritu Creek, Youtcy Canyon, Paige Canyon
<b>Cienega-Rincon Subarea</b>	Agua Verde Creek, Upper Rincon Creek, Davidson Canyon, Cienega Creek, Wakefield Creek, Posta Quemada Creek, Gardner Canyon, Chimney Canyon, Distillery Canyon
<b>Middle Santa Cruz Subarea</b>	Sabino Creek, Bear Canyon, Ventana Wash, Tanque Verde Creek, Agua Caliente Creek.
<b>Tortolita Subarea</b>	Sutherland Wash
<b>Altar Valley Subarea</b>	Arivaca Creek, Las Moras Creek, Pozo Hondo Creek, Thomas Creek, Fraguaita Creek, Penitas Creek

risk for human or wildlife populations. But if the water is put directly from the canals into open water bodies, the risk is relatively high. Fish barriers can be erected to keep fish from going upstream during flood times, but this does not work for the smaller species or the very young stages of fish and frogs. The main time of concern is when flood waters connect the dry washes with perennial and intermittent streams.

One concern about any water source is that any open body of water is an invitation for people to dump species such as aquarium fish and turtles. This may be done with the feeling that it is better for them to live in the wild, because people are tired of them. In bodies of water large enough for fishing, people tend to dump their bait buckets. Many of these introduced species can harm native species.

### **Guidelines for the Use of Wastewater**

The STAT established five basic principles for the use of wastewater.

- . Self-sustaining systems should have priority so that the use of wastewater to replace other water uses to preserve a high water table would be desirable.
- . Wastewater should be used to restore local aquifer conditions by restoring local shallow groundwater systems.
- . Projects should be designed to avoid disturbing existing vegetation and minimize the need for perpetual irrigation.
- . Improve water quality where needed to support aquatic species.
- . Manage riparian and aquatic systems for native species, including public education programs.

In line with these guidelines, the committee ranked a number of projects that had been proposed by various experts.

### **Aquatic Vertebrate Conservation**

The first specific proposal for recovering native species is one to conserve and reintroduce native fish, turtles, snakes, and frogs in places where they do not currently live and enhance some areas where they do live now. The target species are the desert pupfish, desert sucker, Gila chub, Gila topminnow, longfin dace, Sonora sucker, speckled dace, canyon treefrog, Chiricahua leopard frog, lowland leopard frog, black-necked garter snake, checkered garter snake, Mexican garter snake, Sonoran

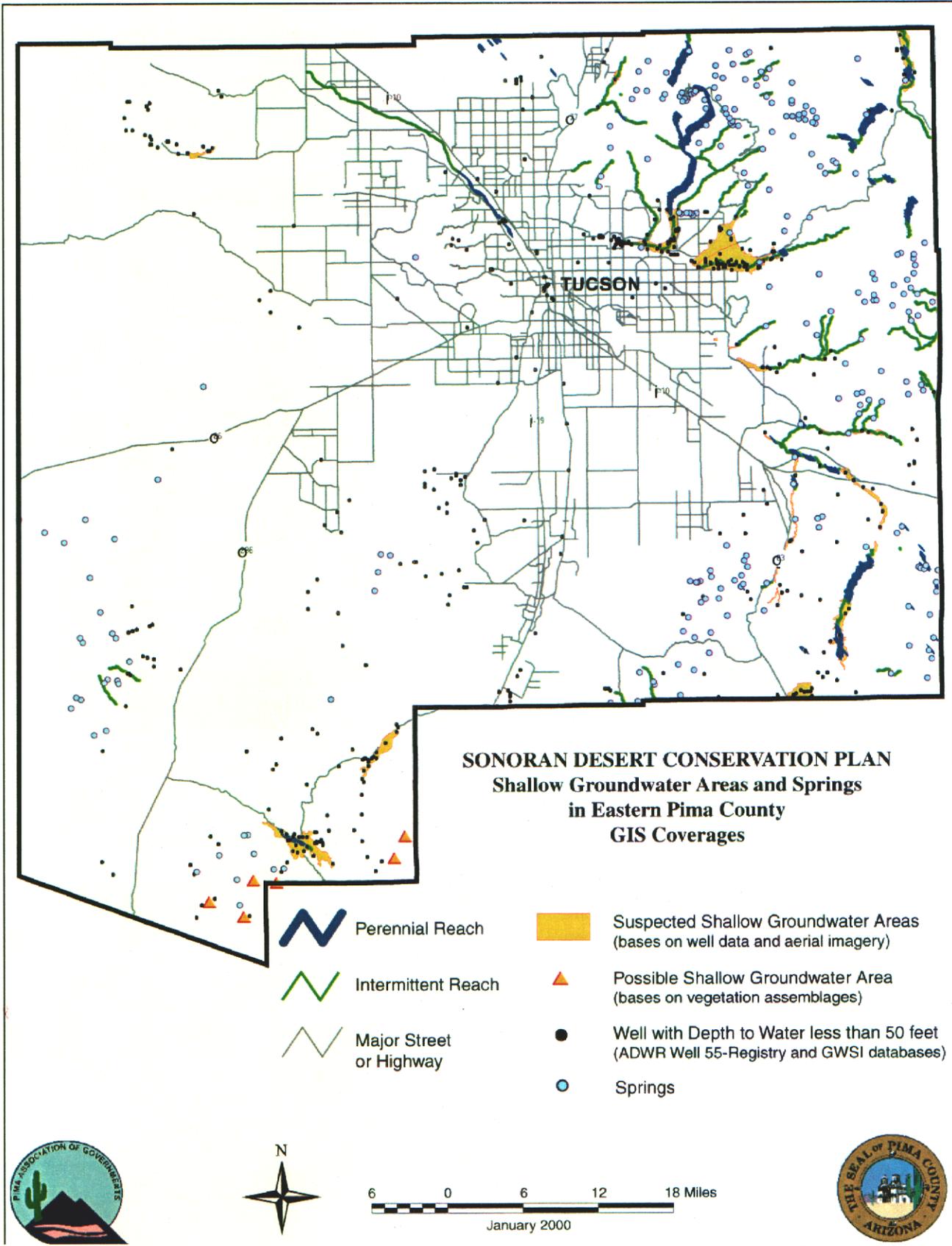
### **The Wildlands Project-Sky Island Alliance Proposal**

The Wildlands Project is an international plan to create connected open space and habitat from northern Canada to Central America. Tucson's Sky Island Alliance has worked with this project to develop a concept for protected areas in the Sky Islands area of Arizona, New Mexico and Sonora. Their criteria include availability of large public land areas or relatively undisturbed private land, availability of viable wildlife corridors, and good habitat. Their proposal fits in well with the SDCP and includes many of the same areas identified in that Plan. The San Pedro River is viewed as an important dispersal corridor. The Catalina, Rincon, and Santa Rita Mountains are all important areas for wilderness and wildlife corridors. The Altar Valley comes into the picture as low use public land with important linkages down into Santa Cruz County and Mexico. See Wild Earth. Spring 2000.

mud turtle, and giant spotted whiptail lizard.

This is not as simple as just putting some creatures in a stream. First, natural flow regimes will have to be restored to some extent or mimicked. This includes both a dependable water supply and allowing the normal flood cycles to operate. In some cases these will be small in-channel stream segments or quasi-cienegas or ponds created and maintained with reclaimed wastewater. In other cases they will be natural springs, or existing perennial streams such as Cienega Creek. The ideal location of these sites would be close enough to similar sites to allow some of the creatures to move between them. These will require commitments to continual management.

Exotic species harmful to the native species will have to be reduced. The most problematic species are bullfrogs, catfish, sunfish, bass, and mosquitofish. Non-native fish can be controlled by periodically drying up the stream or by poisoning. Bullfrogs are more difficult to control since they can disperse overland for some distance. The easiest time to control them is in the tadpole stage, where they remain for about a year, requiring constant water. Drying up the water source can eliminate the tadpoles, but not the adult frogs, but the native frogs tend to remain in the tadpole stage for a much shorter time than the bullfrog tadpoles so there are times when the only tadpoles in the water are bullfrog tadpoles which is a good time to dry up the pond. Of course, some of these measures will also adversely affect native fish. At the present time there are numerous places in the area where exotic species flourish, such as ponds at sand and gravel pits or golf course ponds. Arizona Game and Fish Department stocks some urban lakes with exotic fish so people can fish locally. Management plans should be developed through cooperation with the owners of these sites to eliminate the nonnatives and where appropriate reintroduce native species.



Perennial and Intermittent Streams, Springs, and Shallow Groundwater Areas

## Historic and Cultural Perspectives

Pima County has a rich cultural heritage that goes back at least 12,000 years and includes many cultures from the early prehistoric hunting people through the Hohokam, O'odham, European, Oriental and African people. Many of the physical remains of these cultures have been lost over time, but some have been surveyed, some studied, and a very small number have been preserved for present generations to see.

### The Cultures in Pima County's Past

The first people in this area probably arrived about 12,000 years ago. They were hunters who followed the Ice Age mammals such as mammoth, camels, horses, and bison. As the large game became extinct, possibly because of over-hunting as well as a warming of the climate while the last ice age receded, the hunters turned to other resources. People were farming in the area by about 1000 BC. The Hohokam were the largest tribe of central Arizona and developed extensive irrigated agriculture in the Salt and Gila River valleys and south into the Santa Cruz River valley. Whether or not they were ancestors of the present day O'odham and Pima Indians is still debated. These tribes were settled in villages (often different ones in summer and winter) and farmed by capturing water from monsoon rains.

The Apaches were a nomadic people who arrived in Arizona in the sixteenth century about the same time that the Spaniard conquistadors reached the area. Major changes took place as the Apaches raided the local Indian settlements and the Spaniards not only fought the natives, but also brought new diseases, new crops, new weaponry, and grazing animals - horses and cows.

The Spaniards had three major kinds of settlement - mines, missions, and military garrisons. The presidio of

Tucson protected the few Spanish citizens in the Tucson area. San Xavier Mission was a center of agriculture and grazing, chosen because of its plentiful water and people with an village tradition. Farther south there was a Spanish presidio at Tubac and a mission at Tumacacori, again chosen because of plentiful water sources. Spanish miners worked in the nearby mountains. There was a small European population and fewer O'odham than in previous centuries as a result of warfare and disease. The area was sparsely populated and was part of a network of presidios and missions in Mexico, called Pimeria Alta. The culture throughout the area was predominantly Spanish and Native American. Spanish became the common language for the most part.

A whole new culture, predominantly northern European, arrived in the nineteenth century and by the middle of the century Arizona belonged to the United States as a result of a treaty and land purchase. The new boundary line cut right through Pimeria Alta and eventually divided the larger area into predominantly Spanish speaking people to the south and predominantly English speaking people to the north of the international border. English quickly became the common language in Pima County. Following the American Civil War population began to increase steadily after American military forces conquered the Apaches making it possible for the European population to spread out over the countryside in ranches, farms, mines and towns.

The end of the nineteenth century and beginning of the twentieth ushered in major changes in eastern Pima County. The community began to expand and urbanize, and introduced many new technologies - stagecoaches, trains, water pumps, and new power sources, to name a few. People were then able to change their environment much more quickly and radically than ever before. Surface water supplies soon proved to be inadequate and groundwater pumping technology improved to the point that few springs, cienegas, or perennial flows remain because their water sources dried up.

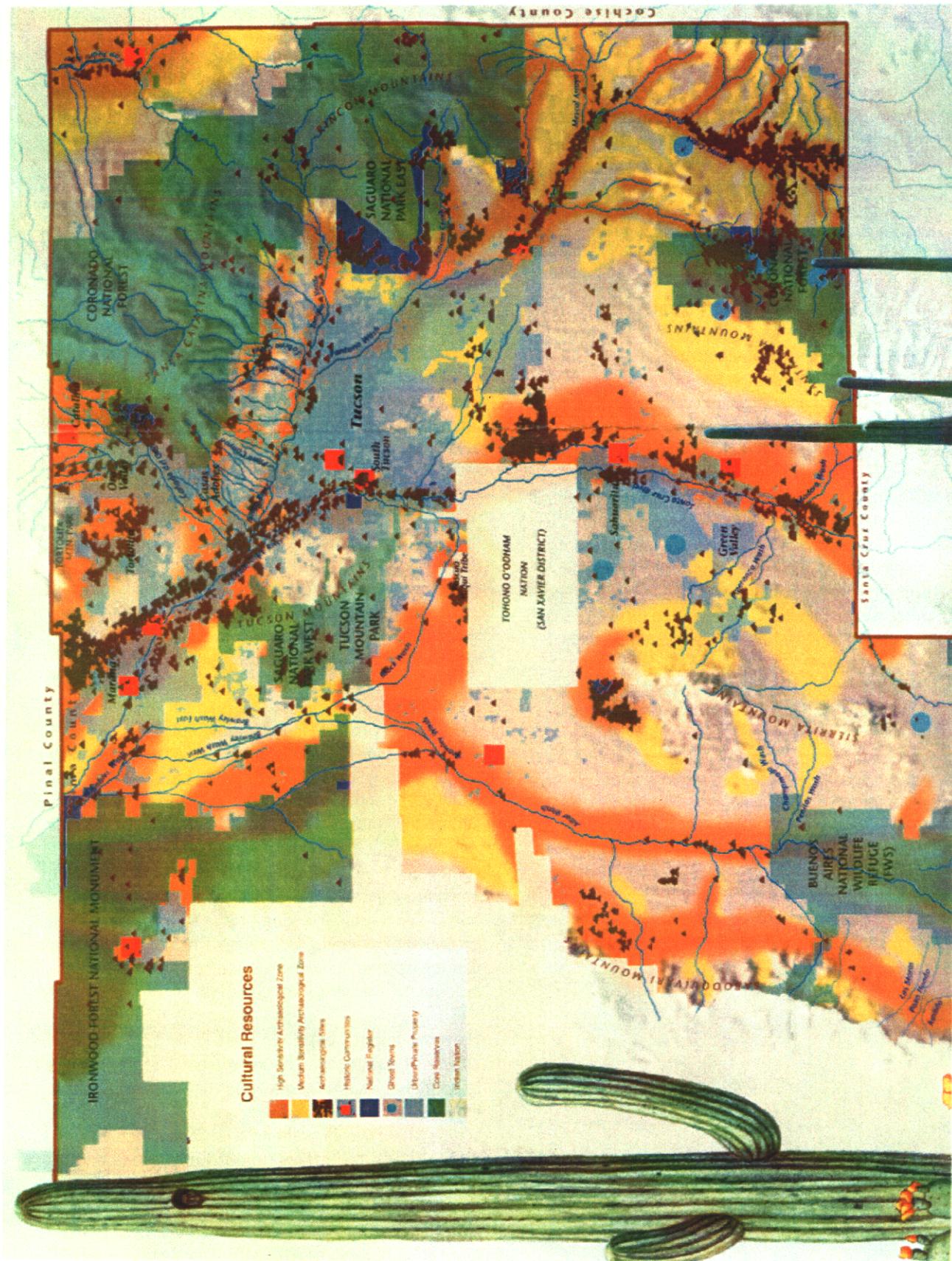
### How we learn about the past

Many cultural sites do not leave visible remains, but are important to traditional peoples. Such sites might be a mountain peak with religious significance, a site where certain plants were traditionally collected, or a water source. It is often difficult to learn about these sites as the information about them is supposed to be kept secret, revealed only to members of the group that values them.

Information from the distant past comes entirely from excavation of sites, usually with scanty remains. Before the days of modern technology people had to live relatively close to dependable sources of surface water - springs and streams. The farming cultures chose flat lands that could be farmed and certain hillsides where they could



Laws that protect sites such as this are often difficult to enforce. Vandalism and theft are serious threats to many kinds of sites especially in remote areas.



**Historical and Archaeological Sites in Eastern Pima County.**  
 Areas of high sensitivity are in brown, areas of moderate sensitivity in yellow.  
 Major sites are indicated by triangles.

capture runoff from the monsoon rains. The geology of an area gives valuable clues to where people probably lived in the past. Some sites are discovered because archaeologists look in those places where sites are likely. A recent study of the Cienega Creek area, for example, revealed many hitherto unknown sites. Many sites, however, are only discovered when some kind of project, such as road widening, reveals new sites. In those situations, archaeologists generally have a relatively short period of time to excavate and study the site before it the building project is completed. In other situations, such as a Hohokam site near Sabino Canyon, excavation and study is ongoing for many years, so the information is more complete.

Some government agencies survey their lands for archaeological sites and have quite a bit of information for their areas. Private lands are generally not surveyed unless some major project is planned and surveys must be done. When sites are found, they are generally reported to the Arizona State Museum which maintains records for the area. Some federal agencies have not reported their finds to the State Museum, so there are some areas which have been studied but are not well-known outside the agency. Fig. 1 shows which areas have been surveyed and where the reported sites are located. It is clear that there are many more sites remaining to be discovered. The State Museum generally does not reveal exact locations of sites for the public to avoid vandalism problems.

For more recent history, information comes from archaeological sites and from written information such as journals and diaries, maps, photos, and oral history. The Arizona Historical Society is a major source of much useful information. Enough is known to give a general picture of the distant past, but many sites remain to be discovered and studied while others were irrevocably destroyed.

### Prehistoric and Historic Sites in Pima County

Archaeological sites make up the bulk of cultural resources throughout the county. This reflects both the history of land use and the choices that archaeologists must make when doing research. Most sites are found near water because of the need for access to water for drinking and cleaning and access to both water and fertile

*"A cultural landscape is a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values." Birnbaum 1984.*

soils for farming. People especially used the mouths of canyons where tributary washes enter the floodplain and upper bajadas near the mountains especially near springs and seeps. In some upland areas with the right kinds of rock formations, rock art and remains of hunting and gathering cultures can be found. Historic land use patterns were very similar until new technology made new water sources accessible. Mining sites are, of course, located near potential ore bodies and where wood for fuel and water could be found.

### Protecting the Sites

Resources are most protected on federal lands because of legal mandates to manage cultural resources. Federal agencies must prepare management plans and policies that address impacts of development as well as inventory and evaluate cultural resources on their lands. State law only moderately protects resources on state lands and state agencies do not have the same mandate or resources to protect the land and enforce the laws as do the federal agencies. The major exception to this is that some State Parks are mandated to protect specific historical resources. There are no historical state parks in Pima County, but in nearby Santa Cruz County the Tubac State Park preserves an important historical resource along the Santa Cruz River

Pima County has legal mandates to protect cultural resources in advance of its own public works projects. The county has not inventoried its own land holdings, especially parks, so the full extent of the resources on county lands is unknown

Cultural resources on private lands are even less protected. The only state law that applies affects only unmarked human graves and associated grave goods. Discoveries of graves must be reported to the Arizona State Museum which is responsible for authorizing further excavation. The law is difficult to enforce and other parts of the site may be destroyed. The county does have the authority to place requirements on dealing with archaeological remains on private property when the development authorized through the development review process for subdivisions. Unregulated development is not covered by this

The City of Tucson, has a historic zone ordinance that restricts changes to properties within the zones so that the historic character is not affected. Oro Valley has a cultural resources preservation ordinance that requires investigations tied to the development review and approval process in advance of major land

Cultural Resources and Threats to Those Resources		
Subarea	Resource Level	Threat Level
Middle Santa Cruz	Low	High
Upper Santa Cruz	Moderate	High
Tortolita	Moderate	High
Cienega-Rincon	High	Moderate
Altar Valley	High	Low
Avra Valley	Moderate	High
San Pedro	High	Low
Western Pima County	High	Low

clearing . Marana does not have an ordinance, but stipulates investigations on a case by case basis. In a recent case, for example, Marana required the developer to sponsor a quick archaeological survey and to reserve four acres of the site as a park. Sahuarita has no historic preservation requirements.

Protecting sites of cultural significance where there are no physical remains such as structures is even more difficult, since these sites are often known to only a few people and are difficult to identify. There are a number of such sites on the Tohono O'odham Nation.

### **The Major Threats to Preservation**

Because prime sites were occupied by successive people over the centuries, some sites are highly disturbed, especially those in the urban area where structures and roads are built where people lived in past times Mining,

ranching and agriculture have caused major disturbances to sites, but urbanization is the main threat to preservation today.

### **Opportunities for Preservation**

Inventories of areas with high potential for archaeological and historic sites on county or private land and identification of those areas where important sites are located can provide a basis for determining which areas should be protected. Some sites already known to have high value could be acquired with public or private funds and, where applicable, could be used for public education purposes.

## **How Land is Used in Pima County**

People use land in many ways in Pima County. The private land uses range from very low density ranch land to high density and commercial uses in the urban core. The Middle Santa Cruz and Tortolita subareas are the most urban subareas, although they have rural sections. Altar Valley, Avra Valley, Middle San Pedro and Western Pima County are predominantly rural. The Upper Santa Cruz and Cienega-Rincon have a mix of urban and rural uses, with urban uses increasing. Land uses constantly change as the population increases.

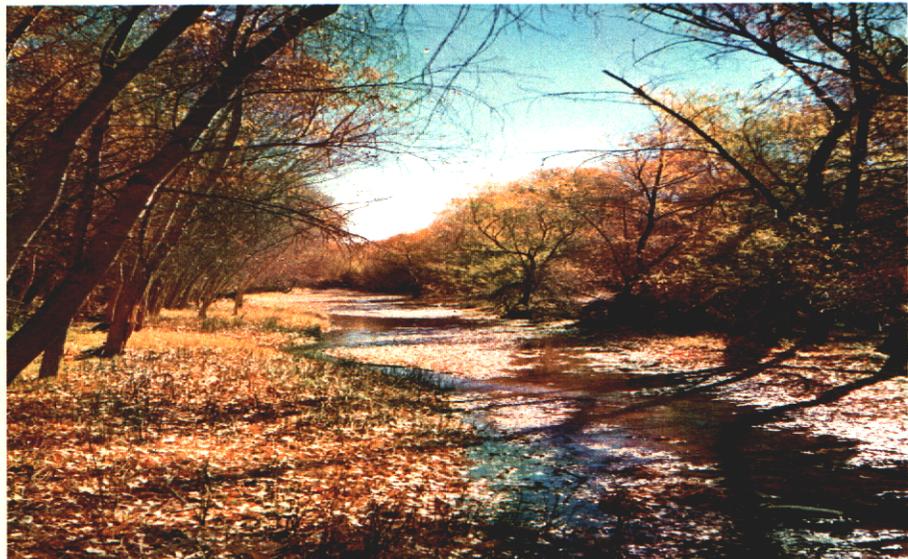
All the subareas have significant portions under public land ownership and used for habitat preservation, open space and grazing. Western Pima County has the highest amount of public land in Pima County.

### **Public Lands**

Land is managed by various governmental entities at the federal, state, and local levels, as shown on the graph. The various entities have different missions and responsibilities. The Bureau of Land Management (BLM) and the U.S. Forest Service (USFS) both have mandates to operate their lands for multiple uses, including watershed protection, grazing, mining, wood cutting, recreation, and habitat preservation. Congress has declared portions of the BLM and USFS lands as wilderness which are operated under more restrictive regulations to maintain the wilderness quality. BLM also operates some congressionally designated areas which have specific mandates to

protect certain values (e.g., the San Pedro Riparian National Conservation Area). The U.S. Fish and Wildlife Service (USFWS) manages lands to protect designated species and their habitats, although other uses such as recreation may be permitted on USFWS preserves if they are compatible with the protection mandate. The National Park Service (NPS) has a mandate to protect specific scenic or wildlife values and to provide means for public access to the areas where appropriate. NPS lands include National Parks (e.g., Saguaro National Park) and National Monuments (e.g., Organ Pipe National Monument). The Department of Defense (DOD) manages land for its value in military training and related uses. Much of the DOD land in Pima County and adjacent counties also Goldwater Bombing Range).

The Arizona State Land Department is mandated to



**Population of Incorporated and Unincorporated Areas and the Tohono O'odham Nation**

operate State Trust Land in a way that maximizes benefits to certain funds, especially education. State Trust Land is managed for multiple use and may be leased and sold under certain conditions. It may not, however, be traded for conservation or other purposes, except to other government agencies. Arizona State Parks manages land to preserve certain specific historic or wildlife values and for recreation. (e.g., Kartchner Caverns State Park).

Pima County and some of the cities also own land for recreation, scenic, flood control, or habitat values. The City of Tucson, for example, owns a large ranch in the San Pedro Subarea to preserve the open space values.

### Preserves

Pima County contains a wealth of beautiful scenery, plants and animals unique to the region, and a wide variety of life zones from very low desert to high mountains. There are some species such as the Organ Pipe Cactus for example, that are only found in the Sonoran Desert and nowhere else in the world.

Over the years, people have worked to preserve the most important places in Pima County for a variety of reasons. Ownership of these lands ranges from the federal government, to local governments, and private nonprofit groups. The reasons for establishing preserves have changed over time as people understood more about the environment and what both people and other species need to live here. At first the preserves were established largely for recreational value (including hunting and fishing) and to preserve water sources. Later the value of preserving scenic areas and promoting tourism became important.

Today we are motivated by all those reasons and new ones including the importance of riparian areas not only to wildlife, but to reducing flood damage and promoting recharge of groundwater. Some species are approaching extinction and others are so reduced in numbers that we may no longer see them in this area. We have also come to understand the importance of saving entire ecosystems,

such as the ironwood forests, and connecting preserved areas so that wildlife can move between them, rather than just maintain isolated areas for their scenic value. Scientific knowledge of species and their needs has increased enormously in recent years to the point that we can now begin to develop effective plans for conserving habitats to protect a range of values and species.

### Existing federal and state natural preserves

There are a variety of natural preserves in Pima County, some operated by the federal government, some by the state and some by local government.

The Coronado National Forest was the first federal preserve in the area. It was established to protect the watershed from overgrazing and excess timber harvesting. It is operated under federal laws as a multiple use area where grazing, mining, some commercial uses, hunting, recreation, and woodcutting are allowed under controlled conditions. The headwaters of almost all our watercourses are on National Forest land and are to a large extent protected there. Some of these lands still have overgrazing problems and are open to mining activities under the 1872 mining law. In parts of them excessive recreation has caused problems. Most of the National Forest land is at the higher elevations, but the forests extend down to the Saguaro-Palo Verde communities in some areas such as the foothills of the Catalina Mountains. There are two National Forest wilderness areas in eastern Pima County.

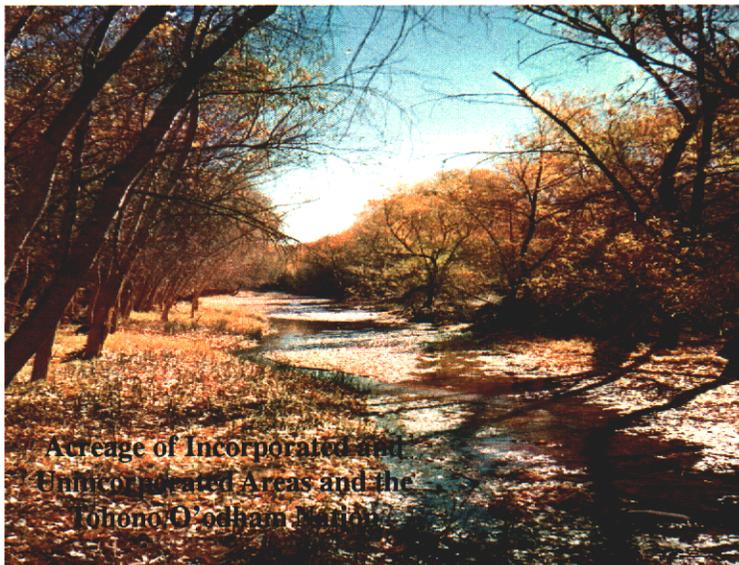
The Saguaro National Park and Organ Pipe National Monument are operated by the National Park Service to preserve the natural landscape and wildlife and to provide recreation. These are entirely in Sonoran Desert habitat.

The Ironwood National Monument is the newest federal preserve in Pima County. President Clinton declared it a National Monument in June 2000. It will be managed to protect the ironwood community and a number of sensitive species and their habitats. This area includes several regions proposed as Pima County Mountain Parks in the first Sonoran Desert Conservation Plan documents. It includes parts of Pinal County and provides a broad expanse of protected habitat while allowing continued grazing, but not new mining.

The Buenos Aires Wildlife Refuge, in the grasslands of the Altar Valley, is operated to protect certain threatened and endangered species and also for recreation. This preserve includes an important cienega at Arivaca and Brown Canyon in the Baboquivari Mountains, a valuable riparian area.

The Bureau of Land Management manages thousands of acres of grassland and low desert, including two wilderness areas. Most of this land may be used for grazing, mining, and recreation, as well as habitat protection.

Catalina State Park is managed by the



state for its recreational potential as well as to protect the habitat along the Canada del Oro and up into foothills of the Catalina Mountains.

### Existing County Preserves

Pima County operates five natural preserves: Tucson Mountain Park, Tortolita Mountain Park, Colossal Cave Mountain Park, Cienega Creek Natural Preserve, and Bingham Cienega Natural Preserve.

Tucson Mountain Park is the oldest county preserve, dating back to 1929. It was set aside to keep the views of the Tucson Mountains natural and prevent piecemeal development of the area by homesteaders. Eventual expansions and development of the West Unit of Saguaro National Park mean that a large continuous protected land area preserves most of the Tucson Mountains for recreation as well as protection of plants and wildlife. The park also contains historic sites, rock art, and traditional O’odham cultural sites.

The Tortolita Mountain Park is much more recent. It was established to protect a portion of the Tortolita Mountains in 1986. This area, too, is rich in archaeological sites, including a large “Indian Town” site.

Colossal Cave Mountain Park includes a large natural cave as well as important vegetative and animal communities. At least 13 prehistoric sites are located in this 2,038 acre preserve.

The Cienega Creek Natural Preserve includes one of the few perennial riparian areas at a low elevation in the county. It contains valuable riparian habitat, and also provides recreational opportunities. The area has a long history going back to prehistoric times. The Pima County Flood Control District bought this 3,979 acre preserve for flood protection purposes, in the belief that preserving the natural floodplain would greatly reduce flood damage downstream. Pima County Flood Control District also bought the Bingham Cienega, on the middle San Pedro River, for the same reasons. This is another valuable

riparian area with historic significance.

### Major Gaps in Preservation

These preserves all play important roles in protecting wildlife and historic values, enhancing flood protection and recharge, and in providing recreation. They are, however, piecemeal approaches and do not take into account some very important gaps in the network. They do not protect the remaining riparian areas from threats such as loss of the water supply. Working towards a more coordinated preserve system would also enhance recreational opportunities for people and increase tourism.

### Proposed Enhancement of Existing Preserves

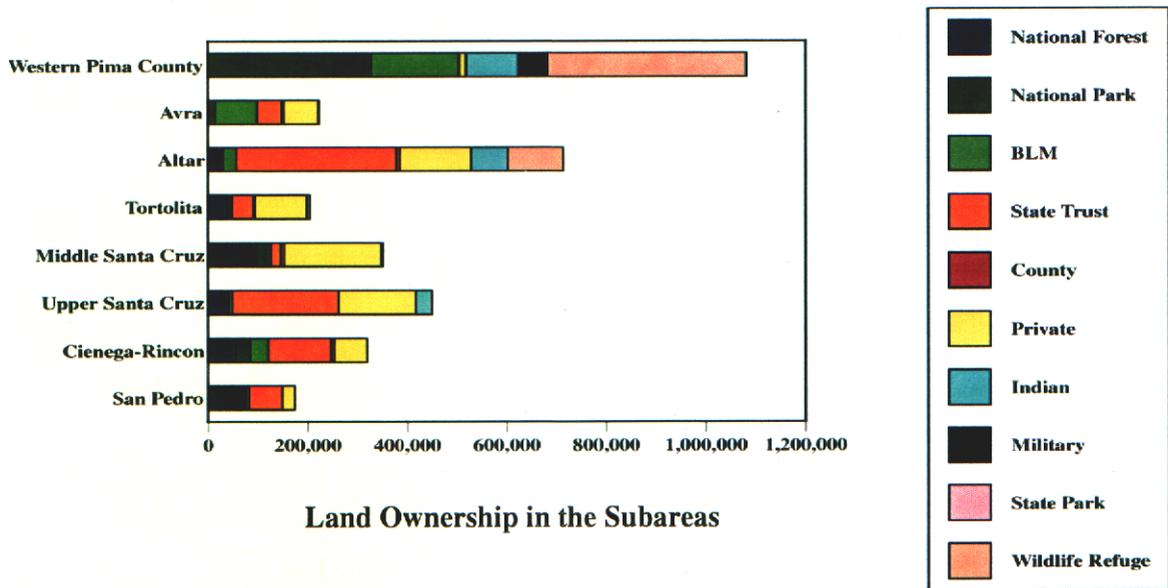
The existing preserves could be enhanced relatively easily to help fill some of those gaps and make the system more unified. These projects are described more fully in Chapter VI. In summary, expansion is proposed for the Tucson Mountain Park, Colossal Cave Mountain Park, and Tortolita Mountain Park. In addition the county proposes to buy land adjacent to Catalina State Park to help connect that area with the Tortolita Mountains.

Work to assure water supplies for the Cienega Creek Natural Preserve includes some extensions to the county land and protected status for other lands in the watershed including Davidson Canyon. Similar plans are proposed for Buehmann-Bingham Natural Preserve which would expand and connect these two preserves in the San Pedro subarea.

New preserves are proposed in the northeastern side of the Santa Rita Mountains (Empire Mountain Park) and the Cerro Colorado Mountains in the Altar Valley.

### Proposed Corridors between Preserves

Most of the preserves are separated from other preserved areas by roads and urban development. While birds and bats are able to fly between preserved areas, most mammals, lizards and other creatures can not do so.



### **Some Voluntary Land Preservation Measures Conservation Easements and Deed Restrictions**

Voluntary methods whereby individuals may protect part of all of their land for conservation purposes. A conservation easement is legally binding on present and future owners and places conditions on use of the land. The individual still owns the land, but for example, may not subdivide it. A deed restriction similarly is legally binding and may be used to limit types and numbers of buildings, ability to have pets, etc. Ideally, such agreements can have advantages for tax and state valuation purposes.

**Mitigation Banking.** A method whereby a developer may provide funds to purchase land for conservation purposes in exchange for being allowed to do some construction in an area where it may be limited because of endangered species or need to protect habitat.

**Transfer of Development Rights.** A program whereby a builder can transfer development rights from a sending area, such as a sensitive area desired for wildlife habitat to a receiving area where higher intensity development is appropriate.

They are effectively trapped within a prescribed area and take the risk of being run over if they venture beyond their small territory. In many cases, a part of their traditional territory has been eliminated. Bighorn sheep, for example, used to graze in the winter where Oro Valley is today. Scientists are not certain why the Pusch Ridge herd is in serious trouble, but loss of an important grazing area is certainly a major factor. Mountain lions require very large territories for hunting. If they are to reproduce successfully, they and their potential mates must be able to roam over a large area.

Until recently a continuous wildlife corridor extended from the Tucson Mountains to Sentinel Peak and the Santa Cruz River. Development in the Starr Pass area and east of there has decreased the corridor value of this area, although the Starr Pass plan calls for washes to be left somewhat natural to serve this function.

Riparian areas have always served as corridors for many species. These areas offer food, shelter, and places for nesting. Watercourses can serve as relatively safe places for travel, especially when bridges cross them and the animals can remain in the watercourse rather than venture onto the road. It is still possible for wildlife to move along the Rillito and Santa Cruz Rivers, for example, although today this is mostly true for smaller creatures. When watercourses are paved and have little or no vegetation, their value as corridors decreases drastically.

The Conservation Plan calls for some riparian areas to be left natural with native vegetation to help animals migrate safely. This has the added benefit of promoting recharge of groundwater and reducing downstream flood potential.

### **Historic and Cultural Preservation**

Preservation of historical remains has not generally been a high priority in Pima County. Many historic sites were destroyed as the community grew, especially sites in the downtown Tucson area. The Convento, a large Spanish period building and major landmark on the west side of the river gradually fell into ruins at the beginning of the Anglo period.

In recent years we have come to realize the value of historic and cultural sites and the importance of gathering knowledge about our history and preserving major sites. Proposed historic preservation projects are discussed in Chapter VI.

An interesting relationship exists between the historic sites and the sites of environmental concern. Since people had to live and farm near sources of surface water before the development of modern technology, many of the important sites are in the same areas that are important to preserve for environmental reasons.

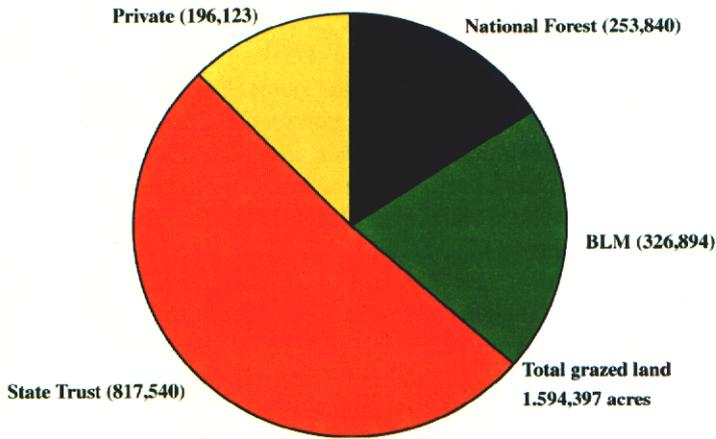
The City of Tucson has major plans for historic preservation combined with riparian enhancement in the Rio Nuevo Project, planned for a corridor along the river through downtown Tucson.

In the past the process has been piecemeal, with no overall vision for the entire area. In the Sonoran Desert Conservation Plan the community has the opportunity to devise an strategy to preserve land and resources that need to be preserved and fit that concept into an overall strategy for making Pima County more livable for wildlife and people and using our financial resources to the best advantage. We have an opportunity to develop a preserve system that will meet requirements of federal laws and be flexible enough to adjust over time as even better scientific information comes available. And such a preserve system can be designed to preserve both environmental and historic values.

### **Uses of Private Land**

#### **Land Use Planning and Zoning**

All private land is either under the jurisdiction of incorporated cities and towns or of Pima County. State law requires that cities and counties do land use planning and have zoning codes. The cities and towns have somewhat more latitude than the county in how they conduct their planning and zoning activities. The county has a citizen Planning and Zoning Commission which makes recommendations to the Board of Supervisors on rezoning matters as well as planning. Tucson, on the other hand, has a citizen commission for planning, but rezoning recommendations are made by staff. State law sets basic requirements for how rezonings must be conducted, including minimum rules for notification of neighbors about proposed changes. Final decisions are made by elected officials in all cases, although citizens have the right to



### Ownership of Grazed Land in Pima County

challenge those decisions through the referendum process.

Each jurisdiction has a basic zoning code that provides areas where different types and densities of uses can occur. While there are differences among the cities and the county, they all contain a low density rural category, increasingly dense residential categories from one house per acre to multifamily and mobile home park zones. There are also categories for small commercial to heavy industrial uses. The figures below show existing land use and zoning on vacant land in unincorporated Pima County. A similar graph for the City of Tucson would show a much lower percentage of vacant and low-density land and much higher commercial and residential percentages.

In general, it is legally more acceptable to rezone land to a higher use than to rezone it to a lower use. Once land has been zoned to a specific category, the landowner is considered to have rights to develop at least part of that land to the designated use, unless there is some clear threat to public health and safety from doing so. The government may set requirements to set aside part of the land to protect a watercourse, for example, or may limit construction on a slope. But if the government denies total use of the land without demonstrating an overwhelming public need to do so, the courts consider that a "taking" and the landowner must be compensated at fair market value. In many cases, the rezoning is only good for a certain time period and if the land is not used by the end of the time period, the zoning may revert to its previous designation. The government does not have to rezone for a more dense land use so the landowner can make a profit.

### Comprehensive Planning

A comprehensive plan sets out policies and guidelines for land use but does not establish zoning for the land. Pima County's Comprehensive Plan designates areas that should be preserved as open space and other areas that should be used in specific ways, such as low or high density residential. If a landowner requests a rezoning that is contrary to the policies in the plan, the elected officials not only vote on the rezoning but on amendments to the plan.

### Conservation-Related Ordinances

Marana, Oro Valley, Tucson, and Pima County have ordinances designed to protect landowners from flood damage and to protect certain aesthetic and conservation values. They all have some type of flood management ordinance, as required by state law. They regulate what may be built in the floodplain and under what conditions and what can and must be done to watercourses for public safety. In addition, Pima County and Tucson have ordinances to protect riparian areas. All four jurisdictions have some type of native plant preservation ordinance. Other local ordinances deal with construction on slopes, preserving selected peaks and ridges, leaving low-density

buffers around public lands, and cluster zoning ordinances which allow for higher densities on part of a property in exchange for leaving another part as open space.

### Land Use Patterns

The subareas all have very different characteristics and within most of the subareas are very different uses of private land. These are described in Chapter IV. Generally, urban uses are mainly concentrated in the Tucson metropolitan area and areas adjacent to it in the foothills and northwest to Marana and Oro Valley. The highest land use densities are in the urban core, the Green Valley area, and on the northwest side. Medium urban densities are found in the Tucson Mountain and Catalina Mountain foothills. Very low densities are primarily in the outlying areas. Industrial use is concentrated around the Tucson International Airport and a corridor along I-10. Commercial uses are scattered through the urban area with concentrations along some of the major transportation route.

Growth patterns have changed over the years. Up until the 1960s the metropolitan area was concentrated near the downtown area and spread out gradually to the north and east. After that time growth began to move toward the east side of town and into the foothills. Over the past ten years the northwest side has been the most rapidly growing area. At the present time the southeast side and the area around Sahuarita are expecting rapid growth since growth has slowed on the northwest because of restrictions related to pygmy-owl habitat.

### Ranching

Ranching is the predominant land use in the outlying subareas, except for Western Pima County. It is also a significant land use on the Tohono O'odham Nation. Approximately 1.6 million acres are used for ranching or agriculture in Pima County. Historically, ranching was more significant in the currently urban subareas. Ranching occurs on a combination of private land, leased state land, and federal land managed by BLM and USFS under a permit system.

Historically, overgrazing played a major role in depleting the land of native grasses and in damaging riparian areas. In recent years grazing practices have improved greatly, partly through new rules for grazing on federal lands and partly through a growing awareness on the part of ranchers of the need to manage grazing for long term land preservation. A hot topic for debate among grazing and anti-grazing spokesmen is whether or not grazing should be allowed on public lands, how much should be charged for grazing, and whether restrictions should be placed on grazing in riparian areas to protect those areas and species dependent on them. In rehabilitating Cienega Creek and Bingham Cienega, Pima County removed grazing from the riparian area by fencing off the areas. This the experts considered necessary to stream renewal. Grazing is not allowed in the National Parks or in most Monuments in order to protect the native species and recreation values. Grazing is allowed in the Ironwood National Monument.

Ranches, however, are some of the most preserved areas in Pima County. They serve to unify the integrity of vast tracts of connected open space and wildlife habitat. Because of its value as open space and its conservation potential for a wide range of wildlife, the Board of Supervisors identified ranch conservation as a conservation element of the SDCP. Ranch preservations helps define the urban boundary. Ranches that are managed well are priority areas for protecting native species and habitats. Ranching is uniquely capable of managing and maintaining the integrity of vast expanses of natural, unfragmented open space that may be owned by a variety of public and private entities.

The subareas with large acreages of State Trust Land near the urban area are the most endangered because that land may ultimately be sold for subdivisions or other uses. The State Trust Land is often interspersed with private land which forms the core of the ranch. Estate taxes may make it difficult for a new generation to inherit the ranch and increased prices for land are appealing.

Various ways exist to preserve ranches, including

outright purchase by government, conservation easements, and financial agreements coupled with incentives to maintain the land as good wildlife habitat. Developers may be able to participate in this process through mitigation banking designed to preserve habitat in certain areas while allowing other areas to be developed.

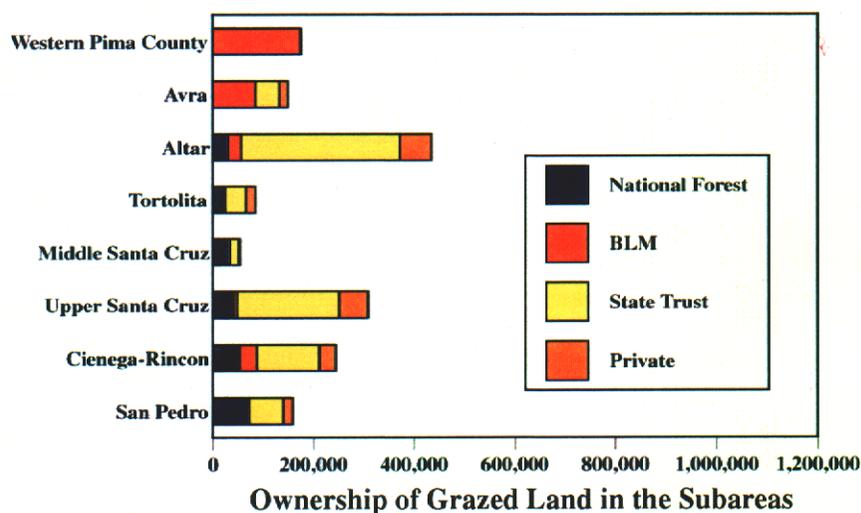
The subareas with the highest productivity or grazing capacity are the Empire-Rincon, Altar, Upper Santa Cruz, and San Pedro subareas and these are also the areas with the highest ranch conservation potential.

### Services and Infrastructure

Population growth of any type depends on provision of wastewater treatment facilities, water, garbage disposal, roads, schools, police and fire protection, power, telephones, mail service, parks and other amenities. These services are provided by a mixture of private and public entities. Generally speaking it is more cost-effective to provide facilities and services when people are concentrated in areas close to the core area than to provide them to people scattered in outlying areas. The sprawl pattern of growth is expensive to serve as pipelines, roads, etc. must extend through unoccupied areas to get to where they are wanted. It also takes longer for police officers to respond to calls in the outlying areas, for example, meaning that more staff are needed to serve the same number of people.

Tucson Water provides water to about three-fourths of the urban population both inside and outside city limits. Five other medium-sized and about a hundred other small water providers serve the rest of the people, both inside and outside the city; Many people, public agencies, and businesses have their own wells. Pima County provides wastewater service to most of the population except those who have their own septic systems. Both cities and counties provide garbage disposal, police protection and parks. Fire protection is by the cities and by fire districts outside city limits.

School districts have their own boundaries which do not coincide with other political boundaries. Phones and

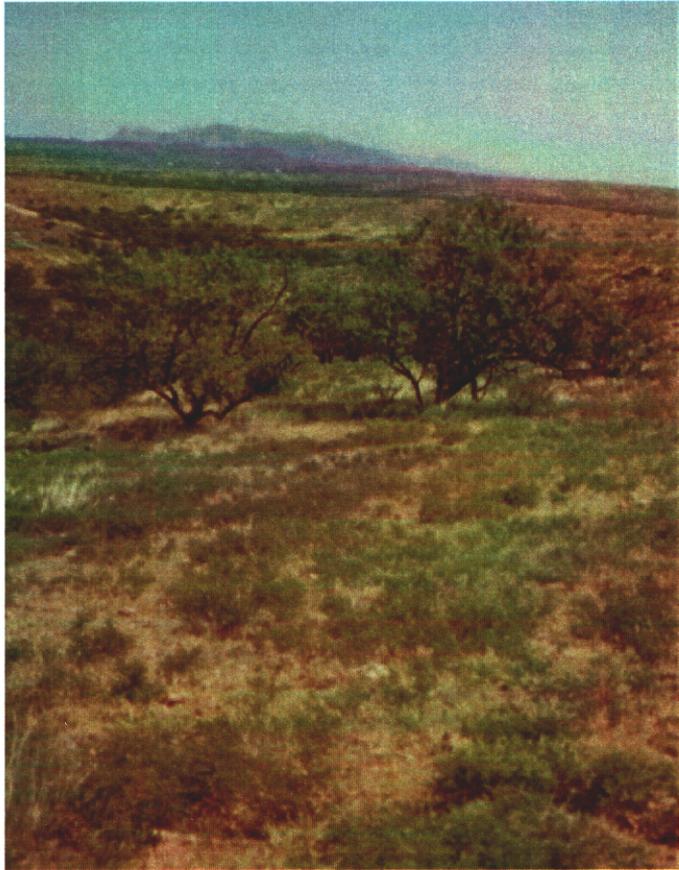


power are provided by public utilities. This mixture of responsibilities can make it difficult to provide services efficiently in rapidly growing areas or in areas far from the urban core.

Government entities can pay for infrastructure with taxes on the general population or through fees paid directly by those who benefit. The tax money is most often from people who live in the city or town, although in some cases the money comes from a larger tax base. An important source of funds for transportation is the federal Highway Fund which comes largely from a tax on gas. During the 1970s and 1980s the federal government paid for construction of wastewater facilities which now must be paid for locally. School construction is paid for through taxes on property within the school district and partly through funds from the State government.

How payment for infrastructure should be distributed is a major issue statewide. State law allows cities and counties to charge "impact fees" which are fees charged to homebuyers (usually through the developer). Pima County, for example, has for many years charged developers a fee for some new sewer lines. Tucson Water does the same thing for new water lines. Some people argue that the impact fees should cover more, or even all, the costs of new development, including schools and parks. Not doing so masks the real costs of growth. This is done in varying degrees in some other rapidly growing states. Others argue that this would increase the cost of housing and put home buying out of the reach of too many people.

"Wildcat" or "unregulated development" is residential housing that occurs in rural areas outside the regular zoning process. Developers putting in a number of homes must go through a process that includes requirements for sewers, roads, flood control, and other services. Individuals putting in their own or just a few homes do not have to go through the same process although they must still get a building permit. Individuals generally provide their own septic systems and often have their own wells. Approximately 1,525 to 2,300 permits are issued each year for this type of development. The cost may be low for the homebuyer and the county initially has to provide few services, but in the long run wildcat development is costly for the county. When a number of such homes appear, the county often finds that the homeowners begin to demand the kinds of services that people in subdivisions have - such as better roads or flood control. In the Three Points area, for example, total tax revenues to the county for the section were \$12,868, but the cost to the county of sheriff's calls alone were almost \$40,000 in 1998. In a more densely populated section of the Cienega-Rincon area near Pantano Wash, on the contrary, the tax revenue was \$172,296 while the cost of sheriff's calls was \$13,440. A final example comes from an area with fully regulated development



**A Scene on the Chilton Ranch in the Altar Valley**

where the tax revenues were \$1,032,397 and the cost of sheriff's calls was under \$50,000. The total deficit to the county of unregulated development is estimated to be between \$35 and \$55 million per year.

When costs are paid for through property taxes, inequities can develop, especially for school districts. The districts with an industrial base can collect more tax money than those with a predominantly residential base. The Springerville School District in northern Arizona, for example, includes a large power plant that provides power to Tucson and elsewhere. Power users far from the Springerville area help pay for schools in Springerville. The School District in Altar Valley, on the other hand, has a very low tax base, as most of the private land is taxed at the low ranching rate. The impact of a large development would be very different if it occurred in Springerville or in Arivaca

In designing the reserves, these cost considerations should be taken into account. Which areas that would have reserve potential would actually save the county money instead of the alternative of allowing continued regulated or unregulated development in the outlying areas? Where would land values be low enough to acquire a large amount of land for a relatively low price without significant loss of tax revenue?

## IV. PERSPECTIVES FROM VARIOUS PARTS OF THE COUNTY

This section looks at Pima County from the perspective of eight different geographic areas. Each of these areas is different from all the others in specific ways, but all the areas have some things in common. In this section the important characteristics of each area are described, including the wildlife habitat, watercourses, cultural resources, history, land uses, and some fiscal considerations. The major threats to each area are outlined, along with opportunities for preservation.

For convenience the county was divided into subareas, based on their watersheds. All of the subareas except Western Pima County and the Middle San Pedro are part of the larger Santa Cruz River watershed whose watercourses flow towards the Gila River.

The first two areas to be discussed form the eastern edge of the County and share some rural characteristics. Much of the land in these two areas is public land of some type. The San Pedro Subarea is the most remote one, on the northeastern side of the Catalina Mountains, accessible only by unpaved road. The Cienega Rincon Subarea, on the contrary has major roads running through it and is at the edge of a growing urban area.

The next three areas include most of the population of the county and have locations where population is expected to continue to expand and where the land is the most costly and from which most of the property taxes

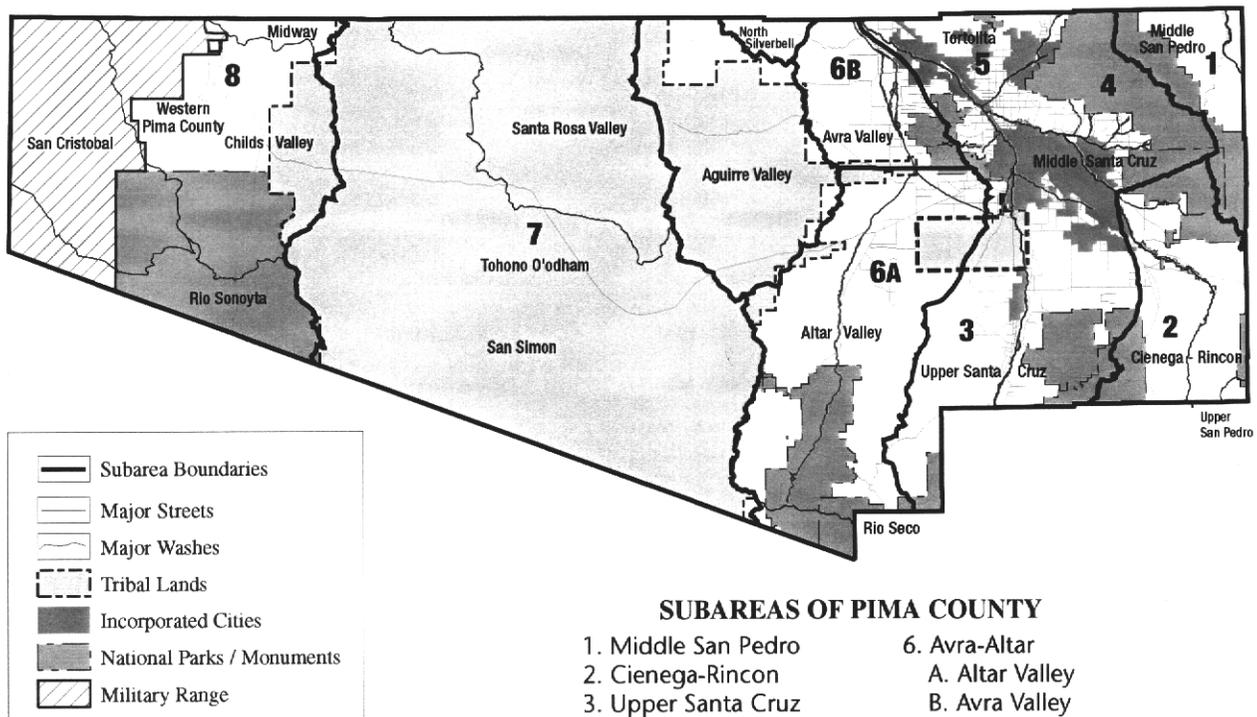
arise. The Upper Santa Cruz Subarea includes the growing areas of Green Valley and Sahuarita as well as the San Xavier District of the Tohono O'odham Nation. The Middle Santa Cruz Subarea includes Tucson and rapidly growing areas in the foothills. The Tortolita area includes Oro Valley and parts of Marana and in recent years has been the most rapidly growing part of the county.

To the west, the Altar Valley and Avra Valley subareas comprise the Brawley Wash watershed. This area has been traditionally used mainly for agriculture and ranching. Here the cost of land is lowest as well as the tax revenue to local government. The growth of Marana on the northern edge of this area is changing the character of that section.

The Tohono O'odham nation comprises the next subarea. This is the largest of the areas, but is not discussed separately in this book because it is outside the jurisdiction of Pima County. It, however, contains valuable wildlife habitat and a rich human history which are briefly discussed in other parts of this report.

The Western Pima County Subarea is almost entirely public land except for the area around Ajo and Why. Here tourism and mining have been the major land uses. It, too, has low land costs and tax revenue.

Finally, this section summarizes major concerns and opportunities common to several subareas.



## The Middle San Pedro Subarea

The Middle San Pedro subarea is very different from the other subareas. It is quite isolated from the rest of Pima County, has fewer people than any other subarea and no incorporated towns. Its only access road enters the area through Pinal and Cochise Counties with which it has more in common than it has with Pima County. Ranching is the primary use of private land and leased public land. It is rich in biological and historical resources of various kinds, many of which are protected by public land agencies, by the Nature Conservancy, and by a group of private landowners highly motivated to preserve the area.

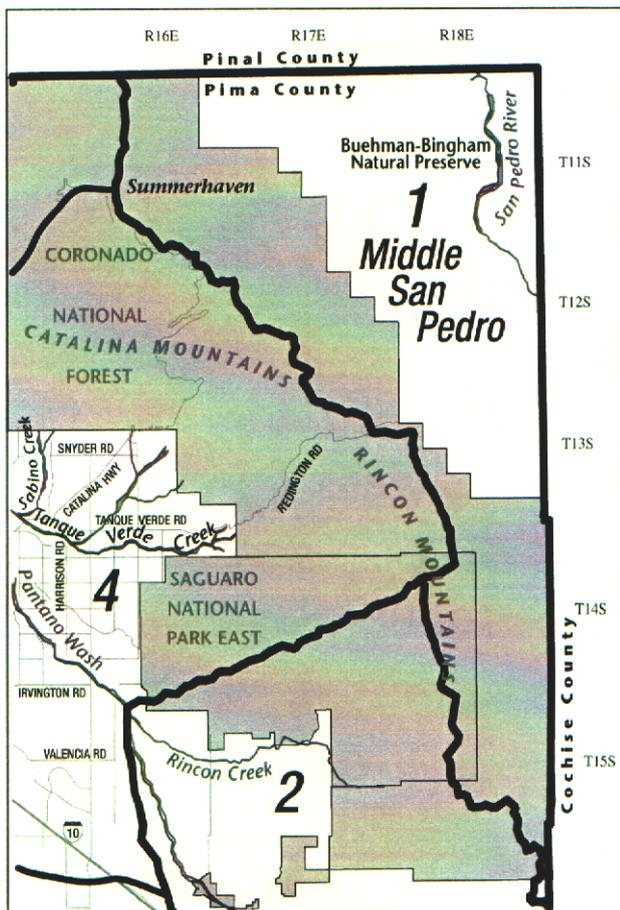


### Land Ownership in the Lower San Pedro Subarea (acres)

#### Description of the watershed

This subarea is in the extreme northeast of Pima County and includes the watershed for that portion of the San

Pedro River. The watershed for the upper part of the river begins in Mexico and includes the Huachuca Mountains and other sources in Cochise County. The Pima County portion of the watershed includes streams originating in the Catalina Mountains and the Galiuro Mountains, including 13.1 miles of perennial streams, 36.3 miles of intermittent streams and 2102 acres of suspected shallow groundwater.



The Middle San Pedro Subarea

#### Land uses and governmental jurisdictions

Most of the subarea is in public ownership except along the river where there are a series of ranches and farms. Redington is unincorporated and is the only community in the subarea. An unpaved road which is not maintained by the County traverses the area. The private land is all zoned rural ranch. Ranching is a major land use in this subarea, occurring on about 73,000 acres of federal land, 67,000 acres of State Trust Land and 18,600 acres of private land, or 91 percent of the total land area.

The full cash value of land in this subarea area is \$136 million with an average cash value per acre of \$782. County property taxes paid in 1998 were \$43,658, or \$.25 per acre.

#### Existing reserves

Most of the higher elevation of the subarea is in the Coronado National Forest which owns 47 percent of the subarea. The Nature Conservancy owns the 2,792 acre Buehmann Canyon Preserve which includes a perennial stream with high value for riparian vegetation and native fish.

The City of Tucson owns the Bellota Ranch which includes 6,800 acres of formerly private land and 34,200 acres of state land with grazing leases.

The San Pedro River Valley here is mostly owned by private landowners, except for the 285 acre Bingham Cienega Natural Preserve which is owned by Pima County. This reserve contains one of the few natural cienegas in Pima County and contains native species of plants and animals.

**Recreation areas**

The National Forest part of this subarea offers opportunities for hiking, wildlife viewing, camping, and picnicking.

**Historical resources**

This subarea has a very rich historic past, from early prehistoric and Anglo times, but the Spaniards did not settle this area. Only 3.3 percent of this subarea has been surveyed, but 153 sites have been found of which 105 were prehistoric and 19 were historic sites. There are one historic community, ten historic ranches, and four historic mines in the subarea.

**Biological resources**

The vegetation in this subarea includes Douglas-fir-mixed-conifer at the highest elevations, pine, oak and manzanita at the mid elevations and mixed grass, creosote, and cactus in the lower elevations with riparian vegetation such as cottonwood and willow along the watercourses.



Beaver were once so common along the San Pedro River that it was called "Beaver River." They have been reintroduced farther upstream. This subarea has possible reintroduction sites.

The subarea has seven species for whom habitat in Pima County is crucial for their existence, fourteen species that are declining throughout their range, two that are rare in Pima County, but may not be rare elsewhere, and five that are rare in Pima County but not at risk overall.

Almost 700 acres are within Critical Habitat for the cactus ferruginous pygmy-owl, including the riparian woodlands. Although the owls are not documented for the area today, they have been sighted there as recently as the

<b>Vulnerable Species in the Upper San Pedro Subarea</b>			
<b>Class 1</b>			
<i>Pipilo aberti</i>	Abert's towhee	<i>Strix occidentalis lucida</i>	Mexican spotted owl
<i>Aimophila carpalis</i>	Rufous-winged sparrow	<i>Rhinichthys osculus</i>	Speckled dace
<i>Melospiza melodia</i>	Song sparrow subspecies	<i>Catostomus insigna</i>	Sonora sucker
<i>Glaucidium brasilianum</i>	Cactus ferruginous	<i>Catostomus clarkii</i>	Desert sucker
<i>cactorum</i>	pygmy-owl	<i>Sonorella bagnari</i>	Bagnara's talussnail
<i>Gila intermedia</i>	Gila chub	<i>Lasiuris borealis</i>	Western red bat
<i>Sonorella sabionensis</i>		<i>Leptonycteris curasoae</i>	
<i>buehmanensis</i>	Buehmann Canyon talussnail	<i>yerbauenae</i>	Lesser long-nosed bat
<i>Muhlenbergia xerophila</i>	Sycamore Canyon muhly	<i>Allium gooddingii</i>	Goodding onion
<i>Coryphantha scheeri</i>		<i>Agave schottii</i> var. <i>treleasei</i>	Trelease Agave
var. <i>robustispina</i>	Pima pineapple cactus	<i>Terrapene ornata luteola</i>	Desert box turtle
<b>Class 2</b>			
<i>Rana yavapaiensis</i>	Lowland leopard frog	<b>Class 3</b>	
<i>Accipiter gentilis apache</i>	Apache Goshawk	<i>Falco peregrinus anatum</i>	American peregrine falcon
<i>Coccyzus americanus</i>	Western yellow-billed	<i>Idionycteris phyllotis</i>	Allen's big-eared bat
<i>occidentalis</i>	cuckoo	<b>Class 4</b>	
<i>Empidonax trailii extimus</i>	Southwestern willow	<i>Progne subis</i>	Purple martin
	flycatcher	<i>Buteo albonatus</i>	Zone-tailed hawk
<i>Vireo bellii</i>	Bell's vireo	<i>Asturina nitida</i>	Gray hawk
		<i>Choeronycteris mexicana</i>	Mexican long-tongued bat
		<i>Agosia chrysogaster</i>	Longfin Dace

late 1980s.

Fish and Wildlife Service is proposing Critical Habitat designation for 46 miles of the San Pedro and 14 miles of Redfield Canyon for the Spikedace and Loach minnow. Although these fish do not inhabit the area today, this is a likely type locality and possible restoration area.

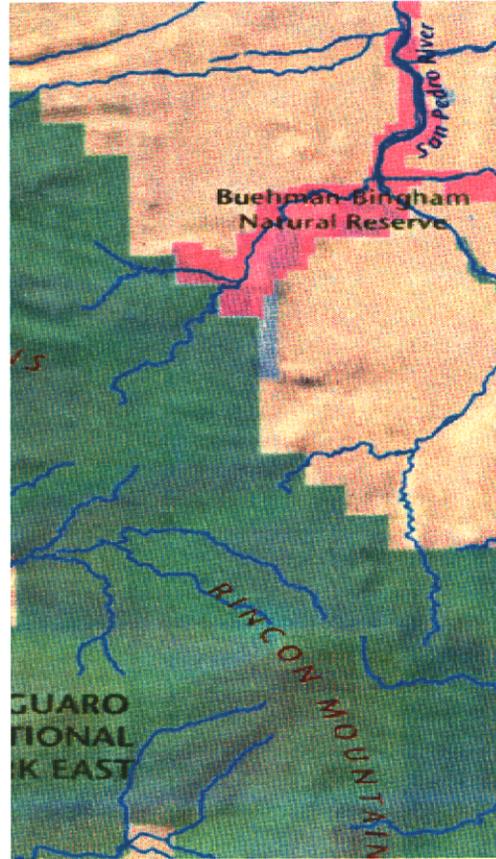
The major current threat to vulnerable species in this area comes from potential increases in exotic species - bullfrogs and nonnative fish. Potential future threats include loss of water sources from increased human use, disturbance from new mining, and loss of habitat if ranch land is converted to more urban uses.

This area has suitable habitat for beaver and could serve as an introduction site as beaver exist both upstream and downstream of the area (reintroduced into the San Pedro Riparian National Conservation Area in 1999).

The major opportunities for preservation are in connecting the existing reserves.

### Proposed reserves

Because this area is in such good condition and has so little private land facing population growth pressures, there is only one major recommendation for this subarea. The proposal is to expand and connect Pima County's Bingham Preserve and the Nature Conservancy's Buehmann Preserve. By doing this it would be possible to make sure the wildlife can move between the reserves to protect the water supply and the health of the watershed. This would also ensure coordinated management of the area in a way that could facilitate reintroduction of vulnerable species, reduction of exotic species, and reestablishment of beaver. The County would also work with local residents to discourage any damaging increase



### The Proposed Buehman-Bingham Reserve

of zoning densities that would threaten the lifestyles in the area. The county would also coordinate activities with the adjacent counties along the river upstream and downstream.



Beaver Dam at Bingham Cienega. Photo Arizona Nature Conservancy

## Cienega-Rincon Subarea

This subarea has a high percentage of protected lands along Cienega Creek in both Santa Cruz County and Pima County, although a major freeway runs through the subarea. It has, in Cienega Creek, one of the few perennial streams and shallow groundwater areas in Pima County. The eastern portion of the subarea on the outskirts of Tucson, however, is zoned for major population increase.

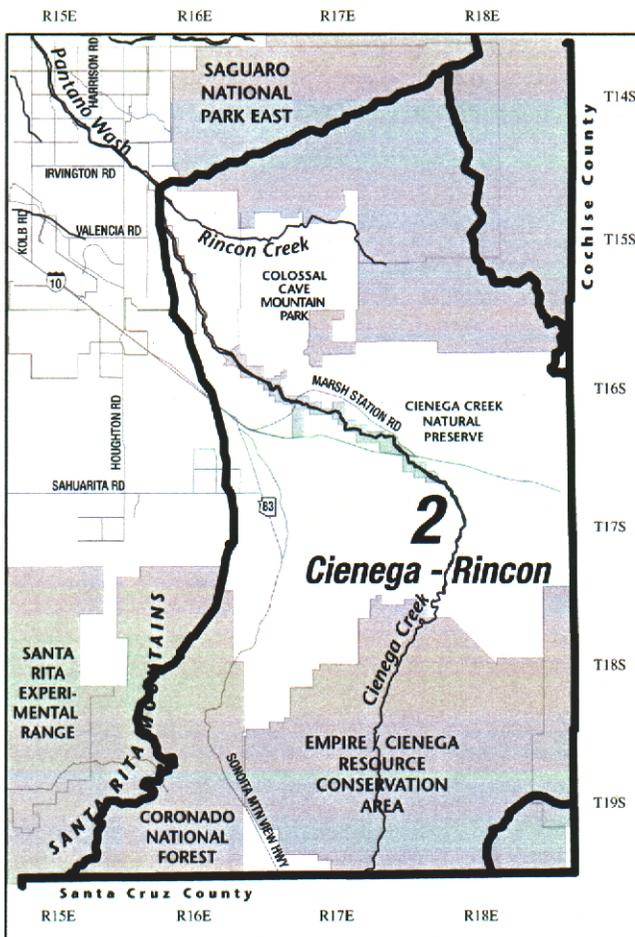
### Description of the watershed

This subarea occupies the southeastern portion of the county and includes important headwaters for Rillito Creek. Cienega Creek comes up from the south, becomes Pantano Wash, and later joins with Tanque Verde Creek to become the Rillito River in the Middle Santa Cruz subarea. It is perennial in stretches and intermittent in others. Another perennial stream, Rincon Creek, with headwaters in the Rincon Mountains, joins the wash at the edge of the subarea. There are 17.7 miles of perennial streams, 59.8



Land Ownership in the Cienega-Rincon Subarea (acres)

miles of intermittent streams and 8,325 acres of suspected shallow groundwater.



The Cienega-Rincon Subarea

### Land uses and governmental jurisdictions

More than half the area is publicly owned by the National Park Service, the Forest Service, Bureau of Land Management, State of Arizona, and Pima County. Some of the remainder is ranchland and the northwestern portion of the subarea privately owned as homes or for future development. The old Rocking K Ranch was rezoned in the 1980s to accommodate thousands of homes on the outskirts of the Saguaro National Park. This rezoning was one of the most acrimonious ones in Tucson's history. The City of Tucson extends into the subarea and the unincorporated town of Vail is along Pantano Wash within the subarea. This area has grown more slowly than anticipated when the IBM Corporation built a large facility in the area, but then left a few years later. Growth pressures are expected to increase in this area in the immediate future, as growth in the northwest side is slowed.

Ranching is a major land use in this subarea, occurring on about 88,000 acres of federal land, 124,000 acres of State Trust Land and 31,000 acres of private land, or 77 percent of the total land area.

The full cash value of land in this subarea area is \$454 million with an average cash value per acre of \$1,426. County property taxes paid in 1998 were \$1,645,633.8, or \$5.17 per acre.

### Existing Reserves

The upland areas are within the Coronado National

Forest. Much of the upstream area of Cienega Creek is part of the Empire-Cienega Resource Conservation Area, which is managed by the U.S. Bureau of Land Management. Pima County Flood Control District owns a perennial section of the creek as the Cienega Creek Natural Preserve. The northeastern part of the area is part of Saguaro National Park. Colossal Cave Mountain Park occupies part of the foothills portion of the area.

### Recreation areas

Many parts of this subarea are used for recreation. The National Forest portion offers opportunities for hiking, camping, hunting, picnicking, wildlife viewing, ORV use, and mountain bike and horseback riding. The National Park is a popular tourist destination for hiking, picnicking, wildlife viewing and sightseeing from the vehicle. The Cienega Creek Preserve is used for hiking and wildlife viewing as is the Empire--Cienega Area which is also available for camping. Colossal Cave is another popular tourist destination.

### Historical resources

This subarea, too, has an extensive prehistory and history. The Spaniards did not settle the area, but it was settled starting in early Anglo times. The Vail and Empire ranches extended over many acres of land. One fifth of the subarea has been surveyed and 554 sites were found.

Of these 423 were prehistoric and 53 were historic sites. There were also one historic community, three ghost towns, 38 historic ranches, 9 mines, and one historic trail. There are three sites and an archaeological district on the National Register.

### Biological resources

Vegetation in the subarea includes pine, oak and manzanita at the higher elevations, grasslands at the mid-elevations and saguaro-cactus, creosote and mixed scrub communities at the lower elevations. The riparian areas have riparian vegetation including sacaton grass and cottonwood-willow forest.

The subarea has eighteen species for whom habitat in Pima County is crucial for their existence, fifteen species that are declining throughout their range, five that are rare in Pima County, but may not be rare elsewhere, and seven that are rare in Pima County but not at risk overall.

Caves in the area are crucial to two species of bats. There are obscure, only partially studied, limestone caves in the area with species endemic to the area. Finally, some of the perennial and intermittent streams are home to threatened and endangered native fish and leopard frogs. The lowland leopard frog is currently proposed for listing.

The major threats to vulnerable species in this subarea are loss of habitat, exotic species, loss of water supply, and urbanization generally. Loss of water supply is especially

### Vulnerable Species in the Cienega-Rincon Subarea

#### Class 1

<i>Rana chiricahuensis</i>	Chiricahua leopard	<i>Charadrius montanus</i>	Mountain plover
frog	<i>Pipilo aberti</i>	<i>Vireo bellii</i>	Bell's vireo
Abert's towhee	<i>Aimophila carpalis</i>	<i>Strix occidentalis lucida</i>	Mexican spotted owl
Rufous-winged sparrow	<i>Melospiza melodia</i>	<i>Leptonycteris curasoae</i>	
Song sparrow subspecies	<i>Glaucidium brasilianum</i>	<i>yerbauena</i>	Lesser long-nosed bat
Cactus ferruginous		<i>Peromyscus merriami</i>	Merriam's mouse
pygmy-owl	<i>Poeciliopsis occidentalis</i>	<i>Lasiurus borealis</i>	Western red bat
<i>occidentalis</i>	Gila topminnow	<i>Plecotus townsendii</i>	Pale Townsend's
<i>Gila intermedia</i>	Gila chub		big-eared bat
<i>Alborix anophthalmus</i>	pseudoscorpion	<i>Echinomastus erectocentrus</i>	
<i>Sonorella imperatrix</i>	Empire talussnail	var. <i>erectocentrus</i>	Needle-spined pineapple cactus
<i>Sonorella rinconensis</i>	Rincon talussnail	<i>Terrapene ornata luteola</i>	Desert box turtle
<i>Sonorella imperialis</i>	Imperial talussnail	<i>Thamnopsis eques megalops</i>	Mexican garter snake
<i>Rothschildia cincta cincta</i>	Cincta silkworm	<b>Class 3</b>	
<i>Sonorella magdalensis</i>	Magdalena talussnail	<i>Falco peregrinus anatum</i>	American peregrine falcon
<i>Amoreuxia gonzalezii</i>	Saiya	<i>Idionycteris phyllotis</i>	Allen's big-eared bat
<i>Muhlenbergia dubioides</i>	Box Canyon muhly	<i>Lupinus huachucanus</i>	Huachuca mountain lupine
<i>Lilaeopsis schaffneriana</i>		<i>Pectus imberbis</i>	Beardless cinchweed
<i>ssp. recurva</i>	Huachuca water umbel	<i>Carex ultra</i>	Arizona giant sedge
<i>Muhlenbergia xerophila</i>	Sycamore Canyon muhly	<i>Arabis tricomuta</i>	Chiricahua rock cress
<b>Class 2</b>		<b>Class 4</b>	
<i>Rana yavapaiensis</i>	Lowland leopard frog	<i>Trogon elegans</i>	Elegant trogon
<i>Accipiter gentilis apache</i>	Apache Goshawk	<i>Progne subis</i>	Purple martin
<i>Coccyzus americanus</i>		<i>Asturina nitida</i>	Gray hawk
<i>occidentalis</i>	Western yellow-billed cuckoo	<i>Elaphe triapsis intermedia</i>	Western green rat snake
<i>Buteo swainsoni</i>	Swainson's hawk	<i>Agosia chrysogaster</i>	Longfin Dace
<i>Empidonax trailii extimus</i>	Southwestern willow	<i>Macrotus californicus</i>	California leaf-nosebat
	flycatcher	<i>Choeronycteris mexicana</i>	Mexican long-tongue bat

a threat to the caves and to Cienega and Rincon Creeks. Increases in sand and gravel mining to provide construction materials for nearby construction would affect Rincon Creek and Pantano Wash.

The major opportunities for preservation revolve around preservation of the remaining part of the Cienega Creek watershed, as proposed below, including reintroduction of native fish and control of the nonnative bullfrogs.

**Proposed Reserves**

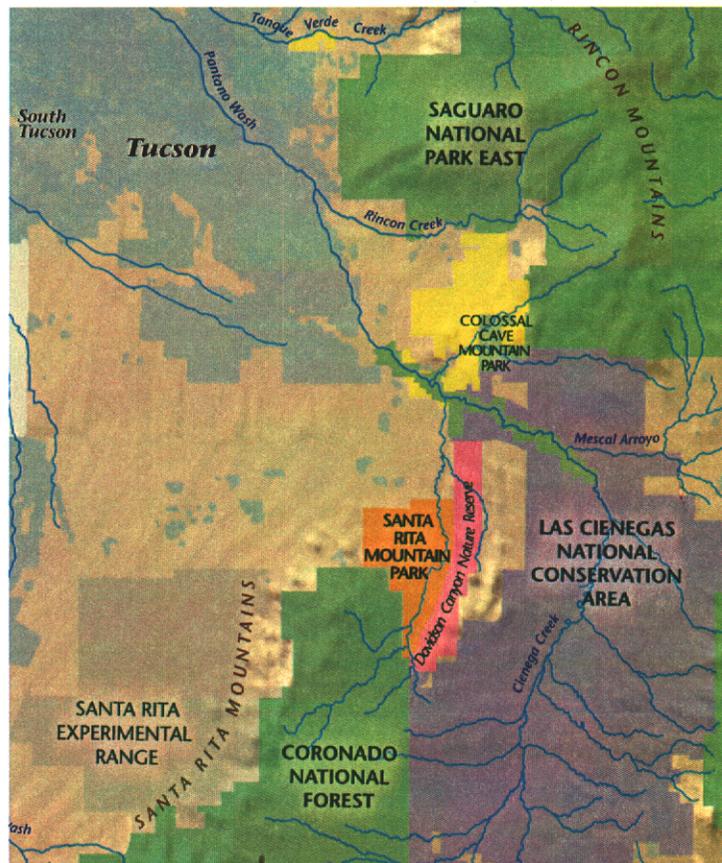
An important biological resource in the area is Cienega Creek. While much of the creek is protected, there are still potential threats to its water supply. The remaining private land along the creek and its immediate watershed should be converted to public land through purchase and land trades with the State Land Department. This can be done in several ways. The Las Cienegas National Conservation Area is one approach, which requires congressional approval. The County could also acquire additional land to expand its current reserve. Davidson Canyon is an integral part of the system and needs to be included in the solution. The management of the entire creek through the Cienega Creek Preserve should be coordinated. In addition, water rights at the downstream end of the County Preserve need to be acquired and an alternate water source



*This subarea has more caves than the others with good roosting sites for several species of bats such as the Pale Townsend's big-eared bat.*

substituted if the land there is developed. This can be done by working with the City of Tucson to provide reclaimed wastewater or CAP water to any new golf courses in the area, or requiring the developer to put in a reclaimed water system if a golf course is approved.

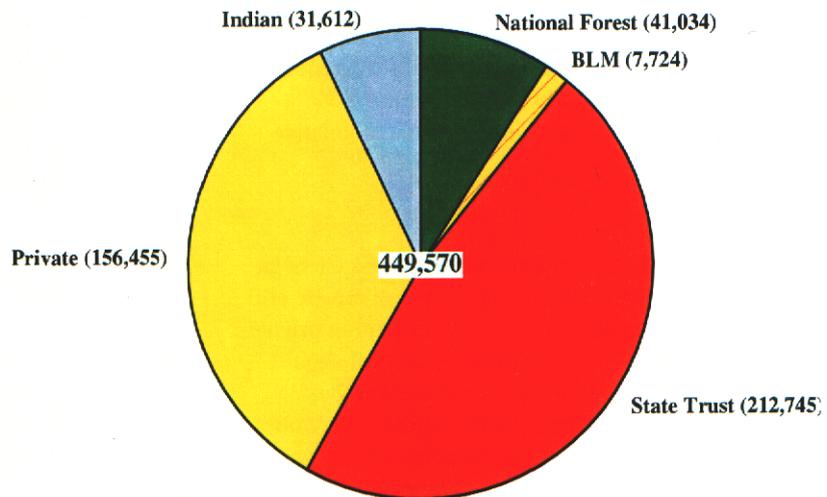
To protect additional portions of saguaro habitat, Colossal Cave Park should be expanded, and Pistol Hill should be protected and connected to the county reserve or Saguaro National Park through coordination with the State Land Department.



**Proposed Reserves in the Cienega-Rincon Subarea**

## The Upper Santa Cruz Subarea

This Santa Cruz River enters Pima County through this subarea which has a rich historic past as an important entryway into the Tucson area in both Spanish and early American times. While it has a high proportion of preserved areas, the private lands are experiencing some of the fastest population growth in the county. This area has experienced the most extensive copper mining in the county and its open pit copper mines are a major landmark of the area. The San Xavier District of the Tohono O'odham Nation occupies much of the northern portion of the subarea and is developing projects for riparian restoration there.



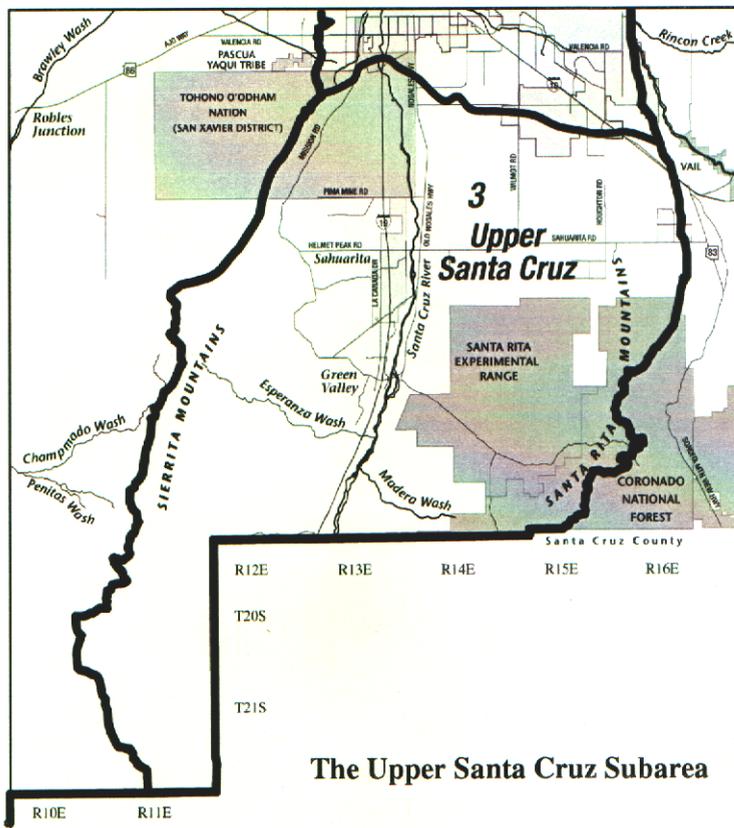
### Description of the watershed

This subarea extends from the Santa Cruz County line through the San Xavier District of the Tohono O'odham Nation and includes the high elevation country of the areas. It also includes a broad area north of the Santa Ritas to the edge of the Cienega-Rincon subarea. The subarea has 4.9 miles of intermittent flow and no areas of shallow groundwater. This area and the piedmont along the mountains to the west have many distributary flow areas,

### Land Ownership in the Upper Santa Cruz Subarea (acres)

as shown by the many dip crossings of Sahuarita Road. If these areas were to be developed coordinated plans for dealing with flood flows overall would be needed.

Green Valley (unincorporated) and Sahuarita are alongside the river in this area. Many of the washes in Green Valley have been straightened and/or cemented for flood control purposes.



### Land uses and governmental jurisdictions

Copper mines are a prominent part of the landscape in this subarea and dominate the landscape from Green Valley into the San Xavier District.

The area once had diversified agriculture, but now the only commercial crop is the pecan which grow in large groves along the river near Green Valley and Continental, a small unincorporated community. New agriculture is planned for the San Xavier District when the Central Arizona Project pipeline reaches the area in 2000.

Sahuarita is the only incorporated town in the subarea. It has plans for rapid growth on both sides of the river in coming years, including a town lake. Green Valley has a larger population, but residents have chosen not to incorporate. The Tohono O'odham Nation is opening up a large new casino just north of Green Valley. Ranching is a major land use in this subarea, occurring on about 48,000 acres of federal land, 203,000 acres of State Trust Land and 57,000 acres of private land, or 69 percent of the total land area.



*The Elegant trogon's range is primarily in Sonora, but it can be seen and heard in the Santa Rita Mountains.*

Central Arizona Project recharge projects are an increasing land use in the area.

The full cash value of land in this subarea area is \$2 billion with an average cash value per acre of \$4,351. County property taxes paid in 1998 were \$11,591,383, or \$25.78 per acre.

### Existing reserves

The higher elevation areas are within the Coronado National Forest, as is the popular Madera Canyon Recreation Area. On the terrace below, the Santa Rita Experimental Range extends over 530,811 acres of grassland. The area is owned by the State and operated by the University of Arizona for research purposes.

### Recreation areas

Recreation opportunities are plentiful in the National Forest portion of the subarea, which people use for picnicking, hiking, wildlife viewing, horseback riding, and ORV use. There are seven golf courses in Green Valley.

### Historical resources

This area had places with plentiful water and so was settled over thousands of years. The Spaniards used the Santa Cruz River corridor as a travel route coming north from Mexico and had several missions and presidios here and along the river in Santa Cruz County and in Mexico. Their trail from Tumacacori to found San Francisco is being

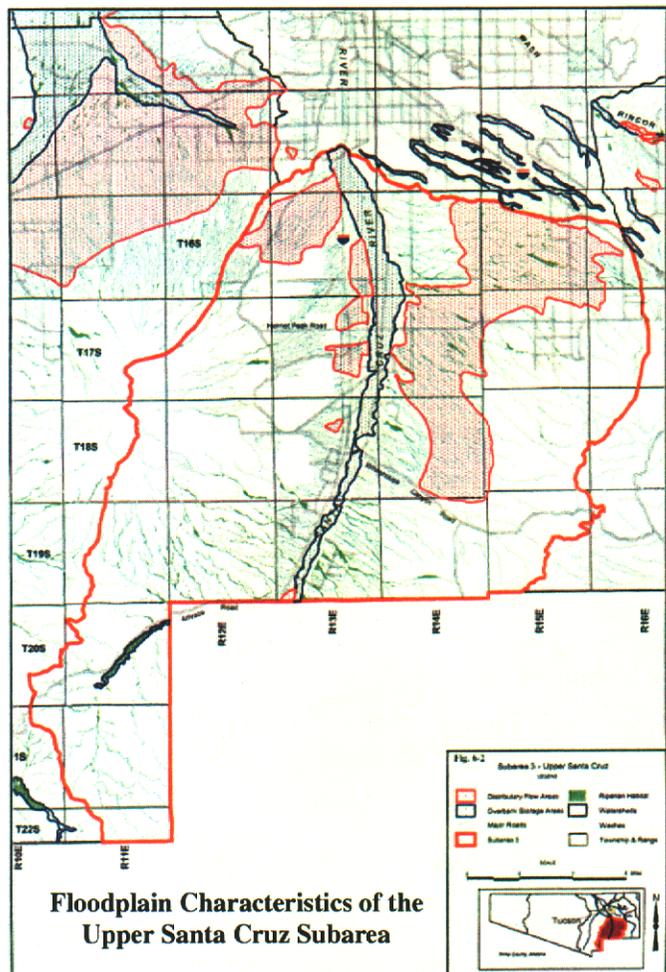
commemorated in the Anza trail which ultimately will extend over the whole route. Anglo travelers, too, traveled along the river on their way from the East to the California gold fields and other points to the West. Both Spaniards and Anglos mined in the area and ranching was also prevalent. The Canoa Ranch at the southern end of the subarea once extended far to the west through the Altar Valley.

Surveys have been done in 16.4 percent of the area and 472 sites were found. Of these 193 are prehistoric, 18 were historic, and ten both prehistoric and historic. The subarea has two historic communities, three ghost towns, 31 historic ranches, eight mines, one historic trail and two sites on the National Register.

### Biological resources

Vegetation in the subarea ranges from conifer forests at the higher elevations through grasslands and mixed scrub down to saguaro-palo verde in the lowlands and riparian vegetation along the watercourses.

The subarea has thirteen species for whom habitat in Pima County is crucial for their existence, fifteen species that are declining throughout their range, two that are rare





**The Historic Canoa Ranch**  
in Pima County, but may not be rare elsewhere, and

seven that are rare in Pima County but not at risk overall.

The major threats to the biological resources in the area are continued urbanization, possible new mining, loss of habitat, and exotic species.

### Proposed reserves

A major resource in this area is the historic Canoa Ranch which is under intense development pressures. The area contains important historic remains as well as biological resources, especially along the river. The owner has requested an intensive increase in zoning to allow for homes, commercial uses and a golf course. A local group, Amigos de Canoa has proposed that the entire area be preserved and developed as a historic site. They are seeking outside funds to purchase the land for this purpose.

County staff has proposed a method whereby the developer would be allowed to build a golf course and develop 15 percent of the property with the rest of the land left as natural open space. This proposal would preserve all the historic sites and important biological resources with funding from required developer fees of various kinds put into a foundation that would be directed towards assuring good land management and historic preservation. This option, too, would have the historic area be used as a museum and public education center.

Whatever the method, there is strong support for having this area as a historic and natural reserve.

### Vulnerable Species in the Upper Santa Cruz Subarea

#### Class 1

*Rana chiricahuensis*  
*Pipilo aberti*  
*Melospiza melodia*  
*Glaucidium brasilianum*  
  
*Aimophila carpalis*  
*Sonorella magdalensis*  
*Rothschildia cincta cincta*  
*Sonorella papagorum*  
*Sonorella eremita*  
*Muhlenbergia xerophila*  
*Amoreuxia gonzalezii*  
*Dalea tentaculoides*  
*Muhlenbergia dubioides*  
*Coryphantha scheeri*  
var. *robustispina*

Chiricahua leopard frog  
Abert's towhee  
Song sparrow subspecies  
Cactus ferruginous  
pygmy-owl  
Rufous-winged sparrow  
Magdalena talussnail  
Cincta silkmoth  
Papago talussnail  
San Xavier talussnail  
Sycamore Canyon muhly  
Saiya  
Gentry indigobush  
Box Canyon muhly  
Pima pineapple cactus

#### Class 2

*Rana yavapaiensis*  
*Strix occidentalis lucida*  
*Vireo bellii*  
*Empidonax trailii extimus*  
  
*Accipiter gentilis apache*  
*Buteo swainsoni*

Lowland leopard frog  
Mexican spotted owl  
Bell's vireo  
Southwestern willow  
flycatcher  
Apache Goshawk  
Swainson's hawk

*Coccyzus americanus*  
*occidentalis*

Western yellow-billed cuckoo  
Merriam's mouse  
Arizona shrew

*Peromyscus merriami*  
*Sorex arizonae*  
*Leptonycteris curasoae*  
*yerbauenae*

Lesser long-nosed bat  
Pale Townsend's big-eared bat  
Western red bat  
Tumamoc globeberry  
Desert box turtle

*Plecotus townsendii*  
*Lasiuris borealis*  
*Tumamoca macedougali*  
*Terrapene ornata luteola*  
*Cnemidophorus burti*  
*stictogrammus*

Giant spotted whiptail

#### Class 3

*Carex ultra*  
*Pectus imberbis*  
*Lupinus huachucanus*

Arizona giant sedge  
Beardless cinchweed  
Huachuca mountain lupine

#### Class 4

*Trogon elegans*  
*Caracara plancas*  
*Caprimulgus ridgwayi*  
*Progne subis*  
*Elaphe triapsis intermedia*  
*Macrotus californicus*  
*Choeronycteris mexicana*  
*Asturina nitida*

Elegant trogon  
Crested caracara  
Buff-collared nightjar  
Purple martin  
Western green rat snake  
California leaf-nosed bar  
Mexican long-tongued bat  
Gray hawk

## The Middle Santa Cruz Subarea

This subarea is home to most of the population of Pima County and has been a population center for many centuries. It is rich in archaeological and historical sites. The valley previously had shallow groundwater in many areas and both surface water and springs in places. Most of those are gone today, but some still remain at the higher elevations and on the east side of the valley. Mountain ranges on the north, east and west sides of the valley are included in this subarea. While this subarea has been more disturbed by human activity than any other, it also has some areas with great potential for preservation and rehabilitation.



Land Ownership in the Middle Santa Cruz Subarea (acres)

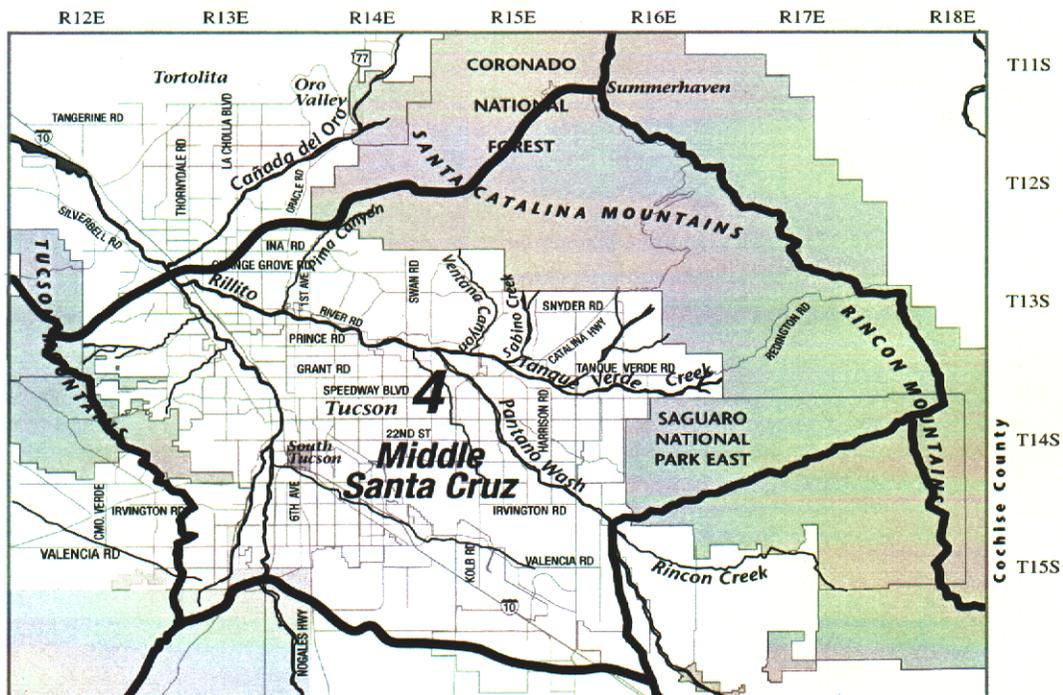
### Description of the watershed

This subarea contains the major watercourses in Pima County, the Santa Cruz River, the Rillito River and tributaries such as Sabino Creek. This subarea also includes the upper elevations of the Santa Catalina Mountains to the top of Mt. Lemmon. In this area there are several perennial and intermittent streams and springs. There are 15.9 miles of perennial flow in the area, almost all in Sabino Canyon. There are also more than 7 miles of perennial flow dependent on discharges of effluent from the Pima County wastewater treatment plants. There are more than 10,000 acres of shallow groundwater areas in Sabino Canyon, Agua Caliente Canyon, and Soldier Canyon in the Catalina Mountains.

This area includes the east slope of the Tucson Mountains with its many dry washes. Almost all of the watercourses in the urban portion of the subarea are drastically changed from their character in the last century.

### Land uses and governmental jurisdictions

Nearly half of this subarea is within the City of Tucson. South Tucson occupies one square mile entirely surrounded by Tucson. This area has most of the industry in Pima County and the highest density residential areas. The density gets less away from the urban core which has expanded from a small area downtown to include land between the two units of Saguaro National Park/Tucson



The Middle Santa Cruz Subarea



The burrowing owl is one of the few vulnerable that can survive in urban areas. This pair lived for months in a drainage pipe along a busy street in downtown Tucson.

Mountain Park to the east and west, and from the International Airport to the Rillito River. Densities are also high on the northwest side. Because much of the cheaper developable and has often been away from the urban core, development has often "leapfrogged," leaving vacant land in its wake, with little wildlife value as it is separated from other such areas by houses and roads.

Ranching is a minor land use in this subarea, occurring on about 34,000 acres of federal land, 18,000 acres of State Trust Land and 3,000 acres of private land, or 16 percent of the total land area.

This subarea has the most valuable land in Pima County. The full cash value of land in this subarea area is \$24.6 billion with an average cash value per acre of

\$67,931. County property taxes paid in 1998 were \$164,689,020, or \$455.13 per acre. The demand for capital improvements are also the greatest in this subarea, as is the demand for services such as police and fire protection.

### Existing reserves

The subarea is surrounded on the north, east and west sides by public lands. Saguaro National Park's East Unit protects a fine stand of saguaros and other species and provides recreation for local residents and tourists. Tucson Mountain Park in this area offers opportunities for wildlife viewing, hiking, and mountain bike riding. The Coronado National Forest offers a multitude of recreational activities, including skiing, fishing, hiking, horseback riding, organized camping, and camping. There are private inholdings within the National Forest, the largest

being at Summerhaven. Sabino Canyon Recreation Area is one of the most popular outdoor recreation areas in Pima County and has so many visitors that traffic has been banned and tourists must enter on foot, bicycle or tram.

### Recreation areas

This subarea was a wide variety of urban recreational resources including neighborhood and regional parks, athletic fields, golf courses, and linear park along the Canada del Oro, and the Santa Cruz and Rillito Rivers. Some of the parks have urban lakes and the Sweetwater Wetlands, a man-made wetland using wastewater, offers wildlife viewing.

The public lands to the east, north and west offer many

## Vulnerable species in the Middle Santa Cruz Subarea

### Class 1

*Pipilo aberti*  
*Melospiza melodia*  
*Glaucidium brasilianum*

*Aimophila carpalis*  
*Gila intermedia*  
*Sonorella magdalensis*  
*Argia sabino*  
*Agave schottii* var. *treleasei*  
*Muhlenbergia dubioides*  
*Muhlenbergia xerophila*  
*Coryphantha scheeri*  
var. *robustispina*  
*Sonora semiannulata*

### Class 2

*Rana yavapaiensis*  
*Buteo swainsoni*  
*Athene cucularia*  
*Coccyzus americanus*  
*occidentalis*  
*Vireo bellii*  
*Strix occidentalis lucida*

Abert's towhee  
Song sparrow subspecies  
Cactus ferruginous  
pygmy-owl  
Rufous-winged sparrow  
Gila chub  
Magdalena talussnail  
Sabino Canyon damselfly  
Trelease Agave  
Box Canyon muhly  
Sycamore Canyon muhly

Pima pineapple cactus  
Ground snake

Lowland leopard frog  
Swainson's hawk  
Burrowing owl  
Western yellow-billed  
cuckoo  
Bell's vireo  
Mexican spotted owl

*Accipiter gentilis apache*  
*Peromyscus merriami*  
*Lasiurus ega*  
*Leptonycteris curasoae*  
*yerbauenae*  
*Allium gooddingii*  
*Tumamoca macdougalii*  
*Thamnopsis eques megalops*  
*Terrapene ornata luteola*  
*Cnemidophorus burti*  
*stictogrammus*

### Class 3

*Falco peregrinus anatum*  
*Idionycteris phyllotis*  
*Penstemon discolor*  
*Lupinus huachucanus*  
*Metastelma mexicanum*

### Class 4

*Empidonax fulvifrons*  
*Progne subis*  
*Caprimulgus ridgwayi*  
*Parabuteo unicinctus*  
*Macrotus californicus*  
*Choeronycteris mexicana*

Apache Goshawk  
Merriam's mouse  
Southern yellow bat  
Lesser long-nosed bat  
Goodding onion  
Tumomoc globeberry  
Mexican garter snake  
Desert box turtle  
Giant spotted whiptail

American peregrine falcon  
Allen's big-eared bat  
Catalina beardtongue  
Huachuca mountain lupine  
Wiggins milkweed vine

Northern buff-breasted flycatcher  
Purple martin  
Buff-collared nightjar  
Harris's hawk  
California leaf-nosed bat  
Mexican long-tongued bat

opportunities for hiking, picnicking, mountain bike riding, wildlife viewing, and other activities. A growing problem, however is loss of access to trails into the public areas, or degradation of the hiking experience because of urban development adjacent to the trailhead. People who have lived in the area for some years bemoan loss of traditional, nonofficial, hiking opportunities they once had in places like Starr Pass or the Catalina Foothills.

**Historical resources**

This subarea has a region south of the downtown area which is claimed to be the oldest continuously inhabited location in the United States. It has been occupied by a succession of prehistoric people, Spaniards and Anglos. The subarea probably had the most prehistoric and historic sites at one time, but the majority have been destroyed. Many of the known sites were found in the process of building highways and buildings.

Only 6.6 percent of this area has been surveyed, but 737 sites were located. This is largely because this area was so important as a water supply. Of these, 454 were prehistoric, 93 were historic sites and 60 had evidence of both historic and prehistoric occupation. This subarea has one historic community, two historic trails, seventeen ranches and ten mines. In addition, the vast majority of historic sites in Pima County that are listed in the National Register are in this subarea. The City of Tucson has an historic district ordinance and has designated thirteen such districts, most in the University-downtown area, with another proposed. This designation limits what can be done with properties in the neighborhood in order to preserve the historic character. In addition, the Ft. Lowell neighborhood is designated historic as is one in the Rincon foothills.

**Biological resources**

The core of this area is highly urbanized and has few undisturbed natural areas. The foothills are primarily palo verde--cactus, creosote, with some ironwood forest. The higher elevations have Douglas fir and mixed conifer, with mixed scrub and oak-pine at the middle elevations. Natural watercourses have riparian vegetation.

The subarea has twelve species for whom habitat in Pima County is crucial for their existence, fifteen species that are declining throughout their range, four that are rare in Pima County, but may not be rare elsewhere, and five that are rare in Pima County but not at risk overall. A small portion of the Tucson Mountains is designated Critical Habitat for the Cactus ferruginous pygmy-owl..

The major threats to biological

resources are continued loss of habitat due primarily the expansion of the urbanized area, exotic species, and loss of water supply. A major problem for wildlife in this urbanized area is loss of the opportunity for wildlife to migrate safely between protected areas. In the outlying areas conflicts between animals and humans often result in removal of the animal from the area, especially when the animal involved is perceived as dangerous, such as rattlesnakes and javelina.

The major opportunities for biological resources are elimination of exotic species and rehabilitation projects, such as a proposed reintroduction of native fish at Agua Caliente Park and elsewhere.

**Proposed reserves, corridors**

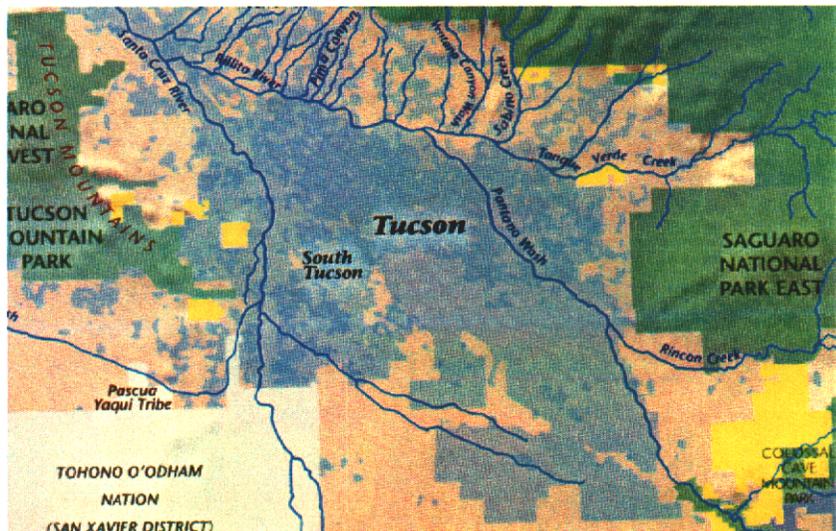
No new reserves are proposed for this area, but expansions of existing reserves are. Pima County's Tucson Mountain Park should be expanded in areas where population growth threatens the scenic and wildlife values of the park. Some areas should be added to the Saguaro National Park's west unit for the same reason.

Connections should be preserved between the public lands and the Santa Cruz River from Tucson Mountains and Saguaro National Monument.

**Other proposed actions**

There are some places on the East side where reintroduction of native fish and frogs is feasible. Agua Caliente Park, for example can be modified to continue to provide recreational values while enhancing the habitat for native fish and frogs.

Protection is needed for shallow groundwater areas, also on the east side, including acquisition of more floodplains and finding ways to provide alternate water supplies for people and companies pumping groundwater in the area.



**Existing Reserves, Proposed Additions and Proposed New Floodprone Land Acquisitions (Light areas)**

Golf Courses in Eastern Pima County

GOLF COURSES ON GROUNDWATER		
NAME	WATER SOURCE	ESTIMATED USE (af / yr)
1. Cliff Valley CC	Type 2 GFR	958
2. Green Valley	Green Valley WC	57.2
3. Desert Hills CC	Green Valley WC	240.3
4. Drexels CC	Green Valley WC	958.1
5. El Compadre CC	Town of Oro Valley	200.8
6. El Compadre Resort CC	Town of Oro Valley	300.7
7. Irony-Nice WC	Green Valley WC	467.0
8. Oak Creek Golf Club	Green Valley WC	457.9
9. Oak Creek Golf Club at Vista	Green Valley WC	488.9
10. Harvest CC	Green Valley WC	847.4
11. The Links at Continental Ranch	Green Valley WC	231.2*
12. Money Creek Hills CC	Lapardito WC	301.8 gpc
13. Mountain View CC	Lapardito WC	455.9
14. Open Hills CC	Lapardito WC	421.8
15. Red Hills CC	Lapardito WC	407.2
16. Rolling Hills CC	Lapardito WC	463.9 gpc
17. SaddleBrook CC	Lapardito WC	1127.0
18. San Jacinto CC	Green Valley WC	
19. Santa Rita CC	Green Valley WC	
20. Santa City Vista CC	Green Valley WC	
21. Irons Horizons CC	Green Valley WC	
22. Tucson Estates CC	Green Valley WC	
23. Tucson National CC	Green Valley WC	
24. Tucson National CC	Green Valley WC	
<b>TOTAL</b>		<b>11,992 (af / yr)</b>

\* all groups have additional non-courses

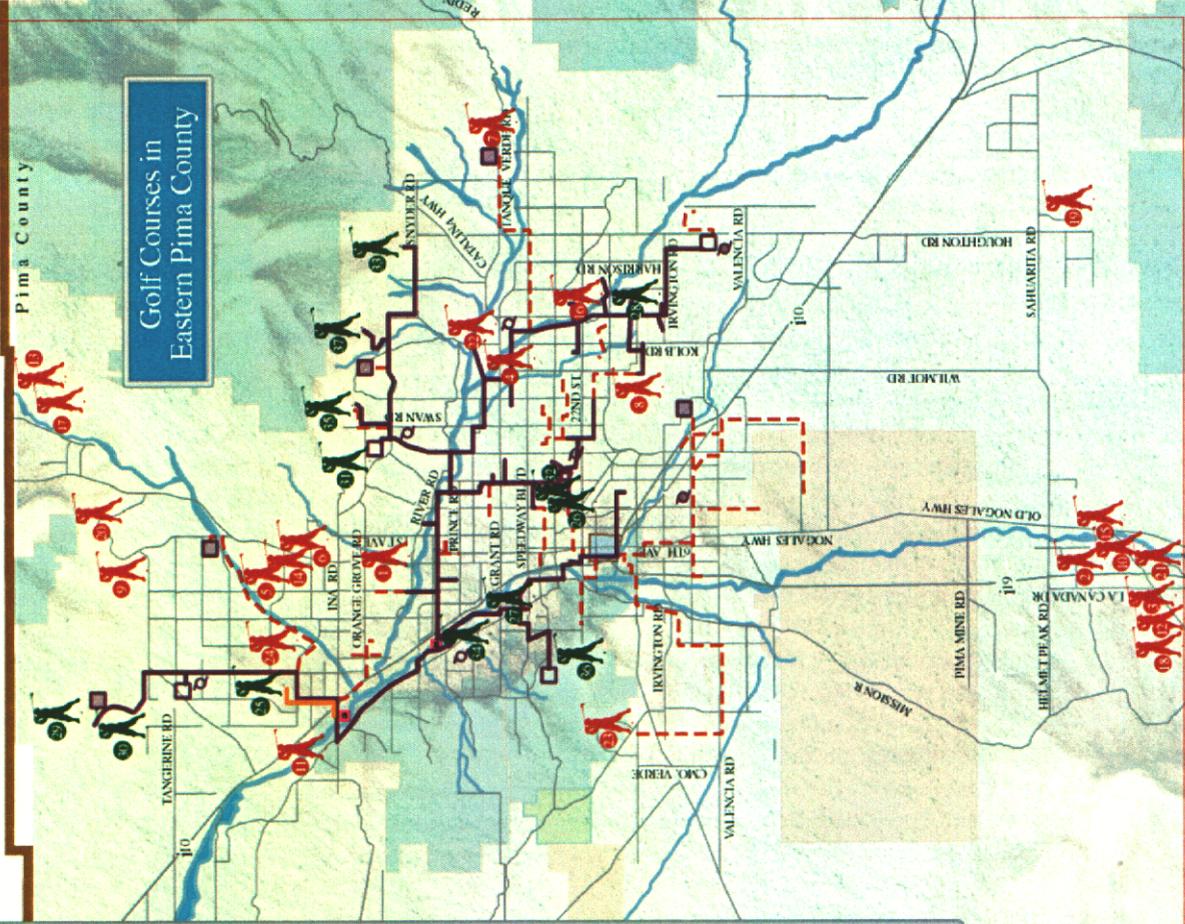
  

GOLF COURSES ON EFFLUENT / RECLAIMED WATER		
NAME	WATER SOURCE	ESTIMATED USE (af / yr)
25. Athlete Inn & CC	Pima County	509
26. DMH Trinch CC	City of Tucson	527
27. El Rio CC	City of Tucson	356
28. Food Park CC	City of Tucson	427
29. The Gallery at Dove Mountain	City of Tucson	648.6 gpc
30. La Paloma CC	City of Tucson	509
31. La Paloma CC	City of Tucson	509
32. Ranoloph CC	City of Tucson	522
33. Rivers CC at Sabino Springs	City of Tucson	449
34. Silverbell CC	City of Tucson	729
35. Skyline CC	City of Tucson	327
36. Sun Valley CC	City of Tucson	327
37. Sunset Canyon CC	City of Tucson	782
38. Veterans Campus CC	City of Tucson	782
<b>TOTAL</b>		<b>6,567.5 (af / yr)</b>

CURRENT TOTAL 17,660 (af / yr)  
 YEAR 2025 PROJECTED ADDITIONAL NEED 9,856 (af / yr)  
 PROJECTED TOTAL UTILIZATION 27,516 (af / yr)

**Legend**

- Existing Reclaimed Pipeline
- Proposed Reclaimed Pipeline
- Secondary Reclaimed Pipeline
- Existing Reservoir
- Existing Booster Station
- Proposed Booster Station
- Proposed Reservoir



Golf Courses in Eastern Pima County

## The Tortolita Subarea

The Tortolita subarea is rich both in archaeological sites and in biological resources. It has until recently been the fastest growing area in Pima County with the expansion of Oro Valley and Marana. Growth slowed in parts of the area in 1999 because it contains habitat for an endangered species, the cactus ferruginous pygmy-owl and regulations for protecting that species are still being developed.



### Description of the watershed

This subarea extends from the top of the Catalina Mountains west to the Santa Cruz River. The southern boundary of the area is roughly Ina Road south to the confluence with the Santa Cruz River. The Canada del Oro is the major tributary of the Santa Cruz River in this area. It's headwaters are high in the Catalina Mountains. Perennial and intermittent streams are found at the higher elevations and down into Catalina State Park. There are 7.9 miles of perennial flow and 13 miles of intermittent flow in the subarea, and 483 acres of shallow flow areas. In addition there are about 22 miles of effluent flow in the Santa Cruz River from the Pima County Wastewater Treatment Plants.

The flanks of the Tortolita Mountains have many small undefined washes. Most of this piedmont is within a distributary flow area in which flooding potential is difficult to predict or control. A Corps of Engineers study found that the costs of channelizing the washes would far outweigh the benefits. Further development of this area

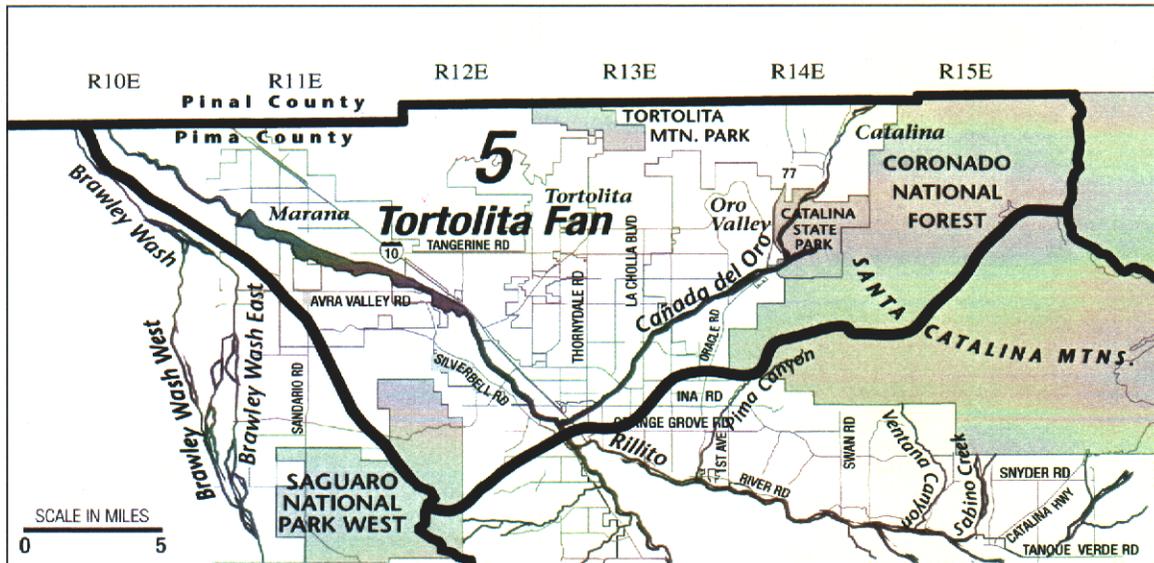
### Land Ownership in the Tortolita Subarea (acres)

would have to be done with flood potential to the developed properties as well as downstream properties carefully considered.

### Land uses and governmental jurisdictions

The two incorporated towns in the subarea are Oro Valley and Marana. The town of Catalina, near the Pinal County boundary is unincorporated. Two areas attempted to incorporate, Tortolita and Casas Adobes, but these incorporations were challenged in court and final resolution of the matter is pending.

Oro Valley has been growing rapidly for about fifteen years, largely as a high-end residential area, including a large retirement community, Rancho Vistoso. Golfing is



## The Tortolita Subarea

### Vulnerable species in the Tortolita Subarea

<b>Class 1</b>		<i>Vireo bellii</i>	Bell's vireo
<i>Glaucidium brasilianum</i>	Cactus ferruginous pygmy-owl	<i>Plecotus townsendii</i>	Pale Townsend's big-eared bat
<i>Aimophila carpalis</i>	Rufous-winged sparrow	<i>Leptonycteris curasoae yerbauena</i>	Lesser long-nosed bat
<i>Pipilo aberti</i>	Abert's towhee	<i>Lasiuris ega</i>	Southern yellow bat
<i>Sonorella tortolita</i>	Tortolita talussnail	<i>Lasiuris borealis</i>	Western red bat
<i>Sonorella sabionensis tucsonica</i>	Tucson Mountains talussnail	<i>Allium gooddingii</i>	Goodding onion
<i>Muhlenbergia xerophila</i>	Sycamore Canyon muhly	<i>Tumamoca macdougallii</i>	Tumomoc globeberry
<i>Agave schottii var. treleasei</i>	Trelease Agave	<b>Class 3</b>	
<i>Chionactis occipitalis kaluberi</i>	Tucson shovel-nosed snake	<i>Falco peregrinus anatum</i>	American peregrine falcon
<i>Sonora semiannulata</i>	Ground snake	<i>Lupinus huachucanus</i>	Huachuca mountain lupine
<b>Class 2</b>		<b>Class 4</b>	
<i>Accipiter gentilis apache</i>	Apache Goshawk	<i>Caprimulgus ridgwayi</i>	Buff-collared nightjar
<i>Buteo swainsoni</i>	Swainson's hawk	<i>Progne subis</i>	Purple martin
<i>Athene cunicularia</i>	Burrowing owl	<i>Parabuteo unicinctus</i>	Harris's hawk
<i>Strix occidentalis lucida</i>	Mexican spotted owl	<i>Macrotus californicus</i>	California leaf-nosed bat
		<i>Choeronycteris mexicana</i>	Mexican long-tongued bat

a featured attraction for Oro Valley where there are nine golf courses, usually associated with residential areas. Commercial uses occur along Oracle Road, including shopping centers, an industrial park, and a resort.

Marana, on the other side of the subarea is also growing rapidly and has annexed many acres of eland in anticipation of future growth. Much of the area between the two towns is sparsely settled.

Ranching in this subarea, occurs on about 24,000 acres of federal land, 42,000 acres of State Trust Land and 18,600 acres of private land, or 42 percent of the total land area.

The full cash value of land in this subarea area is \$5 billion with an average cash value per acre of \$24,769. County property taxes paid in 1998 were \$31,255,324, or \$153.55 per acre.

#### Existing reserves

This area has three reserves and a small part of a third, Tucson Mountain Park. The Coronado National Forest occupies the higher elevations and foothills of the Catalina Mountains which have several perennial and intermittent streams.

The 5,493 acre Catalina State Park abuts National Forest. Arizona State Parks operates the area as an open space reserve and recreation area. Canada del Oro and Sutherland Wash traverse the park.

Pima County owns the 3,446 acre Tortolita Mountain Park on the northern boundary in the Tortolita Mountains and operates it entirely as a natural park. Public access is currently very restricted because access is through private land.

#### Recreation areas

There are many urban recreation areas in this subarea, including golf courses. Hiking, picnicking, camping, horseback riding and wildlife viewing are offered in the

National Forest and Catalina State Park. The Tortolita Mountain Park does not yet offer recreational opportunities because access to the park is through private land.

#### Historical resources

This area has many significant Hohokam sites and some historic ranches and mining sites. The Santa Cruz River was normally dry in this area in historic times, but was on the route from Tucson to the Gila River, a route that was called the "90 Mile Desert" because water was so scarce for travelers. Surveys have been conducted on 35 percent of the area and 970 sites were found, more than in any other subarea. Of these 723 sites were prehistoric, 55 were historic, and 58 had both historic and prehistoric occupations. There were three historic communities, 20 historic ranches, six mines, and two historic trails. Two sites are listed in the National Register.

#### Biological resources

This subarea has some of the healthiest ironwood forests in the county and habitat for the Cactus ferruginous pygmy-owl that was the initial impetus for starting the Sonoran Desert Conservation Plan.

Vegetation ranges from conifer forests at the higher elevations of the Catalina Mountains to saguaro-palo verde, creosote, and ironwood habitat at the lower elevations.

Within the National Forest, Pusch ridge Wilderness Area protects bighorn sheep habitat, although the herd has been in serious trouble.

The subarea has eight species for whom habitat in Pima County is crucial for their existence, ten species that are declining throughout their range, one that is rare in Pima County, but may not be rare elsewhere, and five that are rare in Pima County but not at risk overall.

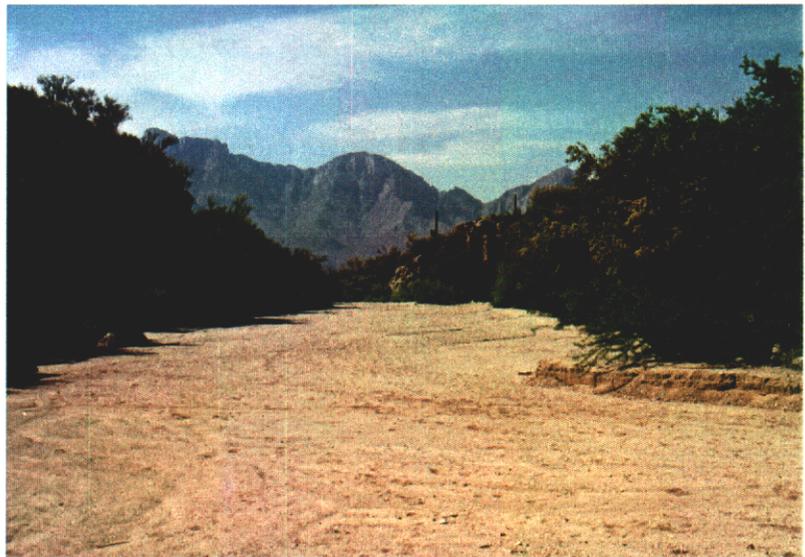
The major threats to biological resources are continued

urbanization, loss of water supply, exotic species, and loss of habitat.

**Proposed reserves**

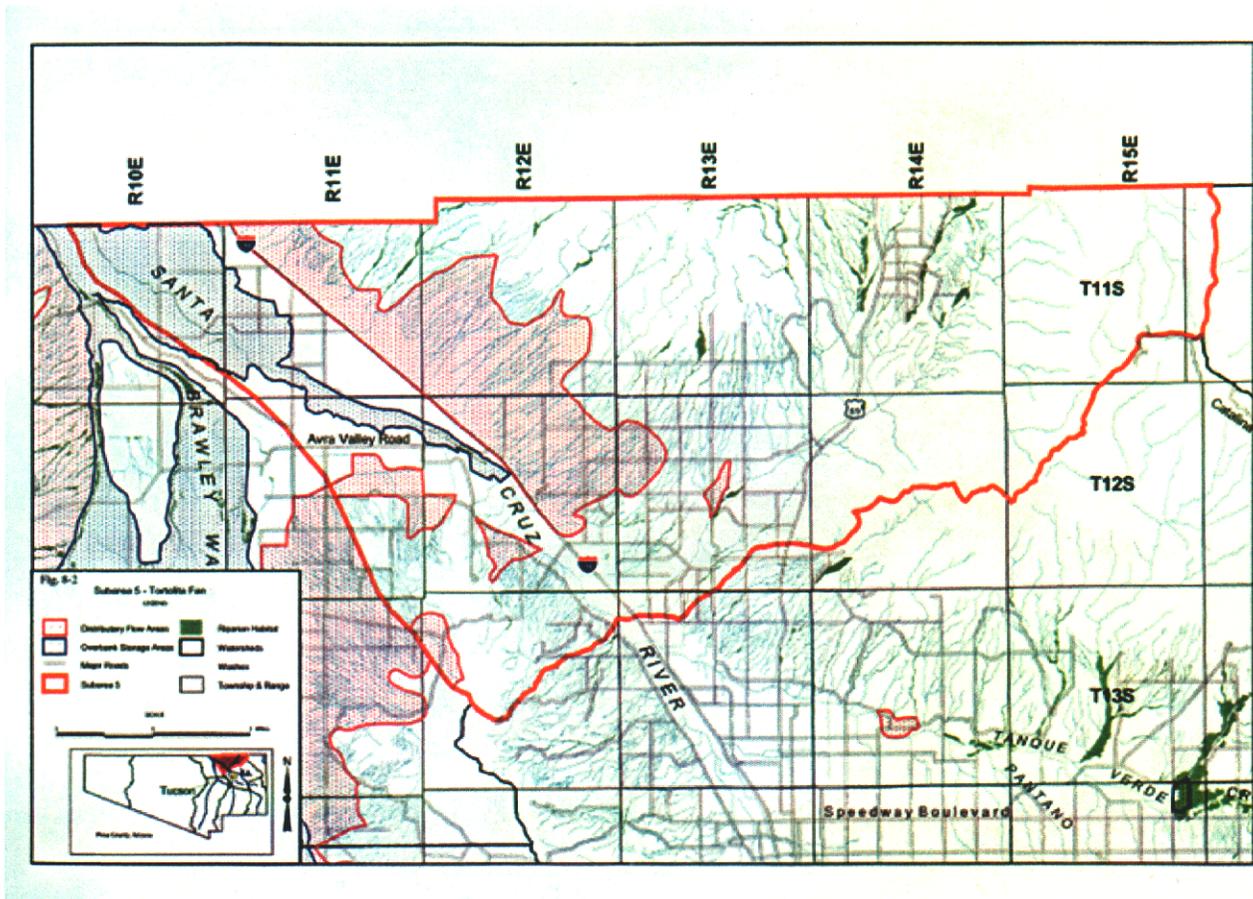
Catalina State Park should be expanded to the north and connected by a corridor to the Tortolitas or it should be buffered by County land acquisition adjacent to the area. Pima County's Tortolita Mountain Park should be expanded and the necessary land acquired to make public access possible.

Oro Valley has proposals to bring CAP water into the area and use it for recharge and habitat restoration along the Canada del Oro. This could raise the level of the water table, or at least keep it from dropping farther as the water will reduce the need for groundwater pumping as well as recharge the aquifer. Water in the Canada del Oro could serve both habitat and recreational purposes. Introduction of untreated CAP water, however, has to be done carefully to avoid the problems discussed in Chapter 3.



**Honeybee Wash**

The pygmy-owl habitat should be preserved and this will be part of the overall Multispecies Habitat Conservation Plan, including allowing some land banking in other areas in return for allowing development in fringe parts of the habitat. Further regulation of construction in the distributary flow areas,



**Watershed map showing distributary flow areas (dotted)**



**Existing Reserves and Proposed Reserve Expansions (light areas) in the Tortolita Subarea.**

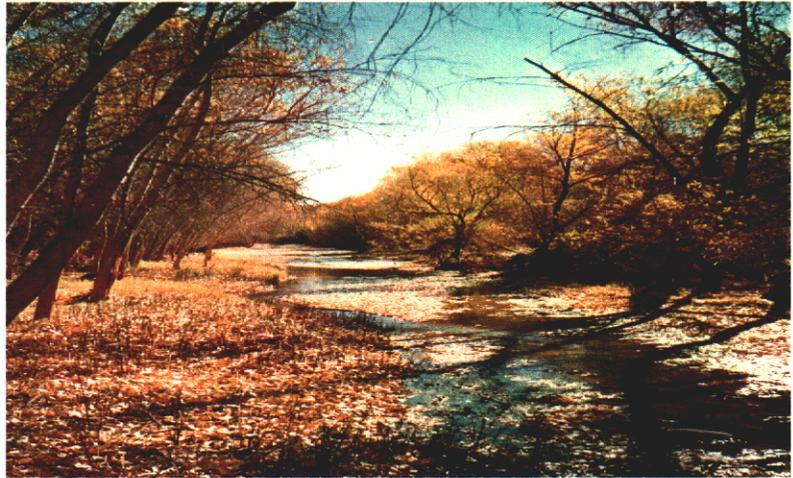
## The Altar Valley Subarea

This is another subarea that is largely rural. Most of the area in the southern portion is either ranched or in the Wildlife Refuge. In the Ajo Way region, however, population pressures are increasing. The subarea has one of the few shallow groundwater areas in Pima County and a cienega. Historically, mining was a major activity in the area and old mines and prospecting areas abound.

### Description of the watershed

This area extends from the Mexican boundary into the Avra Valley to the north. It includes the watershed for Brawley Wash which runs through the area from south to north. Brawley Wash has been deeply incised and subject to erosion because of past human activity. Reclamation of this wash would be difficult without reclamation of tributaries and control of grazing. Brawley Wash is also called "Altar Wash" and "Robles Wash" farther north.

Black Wash, which flows through the northern part of the subarea, has a broad shifting course and offers major



### Land Use in the Altar Valley Subarea (acres)

problems to construction in its floodplain. Pima County has acquired some land along the wash to avoid construction where flood damage is likely.

Most of the area is grassland and is at a higher elevation than the Tucson area. An unusual water feature in the area is the Arivaca Cienega, which is dependent on shallow groundwater. Arivaca Creek is perennial in places and intermittent in others. It is normally dry when it reaches Brawley Wash. There are 2.7 miles of perennial flow and 4.1 miles of intermittent flow in the subarea, all in Arivaca Creek and Brown Canyon, and 4,862 acres of shallow groundwater areas, mostly in the Arivaca area.

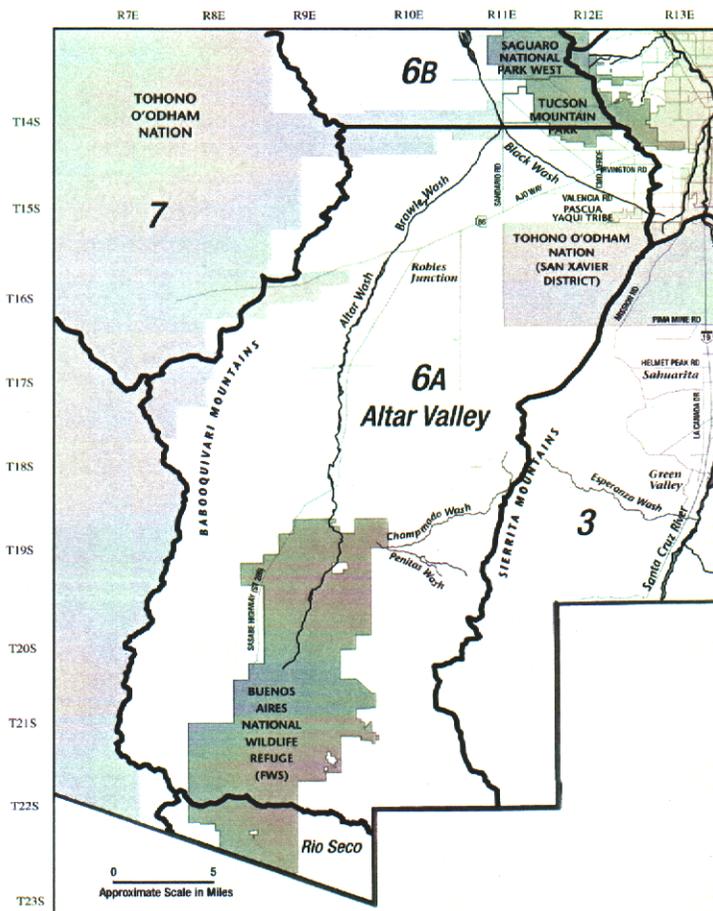
### Land uses and governmental jurisdictions

There are no incorporated towns in this subarea and three small unincorporated communities. Sasabe, on the Mexican border, is a small community based on the border station. Arivaca is a small community on the southeastern edge and Three Points (also called Robles Junction) is towards the northern boundary of the subarea. Ranching is a major land use in this subarea, occurring on about 57,000 acres of federal land, 315,000 acres of State Trust Land and 64,000 acres of private land, or 61 percent of the total land area.

The full cash value of land in this subarea area is \$927 million with an average cash value per acre of \$1,299. County property taxes paid in 1998 were \$2,783,655, or \$3.90 per acre.

### Existing reserves

The 121,308 acre Buenos Aires National Wildlife Refuge is the only preserve in the area, except for



The Altar Valley Subarea

a small portion of the Coronado National Forest in the southwest corner and a small part of the Tucson Mountain Park on the northern boundary. The Wildlife Refuge was established to preserve and improve habitat for the masked bobwhite quail, an endangered species. The Arivaca Cienega is part of the Refuge as is Brown Canyon with its intermittent stream.

### Recreation areas

The primary recreational opportunities in this subarea are in the Buenos Aires National Wildlife Refuge which offers hiking, camping, hunting, wildlife viewing, and picnicking.

### Historical resources

This area has been used from prehistoric times to the present, although was not significantly occupied by the Spaniards. Ranching and mining were prevalent in the early Anglo period and many of today's ranches are currently occupied by descendants of the original settlers.

Only 5.3 percent of this subarea has been surveyed, but 514 sites were found. Of these, 436 are prehistoric, 18 historic sites and 25 had both historic and prehistoric occupation. This is the only subarea where paleoindian sites have been identified. There are two historic

communities, one ghost town, 44 historic ranches and 31 historic mines, twice as many mines as any other subarea. One site is listed in the National Register.

### Biological resources

Vegetation in the area is primarily grassland and mixed scrub, with riparian vegetation along the perennial and intermittent watercourses.

The subarea has twenty species for whom habitat in Pima County is crucial for their existence, twelve species that are declining throughout their range, two that are rare in Pima County, but may not be rare elsewhere, and four that are rare in Pima County but not at risk overall. Of these, three species are only known in Pima County in this subarea: the masked bobwhite quail (*Colinus virginianus ridgwayi*), jaguar (*Panthera onca*), and Kearney's blue star (*Amsonia kearneyana*), although there are probably populations also on the Tohono O'odham Nation.

The main threat to biological resources in this subarea Conservancy or the Sonoran Institute should assist ranchers with incentives to preserve parts of their land with such measures as conservation easements. Incentives should be provided to ranchers working to improve habitat and protect riparian areas.

### Vulnerable Species in the Altar Valley Subarea

#### Class 1

<i>Rana chiricahuensis</i>	Chiricahua leopard frog
<i>Aimophila carpalis</i>	Rufous-winged sparrow
<i>Melospiza melodia</i>	Song sparrow subspecies
<i>Pipilo aberti</i>	Abert's towhee
<i>Glauucidium brasilianum</i>	Cactus ferruginous pygmy-owl
<i>Colinus virginianus ridgwayi</i>	Masked bobwhite
<i>Cyprinidon macularius macularis</i>	Desert pupfish
<i>Poeciliopsis occidentalis occidentalis</i>	Gila topminnow
<i>Rothschildia cincta cincta</i>	Cincta silkmoth
<i>Sonorella ambigua ambigua</i>	Ambiguous talussnail
<i>Sonorella baboquivariensis baboquivariensis</i>	Baboquivari talussnail
<i>Sonorella baboquivariensis depressa</i>	Sierrita talussnail
<i>Sonorella magdalensis</i>	Magdalena talussnail
<i>Sonorella sitiens sitiens</i>	Las Guijas talussnail
<i>Sonorella baboquivariensis berryi</i>	Roskrige talussnail
<i>Sonorella xanthenes</i>	Kitt Peak talussnail
<i>Amsonia kearyneana</i>	Kearney's blue star
<i>Coryphantha scheeri</i> var. <i>robustispina</i>	Pima pineapple cactus
<i>Muhlenbergia xerophila</i>	Sycamore Canyon muhly
<i>Chionactis occipitalis kaluberi</i>	Tucson shovel-nosed snake

#### Class 2

<i>Rana yavapaiensis</i>	Lowland leopard frog
<i>Vireo bellii</i>	Bell's vireo
<i>Coccyzus americanus occidentalis</i>	Western yellow-billed cuckoo
<i>Buteo swainsoni</i>	Swainson's hawk
<i>Athene cunicularia</i>	Burrowing owl
<i>Leptonycteris curasoae yerbauena</i>	Lesser long-nosed bat
<i>Lasiuris borealis</i>	Western red bat
<i>Plecotus townsendii</i>	Pale Townsend's big-eared bat
<i>Panthera onca</i>	Jaguar
<i>Lasiuris ega</i>	Southern yellow bat
<i>Peromyscus merriami</i>	Merriam's mouse
<i>Tumamoca macdougallii</i>	Tumomoc globeberry
<i>Cnemidophorus burti s tictogrammus</i>	Giant spotted whiptail
<i>Thamnopsis eques megalops</i>	Mexican garter snake
<i>Terrapene ornata luteola</i>	Desert box turtle

#### Class 3

<i>Lupinus huachucanus</i>	Huachuca mountain lupine
<i>Metastelma mexicanum</i>	Wiggins milkweed vine
<i>Amsonia grandiflora</i>	Large-flowered blue star

#### Class 4

<i>Caprimulgus ridgwayi</i>	Buff-collared nightjar
<i>Progne subis</i>	Purple martin
<i>Asturina nitida</i>	Gray hawk
<i>Elaphe triapsis intermedia</i>	Western green rat snake
<i>Macrotus californicus</i>	California leaf-nosed bat
<i>Choeronycteris mexicana</i>	Mexican long-tongued bat

### Proposed reserves

This area is a good location for measures to protect vulnerable species since the land has a great deal of connected open space and roadless areas, ranchers are motivated to implement additional measures, and land costs are low so purchase of significant areas for public land is feasible. A new Cerro Colorado Ranch Conservation Area and, to the north, the Sierrita Ranch Conservation Area would be established. This will primarily be done through incentives programs.

### Other Proposed Actions

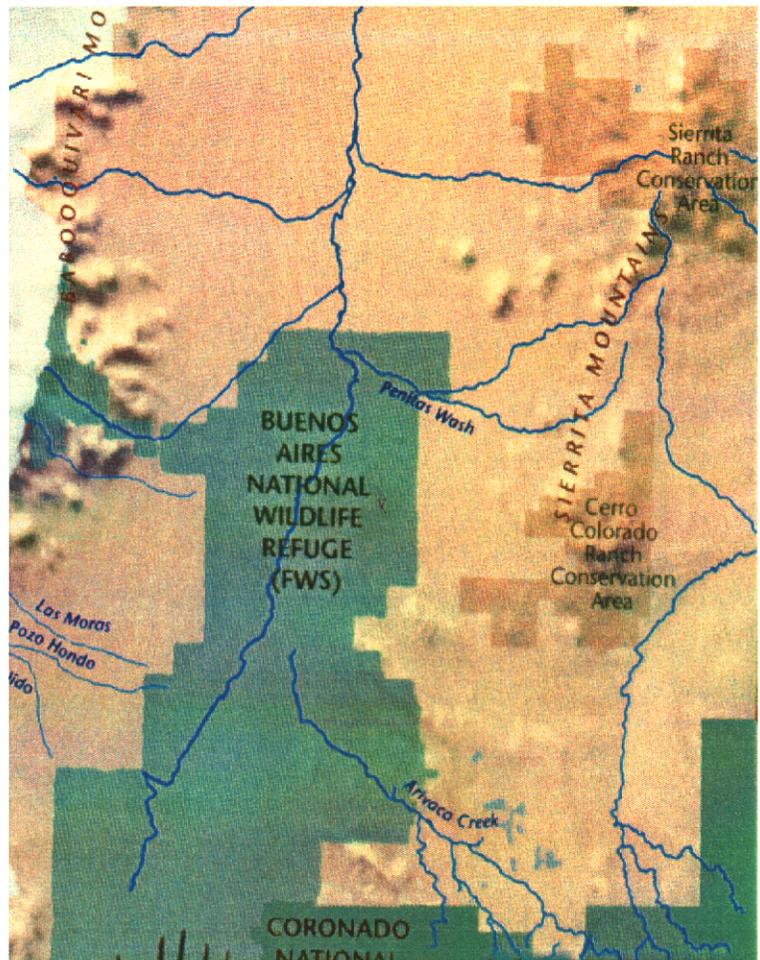
The water supply for the Arivaca Cienega and Arivaca Creek needs to be protected from new groundwater pumping. The County will work closely with the Arizona Department of Water Resources and the Governor's Water Commission to accomplish this goal.

The County and nonprofit groups such as the Nature Conservancy or the Sonoran Institute will cooperate with ranchers to develop incentives programs to preserve parts of their land through such measures as conservation easements and land banking. Incentives programs will be developed to encourage ranchers who are working to improve habitat and protect riparian areas.



*The only Arizona range of the Masked bobwhite quail is in this subarea.*

**The Buenos Aires Wildlife Refuge and Proposed Ranch Conservation Areas (light brown).**





**Ranching is the most common land use in the subarea. Historically, the area was badly overgrazed. In this photo from 1897 no grass can be seen. Photo: Leo Goldschmidt**



**Ranches in the area today are far more well-managed and often provide refuge for threatened and endangered species.**

## The Avra Valley Subarea

Avra Valley has been for more than half a century the agricultural center of Pima County. Although agriculture has been largely phased out in the past twenty years, it is currently being revived with many acres of new agricultural lands on the Shuk Toak District of the Tohono O'odham Nation. The northern part of the subarea is experiencing rapid population growth.

### Description of the watershed

The Avra Valley is a continuation of the Altar Valley and Brawley Wash flows through here mostly in indistinct and shifting channels. Almost the entire valley is floodprone. Most of the Brawley Wash floodplain serves as an overbank storage area, important areas for flood retention and recharge. Much of the rest of the valley has many ill-defined washes, distributary flow, which change with each major flow event.

If housing developments are located in these areas, extreme care must be taken to avoid flood damage to those properties and downstream land. The Aguirre Valley to the West and mostly on the Tohono O'odham Nation has similar topography and is used for ranching.

There are no perennial or intermittent streams and only one small possible shallow groundwater area.

### Land uses and governmental jurisdictions



### Land Ownership in the Avra Valley Subarea (acres)

Marana is an incorporated town with jurisdiction over the northeastern part of the subarea. This is projected as a rapidly growing urban area, with urban uses replacing agricultural uses for the most part. Numerous subdivisions are planned within Marana.

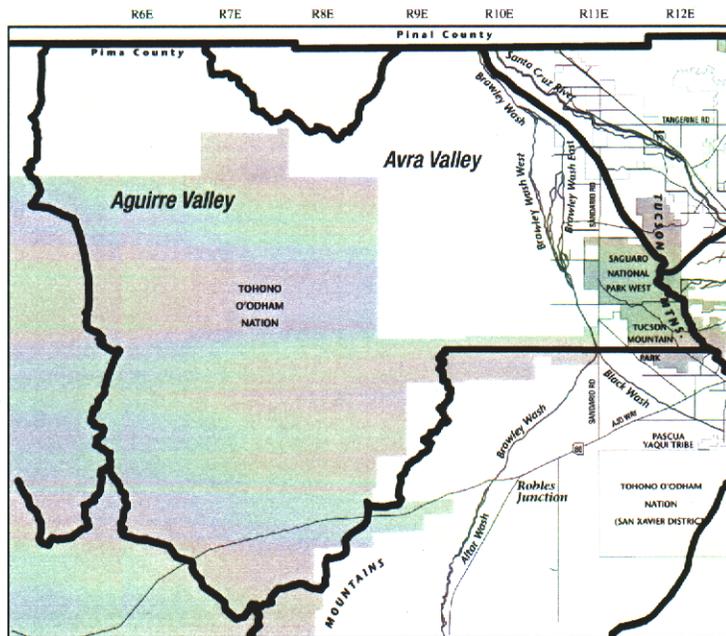
Much of the northern part of the area is occupied by single family residences that are not in subdivisions and thus largely unregulated. Development along Picture Rocks Road, for example, is of this type, with many people living in mobile homes, using septic systems and their own wells.

More than 20,000 acres of land are devoted to providing a water supply for the Tucson area. Tucson Water purchased farm land in order to claim the water rights and transfer the water to Tucson. Tucson Water is also using land in the area for groundwater recharge projects, using CAP water. The Central Arizona Project comes through this area and the central treatment plant for the water is just south of this area in the Altar subarea.

On the southern boundary of the subarea, the Tohono O'odham have cleared thousands of acres of desert land in order to grow crops using CAP water. There is little other agriculture in the area except in the immediate vicinity of Marana.

Ranching is a major land use in this subarea, occurring on about 85,000 acres of federal land, 48,000 acres of State Trust Land and 16,000 acres of private land, or 68 percent of the total land area.

The full cash value of land in this subarea area is \$443 million with an average cash value per acre of \$2,003. County property taxes paid in 1998 were \$1,543,216, or \$6.97 per acre.



The Avra Valley Subarea



This subarea has a protected area for the Nichol's Turk's head cactus.

### Existing reserves

Tucson Mountain Park and Saguaro National Park occupy the higher elevations and foothills. The two reserves together cover 41,547 acres spread out in the Altar Valley, Avra Valley and Middle Santa Cruz subareas. These reserves protect some of the best saguaro habitat in the county. The National Park Service operates Saguaro National Park as the west unit of a National Park originally designated on the east side of town. Its mission is preservation of the vegetation and habitat and recreation. Pima County operates Tucson Mountain Park as a reserve and recreation area.

Pima County's newest reserve is in the northwest part of this subarea. The Ironwood National Monument, designated by President Clinton in 1999, includes lands on several mountain ranges in Pima and Pinal County with rich ironwood forests an important wildlife habitat.

### Recreation areas

The Arizona Sonora Desert Museum and Old Tucson are popular tourist destinations within the Tucson Mountain Park which also offers camping, picnicking, hiking

and wildlife viewing.

### Historical resources

This area has fewer historic resources than the other subareas. There was little dependable water in the area to attract permanent settlements. Intense agriculture in the area dates from the 1930s. Mining was the most significant historical activity in the early territorial days.

Eight percent of the subarea has been surveyed and 141 sites were found, of which 112 are prehistoric, 19 are history, and two both historic and prehistoric occupation. The historic sites include one historic community, one ghost town, five ranches, 15 mines and an archaeological district in the National Register.

### Biological resources

Natural vegetation in this subarea is primarily saguaro-palo verde and creosote. Many acres of this subarea have been farmed for many years and where that farmland has been abandoned, exotic species often predominate. In the northwestern part of the subarea ironwood forests predominate. Part of the western area is grassland.

The subarea has four species for whom habitat in Pima County is crucial for their existence, ten species that are declining throughout their range, and one that is rare in Pima County but not at risk overall. One, the Nichol's Turk's head cactus (*Echinocactus horizonthalonius* var. *nicholii*) is only found in Pima County in this subarea and on the Tohono O'odham Nation. This species is on protected land.

The Bureau of Reclamation set aside land as a wildlife corridor as mitigation for damage done while building the CAP canal. This area was originally designed to connect the undisturbed land on the Tohono O'odham nation with protected lands in Saguaro National Monument and Tucson Mountain Park. The connected Tohono O'odham land, however, has been mostly cleared for new agriculture in order to take advantage of the tribe's share of CAP water.

Major threats are continued urbanization, ORV use, exotic species, and loss of habitat.

### Vulnerable Species in the Avra Valley Subarea

#### Class 1

*Echinocactus horizonthalonius*  
var. *nicholii*                      Nichol's Turk's head cactus  
*Pipilo aberti*                                      Abert's towhee  
*Aimophila carpalis*                      Rufous-winged sparrow  
*Chionactis occipitalis kaluberi*      Tucson shovel-nosed  
snake

*Sonora semiannulata*                      Ground snake

#### Class 2

*Tumamoca macdougallii*                      Tumomoc globeberry  
*Buteo swainsoni*                              Swainson's hawk  
*Coccyzus americanus*  
*occidentalis*                              Western yellow-billed  
cuckoo

*Vireo bellii*                                      Bell's vireo  
*Athene cunicularia*                              Burrowing owl  
*Plecotus townsendii*                      Pale Townsend's big-eared bat  
*Lasiurus borealis*                              Western red bat  
*Lasiurus ega*                                      Southern yellow bat  
*Leptonycteris curasoae yerbauena* Lesser long-nosed bat

#### Class 3

*Lupinus huachucanus*                      Huachuca mountain lupine

#### Class 4

*Parabuteo unicinctus*                              Harris's hawk  
*Choeronycteris mexicana*                      Mexican long-tongued bat  
*Macrotus californicus*                      California leaf-nosed bat

**Proposed reserves**

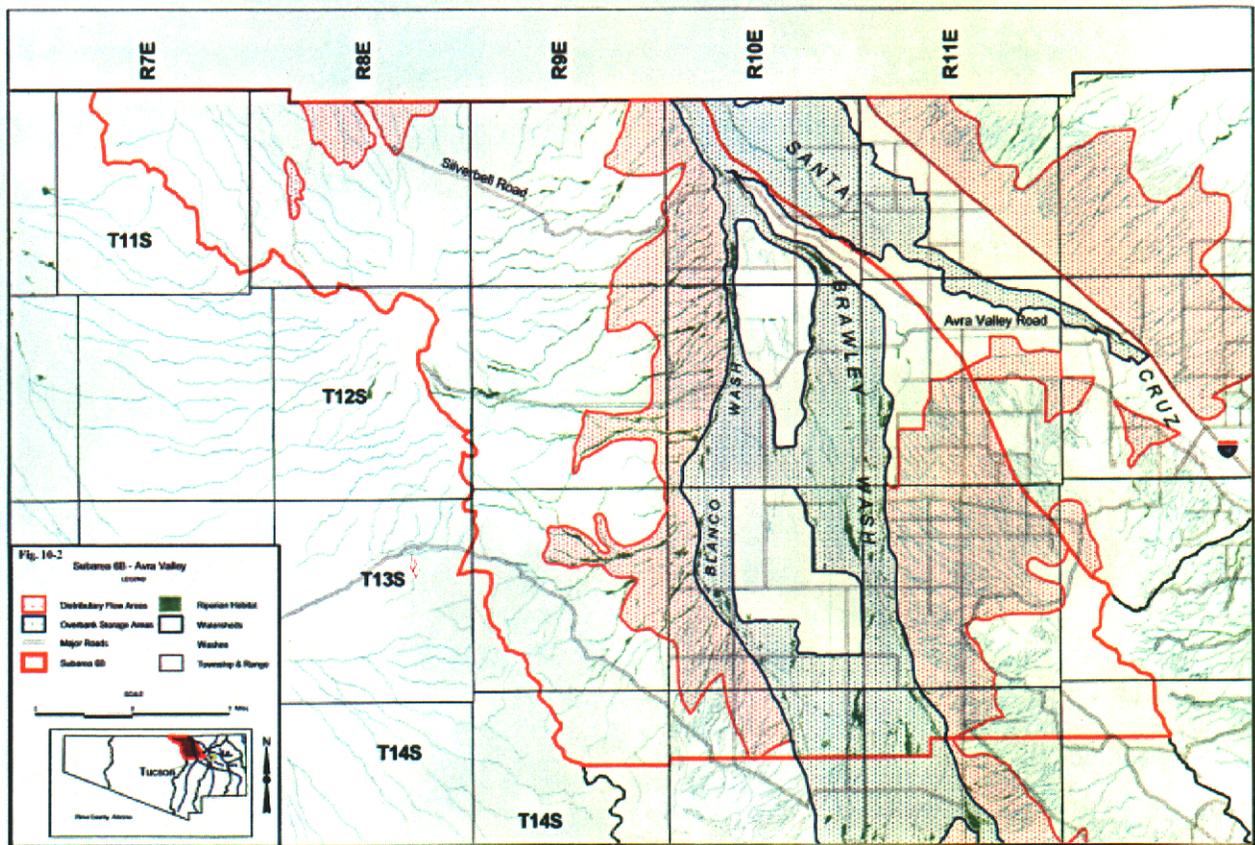
Ironwood National Monument is now established, but land trades are needed to consolidate State Trust Land holdings and expand the protected area in Pima and Pinal counties. Appropriate management plans should be developed. The County and nonprofit groups should work with ranchers to develop incentives for land preservation and good land management through measures such as conservation easements.

In this area and the Tortolita area, the County should work with Marana and agricultural interests to support riparian rehabilitation projects along the Santa Cruz River. The effluent-dominated portion should be protected and enhanced. Recharge projects along the river should be designed to benefit wildlife.

**Other proposed actions**

The County will work with Tucson and nonprofit groups to optimize use of vacant Tucson Water lands to benefit wildlife and native vegetation. Use of CAP water to rehabilitate lands dominated by exotic species is a viable option.

The County will work with the Tohono O’odham Nation to preserve wildlife corridors between the Nation and the Tucson Mountain Park and Saguaro National Park.



**Floodplain Characteristics of the Avra Valley Subarea**  
 Most of the lowland is either in distributary flow (red dots) or overbank storage areas (blue dots).

## The Western Pima County Subarea

This subarea is the most distant from the urban core, but is a frequently travelled tourist route between Tucson and Organ Pipe National Monument and Rocky Point, Sonora. It has a less dependable water supply than any other part of the county, but is rich in biological and archaeological resources. The open pit copper mine in Ajo was for nearly a century a major mining center.



### Description of the watershed

This subarea is west of the Tohono O'odham Nation. This is the driest part of Pima County and receives an

average of less than three inches annual rainfall. Quitobaquito Springs on Organ Pipe National Monument is a significant surface water area with biological and historic significance. The southern part of the Monument is part of the Sonoyta River drainage of northern Sonora.

The rest of the area has many xeroriparian areas but no natural surface water sources or areas of shallow groundwater.

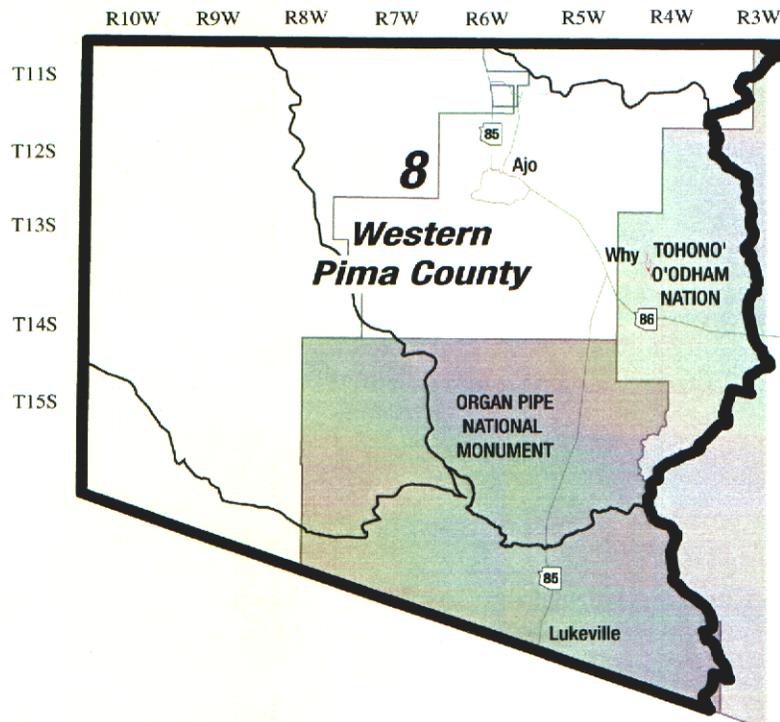
### Land uses and governmental jurisdictions

Almost all the land in this subarea is in public ownership. Part of the eastern border is within the Tohono O'odham Nation. The southeast portion is Organ

### Land Ownership in the Western Pima County Subarea (acres)

Pipe National Monument and west of that is the Cabeza Prieta National Wildlife Refuge. The remainder of the western part and the northern part of the area are owned by the U.S. Department of Defense. The only private land is around the towns of Ajo and Why. The wildlife refuge and military lands are mostly outside of Pima County

Mining has been the major land use on the private land for nearly a century and long formed the economic base for Ajo. Although the open pit copper mine has been closed for more than ten years, ASARCO has plans to reopen the mine using new technology.



The Western Pima County Subarea



The Organ Pipe Shovel-nosed Snake is only found in Organ Pipe National Monument and surrounding areas in Sonora and western Arizona.

Since the mine closed, tourism has been the most important element of the economy. Tourists visit the National Monument and also travel through the area to reach Rocky Point, a tourist destiny in Mexico.

Because of extremely limited water supplies, extensive population growth is not anticipated in the area.

Ranching is a minor land use in this subarea, occurring on about 175,000 acres of federal land, 700 acres of State Trust Land and almost no private land, or 16 percent of the total land area.

The full cash value of land in this subarea area is \$240 million with an average cash value per acre of \$222. County property taxes paid in 1998 were \$566,177, or \$.52 per acre. Mining accounts for a significant portion of the property value here.

### Existing reserves

Organ Pipe National Monument was established in 1937 to protect the only large stand of organ pipe cactus in the United States. Many other unusual species are in the area and the occasional spring wildflower displays attract thousands of tourists.

Cabeza Prieta National Wildlife Refuge was established to protect endangered species including the Sonoran pronghorn antelope. The refuge is maintained as a limited access area where visitors must not only have permits but also four-wheel drive vehicles.

The Goldwater Gunnery Range is operated for military training purposes, primarily aerial bombing practice. The land itself is seldom used for military purposes and in many places has served well as a wildlife reserve. Agencies have worked often together for coordinated management of the three areas.

### Recreation areas

Organ Pipe National Monument is the primary recreational area in the subarea and is a popular tourist destination in the cooler months. The Cabeza Prieta National Wildlife Refuge offers wilderness recreational opportunities to individuals with 4-wheel drive vehicles.

### Historical and cultural resources

Although little of the area has reported surveys, 443 sites are identified, including 337 prehistoric sites and 61 historic sites. There are two historic communities, and two ghost towns. Although there was historic mining in the area, specific information is not available. Nine sites are listed in the National Register of Historic Places, including the Camino del Diablo Historic Trail.

There are also two recognized traditional cultural places. I'toi Mo'o (Montezuma's Head) is a natural feature in the Ajo Mountains that is associated with the creator figure I'toi Mo'o, sacred to the Tohono O'odham people. Quitobaquito Springs, near the international border in Organ Pipe National Monument is the site of a

## Vulnerable Species in the Western Pima County Subarea

### Class 1

*Aimophila carpalis*  
*Glaucidium brasilianum*

*Pipilo aberti*

*Cyprinidon macularius eremus*

*Rothschildia cincta cincta*

*Sonorella meadi*

*Antilocarpa americana sonoriensis*

*Agave schottii var. treleasei*

*Echinomastus erectocentrus acumensis*

*Peristyle ajoensis*

*Tryonia quitobaquitae*

*Chionactis palarostris organica*

*Cnemidophorus burti xanthonotus*

*Kinosternon sonoriense longifemorale*

Rufous-winged sparrow

Cactus ferruginous  
pygmy-owl

Abert's towhee

Quitobaquito pupfish

Cincta silkmoth

Mead's talussnail

Sonoran pronghorn  
antelope

Trelease Agave

Acuna cactus

Ajo rock daisy

Quitobaquito tryonia

Organ Pipe  
shovel-nosed snake

Red-backed whiptail  
lizard

Sonoyta mud turtle

### Class 2

*Athene cucularia*

*Toxostoma lecontei*

*Vireo bellii*

*Atta mexicana*

*Lasiurus borealis*

*Lasiurus ega*

*Leptonycteris curasoae*

*yerbauenae*

*Peromyscus merriami*

*Plecotus townsendii*

*Tumamoca macdougallii*

### Class 3

*Lupinus huachucanus*

### Class 4

*Buteo albonatus*

*Parabuteo unicinctus*

*Peniocereus striatus*

*Triteliopsis palmeri*

*Macrotus californicus*

*Choeronycteris mexicana*

Burrowing owl

Le Conte's thrasher

Bell's vireo

Mexican leaf-cutter ant

Western red bat

Southern yellow bat

Lesser long-nosed bat

Merriam's mouse

Pale Townsend's big-eared bat

Tumomoc globeberry

Huachuca mountain lupine

Zone-tailed hawk

Harris's hawk

Dahlia-rooted cereus

Blue sand lily

California leaf-nosed bat

Mexican long-tongued bat

natural tinaja or waterhole that is sacred to the Tohono O'odham people. A nearby ancient cemetery is still visited regularly by the O'odham. There are also six rock art sites in the area.

### **Biological resources**

The subarea has fifteen species for whom habitat in Pima County is crucial for their existence, nine species that are declining throughout their range, and six that are rare in Pima County but not at risk overall. All but one are on federally protected land and more than half occur in Pima County only in this subarea and possibly on the Tohono O'odham Nation. The Tumamoc globe berry is found on land possibly subject to damage from construction and other human activity.

Exotic species are not a major problem in the area, except for several grass species, especially buffelgrass, that present a fire danger. Buffelgrass is being

aggressively managed by the Organ Pipe National Monument. Other threats are road kills, construction, collecting, and impacts of cross-border illegal encroachment. The road through the National Monument is a growing concern. To handle increased traffic to and from Mexico transportation officials believe they should widen the road and increase the speed, but National Monument officials have opposed allowing this road to become more of a high-speed road. Other routes have been proposed as an alternative, but no decision has been made.

### **Proposed reserves**

Since the area is largely in public ownership, there is little opportunity for new reserves in the area. There is, however, a proposal to consolidate all of the existing reserves into a National Park under integrated management. Since this region is closely connected biologically and geologically with the Pinacate National Park in Sonora, a binational park is conceivable in the future, but not proposed at present. Pima County supports the National Park proposal.



*The Sonoran pronghorn antelope was once common in Pima County grasslands. It is now an endangered species. A small population is found in the Cabeza Prieta Wildlife Refuge.*

# Issues Common to Several Subareas

## Overview

Each subarea has its own characteristics and its own needs, yet all are connected to the others. Many wildlife species move from one to another. All share the same county tax base and supply of revenue. Watercourses run from one subarea to another, as does floodwater. Most subareas share the same limited water supply. Some subareas are highly developed while others have extensive open space.

What happens to vacant land in one subarea affects the others. If housing construction slows down in one subarea, it is liable to increase elsewhere. If land converted into public land in one subarea, the private land nearby is liable to become highly desirable for resort or high-end residential development. On the other hand if State Trust land is converted to private land in one subarea, this can affect other lands in the subareas as well as in adjacent ones, especially those downstream.

## Factors that Influence

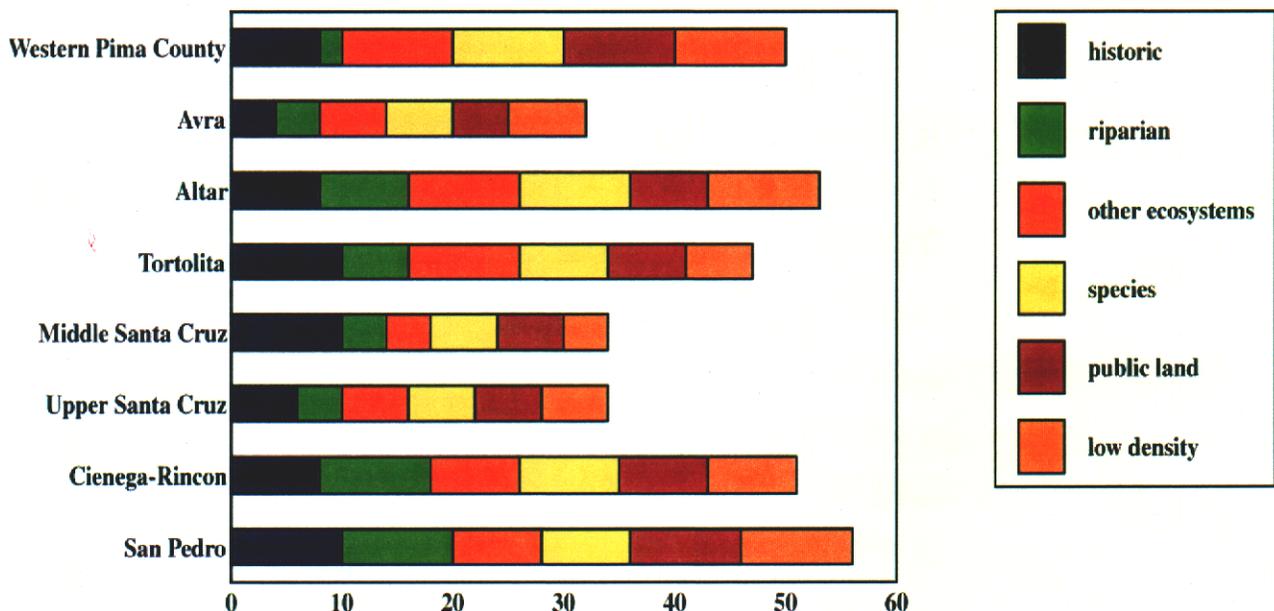
### Where Development Occurs

Factors that influence where housing will be built are proximity to areas where people work, availability and cost of land, availability and cost of infrastructure and water, ease and cost of construction, and scenic values. In the case of some high-end development, availability of land and water for a golf course may also be significant. Factors that Affect Wildlife Habitat

Many people consider the term "development" to be highly misleading, since it implies that somehow native desert is lacking until man-made structures are put on it. One this has happened, it has been developed which implies "improved." For lack of a better term in common use, we speak of development when we mean the addition of man-made structures and the amenities that go along with them, such as roads and sewers.

Most wildlife has very specific requirements that are usually in conflict with the demands of humans, although some species such as lizards and quail may coexist quite well with humans in certain areas. Availability of food, shelter from the elements and from predators, nesting and breeding areas, water, and relatively undisturbed travel routes are factors that affect many species.

In addition many species have much more specific requirements. Some plants, for example, only grow on limestone soils. Many bats require caves of a specific temperature that are undisturbed for roosting. Native fish species require dependably flowing streams that are not dominated by bullfrogs. Little is known at this time about the minimum and preferred requirements of some rare species.



**Comparative Resources of the Subareas.** This chart is a schematic representation of how the subareas compare in certain significant ways. Each resource is measured on a subjective scale of 1 to 10.

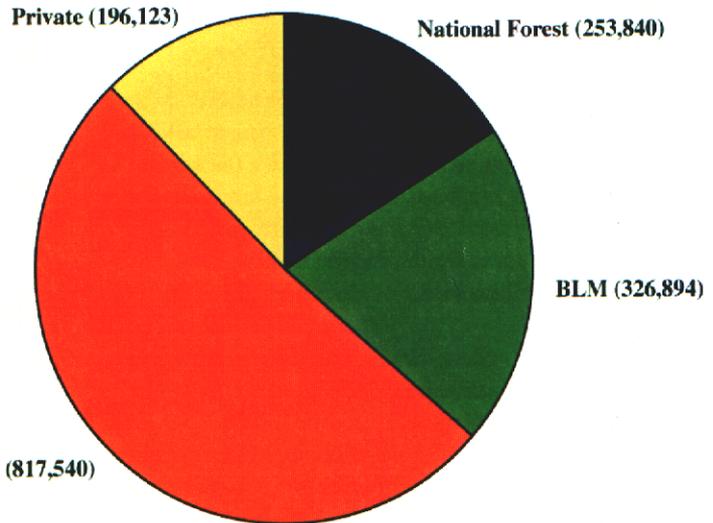
## The Rural Subareas

The San Pedro, Cienega-Rincon, Altar Valley, Avra Valley, and Western Pima County subareas are predominately rural, although parts of the Avra Valley are beginning to urbanize. These areas all have a high percentage of public land

Ranching is a major land use in these areas, especially in the San Pedro and Altar Valleys where historic family ranching predominates. The ranching lifestyle is important to residents. Because of the low population levels, these areas are also refuges for wildlife and native plant species as well as offering the other values of open space. The Western Pima County, Altar, and Cienega-Rincon subareas have more species that are endangered throughout their range than the other subareas as well as more vulnerable species of all types.

These areas also tend to have many known undisturbed archaeological and historic sites, although they are only partially surveyed.

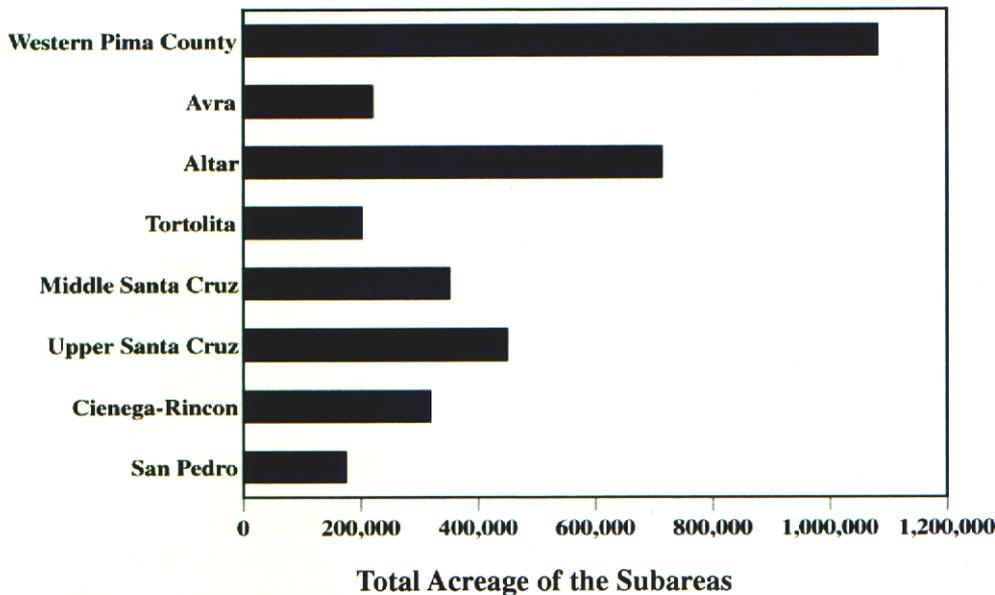
Land values in these areas are generally low so it is sometimes possible for a developer to acquire large areas of land cheaply. There are, however, few services such as wastewater treatment, roads, or sheriff service in these areas and it is much more costly to provide those services in remote areas than it is to provide them in the urban core. The water supply is often limited in these areas and alternate water supplies not economically available, except in the Avra and northern Altar subareas.

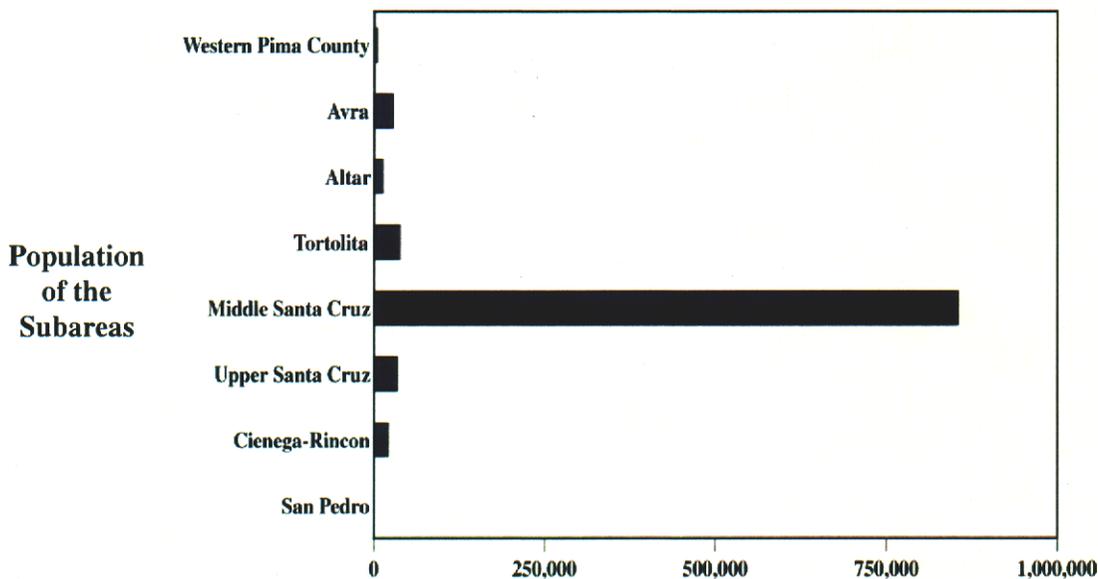


Land Ownership of Grazed Lands (acres)

### Things to think about

The main issues are whether or not to make efforts to preserve the open space character of these areas, and what methods to use if preservation of the area and its rural lifestyle is the goal. If these lands are to continue to be good locations for wildlife, what provisions should be made to protect the wildlife while respecting property rights. Should developers be offered the opportunity to put subdivisions in less vulnerable areas elsewhere by setting aside lands in these areas? What assistance (if any) can and should be offered to help ranchers keep their private and leased lands? How can nonprofit groups help in facilitating measures such as conservation easements? Should incentives be offered for land management that enhances habitat, such as fencing off riparian areas?





### The Urban and Urbanizing Subareas

The Upper and Middle Santa Cruz and the Tortolita subareas are predominantly urban or in the process of urbanizing, as are parts of the Cienega-Rincon and Avra subareas.

Population in the early years was almost entirely centered in or near the original square mile city, so population density in the City of Tucson in 1880 was 3,500 people per square mile. Over the years the city limits expanded, so now that there are 482,000 people in city limits, the density is only 2,500 people per square mile. Further much of the population spread has been outside Tucson city limits where population pressures are the greatest.

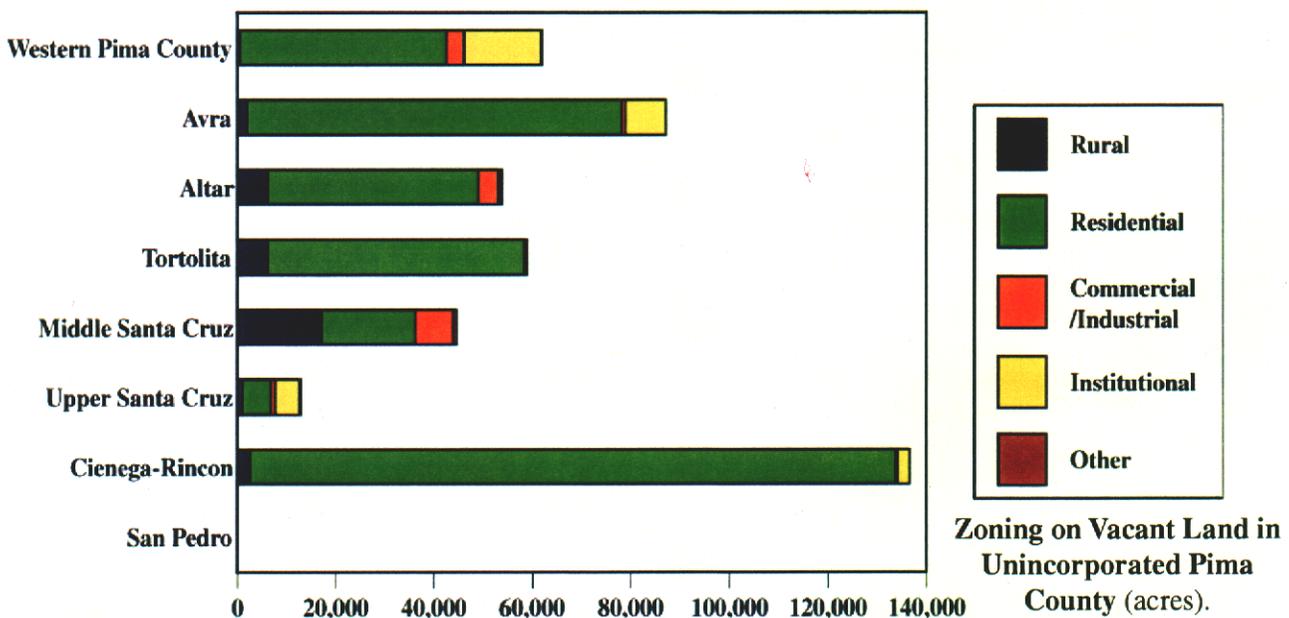
Population is unevenly spread around the county, but the vast majority of the people live in the Upper and

Middle Santa Cruz and Tortolita subareas today. As these areas have begun to fill up land values generally increase and population pressures move to outlying areas. In addition, population growth in the Tortolita subarea has slowed down greatly with proposed designation of critical habitat there.

Today we see increasing population pressures in the Cienega-Rincon subarea, the Avra subarea, and in the Upper Santa Cruz subarea where there is still vacant land at a lower price than in other areas. Since some of these areas have prime wildlife habitat, important aesthetic values, lack of infrastructure, and flooding problems, the impacts on these subareas needs to be considered, as do the impacts of continuing to populate the core areas.

### Things to Think About

How to provide affordable housing with the necessary



public services without damaging other values is a major issue. Should new development be more closely tied to planned provision of infrastructure, or should provision of infrastructure continue to follow new development for the most part? Are more impact fees appropriate to pay more of the costs of infrastructure and services? Should development outside of planned subdivisions be required to pay more of the costs created by them if developers are required to do so?

Are more recreational facilities (both natural parks and places such as playgrounds and ballfields) needed for the growing population so that existing areas are not overused to the detriment of people and wildlife? Should more restrictions be placed on golf courses and their water use?

## Subareas with Riparian Resources Watercourses

Subareas with perennial or intermittent riparian resources are San Pedro, Cienega-Rincon, and Altar Valley. The Upper and Middle Santa Cruz and Tortolita subareas also have riparian areas, but primarily on public lands, although those areas formerly have much more extensive surface water resources. These natural riparian areas and cienegas that get their water from shallow groundwater and precipitation are valuable wildlife habitat, especially for native fish, frogs, and birds. Generally, the longer the perennial or intermittent stretch, the greater the wildlife value, although small areas can be important for many species. These areas are threatened by exotic species, groundwater pumping, and by construction in and close to the floodplain.

Downstream of the Roger Road and Ina Road wastewater treatment plants are riparian areas dependent on treated wastewater of poor to moderate value for wildlife.

All of these subareas have xeroriparian areas that only flow a few times a year or even less, yet support more vegetation than the surrounding area. These can play important roles for wildlife as well as for mitigating flood

damage. Xeroriparian areas in the urban regions are the most threatened when they are straightened or cemented to optimize land use in the floodplain and adjacent areas.

## Springs

Most of the more than 250 springs in Pima County are in the Coronado National Forest, both in the Catalina Mountains and the Santa Rita Mountains. Springs are also found in the Altar Valley, Cienega-Rincon subarea and the far eastern side of the Middle Santa Cruz subarea. Fourteen of the springs are thought to have perennial flow, and the remainder flow intermittently. Twenty five are found on private land, with the majority of those in the Middle Santa Cruz and San Pedro subareas. Thirteen springs are on the Tohono O'odham Nation. Springs are important to thirty vulnerable species and seven springs have fish, including both native and nonnative species.

A well-known spring in the Tucson Valley is at Agua Caliente Park on the far east side. This park is owned by Pima County and used for birdwatching, hiking, and picnicking. Another spring in this area is La Cebadilla Spring which provides water for a lake owned by the La Cebadilla Homeowners Association. Nine Sabino Springs in that general area are privately owned and within a golf course and some are diverted into a detention basin.

The main concerns are ensuring that springs on private land, or whose water supply depends on water sources on private land, are protected from loss of their water supply, and management of nonactive species. Some of the springs are good locations for reintroduction of native fish and frogs.

## Shallow Groundwater Areas

Many of the perennial intermittent water sources flow because they are in shallow groundwater areas where the water table is high enough to connect with the surface water. In historic times shallow groundwater occurred

### Significant Riparian Features in the Subareas

Subarea	Major Riparian Features	Characteristics
Cienega-Rincon	Cienega Creek, Davidson Canyon	Perennial, intermittent, shallow groundwater
San Pedro	San Pedro River Buehman Canyon and other streams	Intermittent, riparian Perennial, intermittent
Upper Santa Cruz	Streams, springs in the Santa Rita Mountains	Perennial, intermittent
Middle Santa Cruz	Streams, springs in Catalina Mountains and foothills Tanque Verde, Agua Caliente and other east side locations Santa Cruz River	Perennial, intermittent Shallow groundwater, spring Effluent-dominated
Tortolita	Streams, springs in Catalina Mountains and foothills Honeybee Canyon	Perennial, intermittent Intermittent
Altar Valley	Arivaca Creek Streams in Baboquivari Mountains, Brown Canyon	Perennial, intermittent, cienega Perennial, intermittent
Avra Valley	None	
Western Pima County	Quitobaquito	Perennial spring, pond

along the Santa Cruz River, the Rillito River and numerous other locations. Now, the subareas with shallow groundwater are along the San Pedro along the river, the Cienega-Rincon subarea along Cienega Creek and Davidson Canyon, on the far east side of the Middle Santa Cruz subarea along Tanque Verde Creek, Sabino Creek and some other areas, and in the Altar Valley subarea in several places.

A very slight drop in the water table can interrupt the perennial flow and a drop of a little more can interfere with intermittent flow. There is some groundwater pumping along shallow groundwater areas in most of these places already. Any additional pumping in any of these areas would jeopardize the flow and ability of watercourses to support riparian vegetation and wildlife. Arizona water law does not have any provisions to limit pumping to protect these areas. Major concerns are to find other ways to limit pumping such as providing alternate water sources, limiting rezonings, and purchase of land where such pumping might occur.

### Things to Think About

What measures should be taken to protect the remaining perennial and intermittent streams on private land? Should local governments purchase additional floodprone areas to protect the watercourses in the area and downstream?

Should programs be developed to reintroduce native species in appropriate locations? Should programs be developed to reduce harmful exotic species through removal and public education to help the native species or make native species reintroduction feasible?

Should new water sources be provided either to replace groundwater pumping for aquifer recharge, or for direct use in the streams? New water sources are most easily available in the urban area where CAP water and reclaimed wastewater are most readily available. What precautions need to be taken to assure that such introduction does not cause new problems?

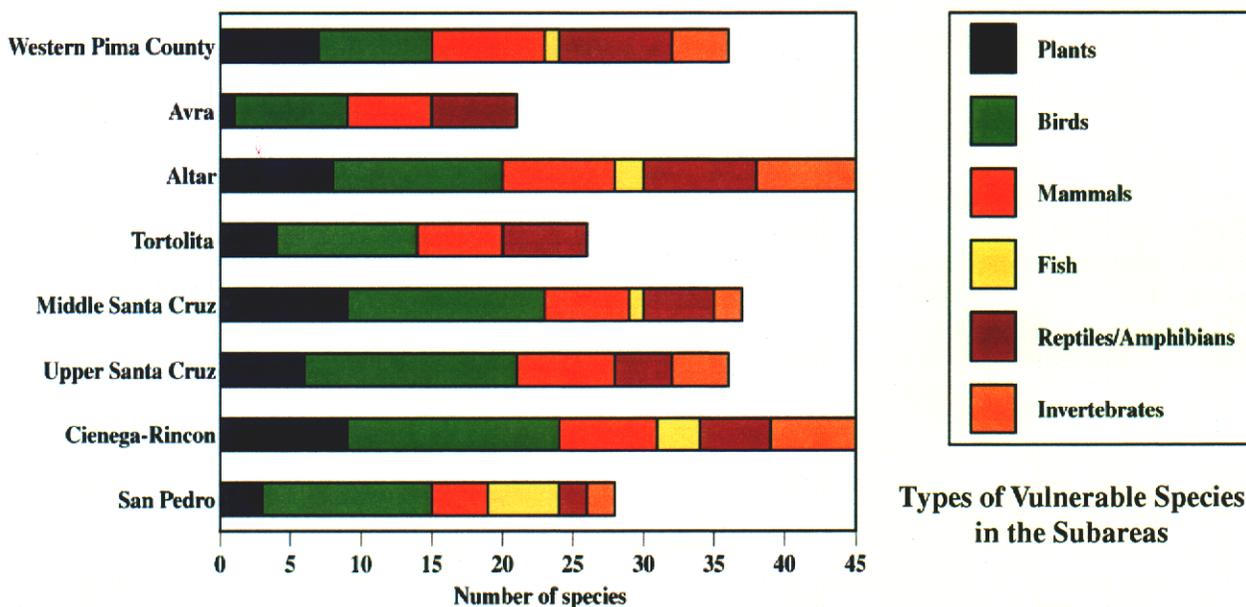
Are stronger local ordinances needed to protect the xeroriparian watercourses? Should local government acquire more of the watercourses still in a relatively natural state and connected with reserves in order to preserve the wildlife corridors?

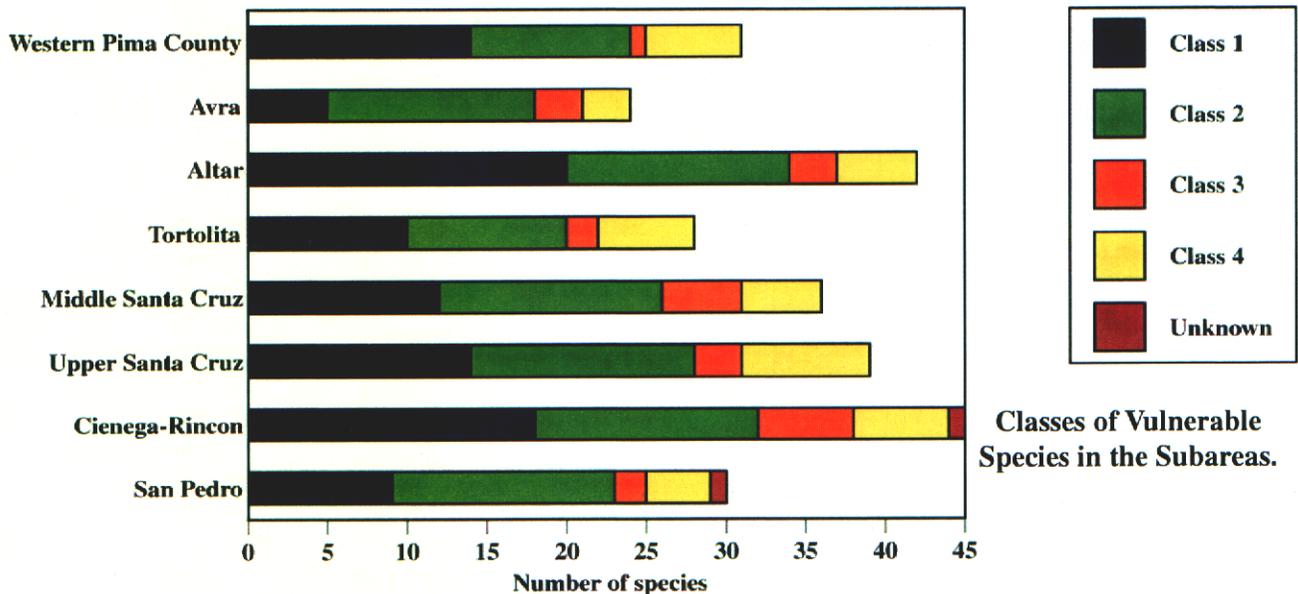
### Subareas with Vulnerable Species

Vulnerable species are found in all the subareas. The subareas with the most critical species (those in Class 1) are Cienega-Rincon, Altar, and Western Pima County subareas, closely followed by Middle and Upper Santa Cruz subareas. The same subareas also have the greatest number of the most vulnerable species, those Class 1. The San Pedro subarea has more native fish species than the others. While in many cases, the vulnerable species spend much of their life on protected land at the higher elevations, many others require the lower elevations for at least part of their life. The Cactus ferruginous pygmy-owl, for example, is not found above about 4,000 feet elevation and thus is mostly found on private and state land subject to development and rather than in the National Forest. More than one-fourth of the vulnerable species are plants with very specific requirements for where they can survive. The Nichol's turks head cactus, for example, is only found in the far northwest part of the Avra subarea in a hilly location and at similar places on the Tohono O'odham Nation.

Some species only survive in a few parts of Pima County, although they once were common more generally over a large area. The Sonoran pronghorn antelope once roamed over large areas of Southern Arizona but is now only found in the Western Pima County subarea and adjacent remote parts of Yuma County and Sonora because of hunting and loss of habitat. Attempts to reintroduce antelope into the Altar subarea have had a poor success rate.

Some species were once common in Pima County, but





are no longer found here. They have been extirpated from the area. Nineteenth century settlers found a plentiful supply of wild turkeys along the Upper Santa Cruz River, for example, but these are gone because of hunting and loss of habitat. The settlers also described encounters with grizzly bears through the 1890s, not only in the mountains, but also along the Santa Cruz and Altar valleys. The last grizzly bear in Arizona was killed in Gila County in the 1930s. The closest wild grizzlies today are far to the north in Wyoming and Montana.

While the Middle Santa Cruz subarea has a very high number of vulnerable species, few, if any, of those species are found in the populated areas. A similar trend occurs in the Upper Santa Cruz, Cienega-Rincon and Tortolita subareas where the vulnerable species are most liable to be found on protected land, often at the higher elevations.

The subareas facing the most threats to vulnerable species today are the Tortolita subarea, the northwestern part of the Cienega-Rincon subarea, and the eastern part of the Middle Santa Cruz subarea. This is because these are the areas where development pressures are the greatest.

Federal law requires that species designated as threatened or endangered by the U.S. Fish and Wildlife Service be protected as described earlier in this book. Special protective rules apply in certain areas designated as "critical habitat." The Arizona Native Plant Law prohibits removal of protected plants from a property, but does not prohibit destruction of the same plants once certain requirements have been met. Pima County and some cities have ordinances limiting destruction of native plants under some conditions. These laws help but do not fully protect vulnerable species.

### Threats to Vulnerable Species

The primary threats to vulnerable species are loss of habitat in the areas where population is expanding, loss of water supply in riparian areas as described in the preceding section, conflicts with humans and their pets, competition

from exotic species, especially in the riparian areas, and increased fire hazards where exotic grasses have invaded areas where plants occur that are not adapted to fire, especially in the Saguaro National Park and Tucson Mountain Park.

### Things to Think About

How should we design our plans for protecting the species that must be protected under federal law? What is the most effective way to protect the individual species while conserving habitat for other less protected species? How should this be done to increase predictability for landowners and builders?

What should be done to reduce the threats to, those species? To what extent should protection be done by new ordinances, by incentives, by land acquisition, or by working with private landowners in ways that benefit them and the species?

### Subareas with Potential and Actual Connected Biological Resources

While all of the subareas except Western Pima County are connected to nearby subareas, the subareas where major biological resources cross subarea lines and where secure connections between reserves will be valuable are:

- . Cienega-Rincon and Middle Santa Cruz
- . Tortolita, Avra, and Middle Santa Cruz
- . Upper Santa Cruz and Cienega-Rincon
- . Middle Santa Cruz and Avra

In addition, four subareas are connected to biological resources in adjacent counties.

- . Tortolita and Avra subareas and Pinal County
- . Upper Santa Cruz, Cienega-Rincon and Altar subareas and Santa Cruz County
- . San Pedro and Pinal and Cochise Counties.
- . Western Pima County and Yuma and Maricopa counties

Finally, the Altar and Western Pima County subareas are connected to Sonora.

While some wildlife, especially those with wings, can move easily between reserves, earthbound creatures such as mammals and lizards cannot. Some, such as the mountain lion require large ranges for hunting. Other species such as bighorn sheep have smaller ranges but may need to move around to find mates if they are to avoid inbreeding. Some also require different ranges in different seasons to find plentiful food year-round. Still others, such as tortoises have small ranges but need to cross roads while foraging.

Riparian areas and dry washes often serve as wildlife corridors and when these watercourses go under bridges the animals can continue on safely. Other methods can also be used to assure relatively safe passage.

### Things to Think About

Should watercourses generally be left natural in order to function as wildlife corridors? What efforts should be made to minimize road kill? Are more land use restrictions needed to preserve corridors and connect open space reserves?

Should local governments acquire additional land to help make the connections? Should they work with private landowners to assure that existing corridors continue to serve their purposes?

### Subareas with Significant Cultural Resources

Measuring the historical, archaeological, and cultural values of an area by the number of known sites can be misleading for three reasons. First, sites are hidden and are only found when someone actively searches for them or when construction of new structures reveals them.

Secondly, many sites were destroyed before they could be recorded. Third, the number of sites is not a very good indicator of the number of people or their length of using the site. A small number of people probably occupied many of the prehistoric sites for relatively short periods of time or even seasonally. One historic ranch house might be an indicator of a very small number of people who actually controlled a large territory. There are undoubtedly many more places where humans lived in the past than will ever be discovered.

The chart below, however, gives some idea of the relative richness of the subareas. All the subareas have significant historical and archaeological resources, but the subareas with the highest level of known prehistoric resources are Tortolita, Cienega-Rincon, and Middle Santa Cruz subareas. The San Pedro subarea has the fewest prehistoric sites. The Middle Santa Cruz and Cienega-Rincon subareas have the most historic period sites, while Altar, Avra, Upper Santa Cruz and San Pedro have the fewest.

The subareas with the greatest threats to archaeological and historical resources are the ones where development pressures are the greatest, the Middle Santa Cruz, Tortolita and Upper Santa Cruz. One really important Hohokam site, for example was found, briefly studied, and built over within a period of just a few months when a freeway interchange at Miracle Mile was upgraded.

The laws controlling destruction of sites are limited in their effect. Federal laws protect sites on federal property from looting and destruction, but in some instances can apply to nonfederal lands, including private property. State laws protect human remains on private property but do not protect the sites where the grave are located. Local



Number of Archaeological and Cultural Sites in the Subareas.

laws, when applicable, are geared mostly toward salvage in advance of development, not conservation for the future.

### Things to Think About

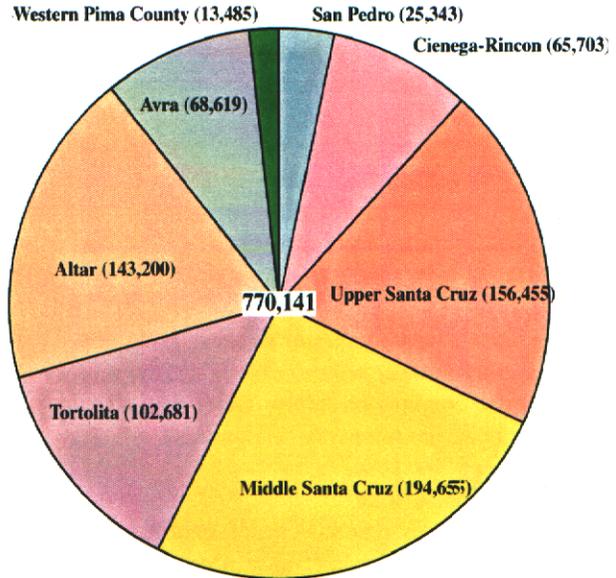
Should sites like the Canoa Ranch in the Upper Santa Cruz be preserved and made into a living history museum? How should The City of Tucson incorporate historic museums and sites into its Rio Nuevo Project? What other sites should be preserved and made into tourist and educational attractions?

Do we need stronger local ordinances to prevent destruction of important sites on private land? Should we have incentives for preserving historic portions of land used for subdivisions or other purposes?

### Subareas With Development Pressures

All the subareas have land that can be developed because it is in private hands and may, be used at least to the level of its current zoning. In addition, all subareas have State Trust Land which may be sold for private use. Parts of these lands may not be developable for various reasons, such as that they are in floodplains or on steep slopes.

The subareas with the largest amounts of private land are the Middle Santa Cruz, Upper Santa Cruz, Tortolita and Altar Valley subareas. The same subareas have the largest amounts of combined private and State Trust Land which could be subject to development, with Altar Valley having the most "developable" land. The Avra, San Pedro and Western Pima County have the least private and developable land. In general, existing land uses and zoning in the least developable areas are rural, except for the town of Ajo. Zoning in the most developable areas range from



Private land in the Subareas (acres)

rural to very dense. In the Altar Valley there is Should these areas be targeted for land and habitat preservation purposes? What voluntary or mandatory measures should be adopted to reach the goal? Should dense development be directed toward the existing urban areas? If so, how?

### Subareas with Multiple Jurisdictions

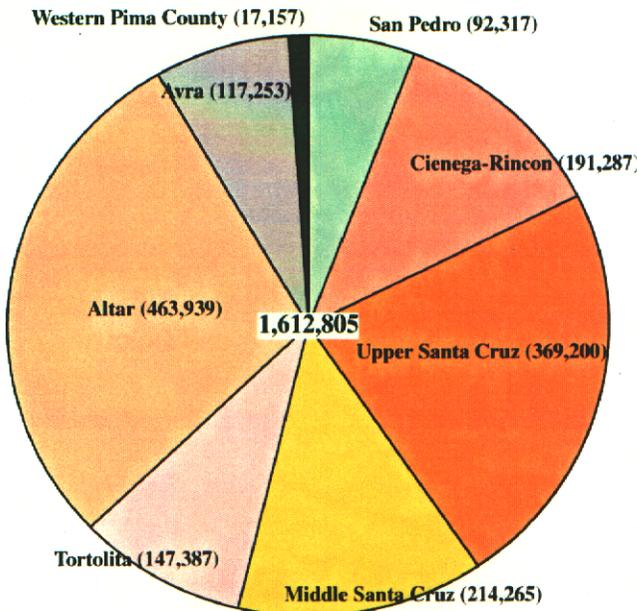
Some of the subareas are governed by more than one local jurisdiction which can make coordinated planning difficult if the jurisdictions do not agree.

A portion of the Cienega-Rincon Subarea is within the City of Tucson and annexation of additional parts is likely. The rest is unincorporated. The Upper Santa Cruz subarea has the incorporated town of Sahuarita, unincorporated areas like Green Valley, and the San Xavier District of the Tohono O'odham Nation.

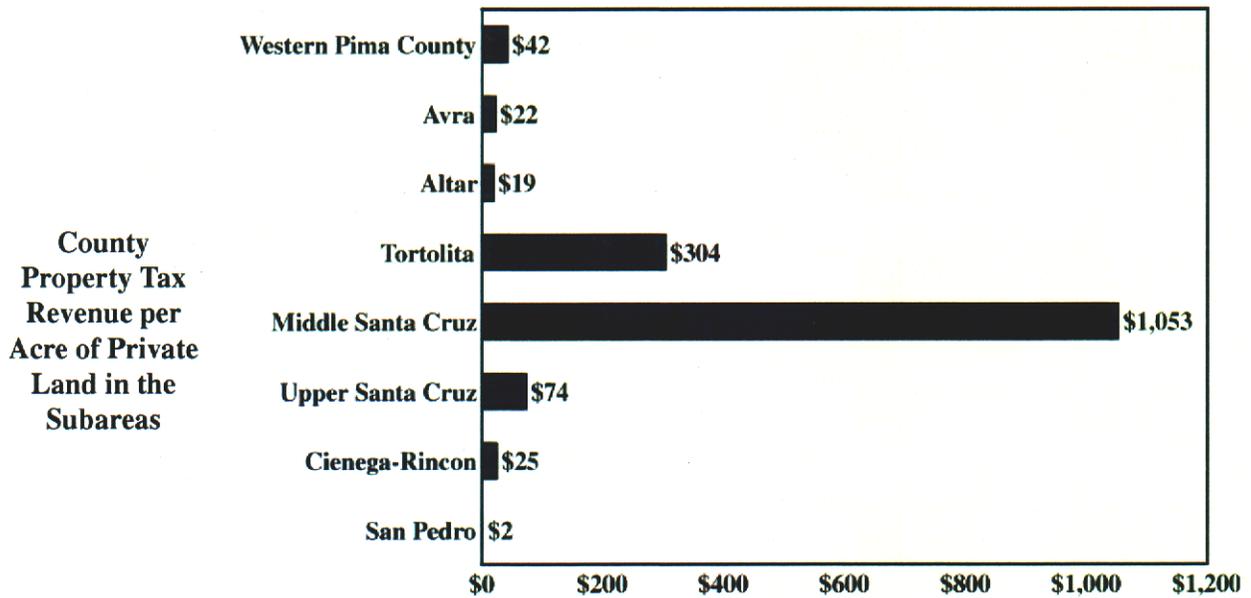
The Tortolita subarea has the towns of Marana and Oro Valley, the potential for two more towns, Tortolita and Casas Adobes, and unincorporated land. The Middle Santa Cruz Subarea contains Tucson, South Tucson, Marana, and unincorporated areas. The Avra Subarea contains the town of Marana and unincorporated areas. Western Pima County is entirely unincorporated.

In addition, state and federal public agencies own major portions of most subareas. School district boundaries can only be changed by a vote of residents, while cities can change their boundaries by annexation through a public process.

Tucson School District #1 is mostly within the City of Tucson but Tucson also includes parts of the Amphitheater, Flowing Wells and Sunnyside Districts. The Amphitheater School District extends into Oro Valley and Marana, as well as unincorporated areas. Decision making about where new development will go is made by decision makers without responsibility for providing the schools. Developers, for the most part, are not required to provide



Potentially Developable Land in the Subareas: Private and State Trust Land (acres).



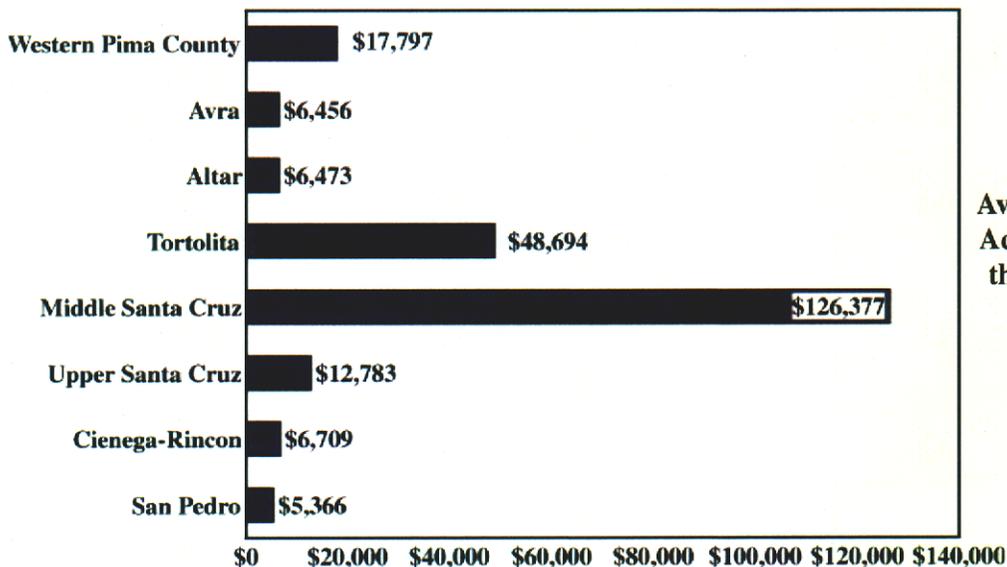
land for new schools or help build new schools through impact fees, as they are in some other localities. School districts are dependent mostly on property tax revenue which is lower in the rural subareas and on state money which lags far behind the need.

More than 150 water providers serve water customers in the county, although the vast majority of customers are served by Tucson Water and five other companies. Water service, too, ignores city boundaries, with Tucson Water providing service both inside and outside the city and private water companies also providing service within city limits. In addition, more than 20,000 individuals have their own wells. This patchwork of water utilities makes overall water management in the area difficult and also makes it difficult to protect shallow groundwater areas by

bringing in alternate water supplies. Since utilities must provide service to new customers within their service area,

#### Things to Think About

Are more coordination and cooperation needed among cities, school districts, water providers and the county to assure that growth impact and expenses occur where they will be cost-effective for governments? Is more coordinated water management needed in the area so that alternate water sources can be spread more equitably? Should additional impact fees be charged to help pay the costs of new development both for the government entity responsible for the rezoning and for new facilities and services?



Average Cash Value Per Acre of Private Land in the Subareas (Includes buildings and other improvements).

## Some Conclusions

The subareas have very different resources and characteristics as discussed in the previous pages. When all the most important features are combined, some significant trends emerge.

The table below shows the relative resource values in the subareas. Green indicates the area with the most desirable rankings for each resource and red the least desirable from the point of view of the biological and historical resources. Column 1 gives the number of priority streams. Column 2 shows the number of vulnerable species. Column 3 indicates the number of acres grazed. Column 4 measures integrity of historical and archaeological resources, fewest people.

There are many factors to consider when deciding how to spend limited resources to protect the maximum resource values. The next chapter looks at some of those other factors.

Most of the vulnerable species in these subareas are on National Park and National Forest lands, while in the rural subareas the species occur throughout the area, including the private and State Trust lands.

Low population density, however, is not the only factor in the number of vulnerable species or priority streams. The Western Pima County subarea is almost entirely in federal ownership and much larger than any other subarea, yet the number of species is relatively low and there is

only one priority stream. Here the rainfall is very low and the desert conditions extreme, important factors. The San Pedro subarea has a surprisingly small number of vulnerable species and priority streams, but is also the smallest subarea.

## Setting Priorities for Preservation

These comparisons can, however, help somewhat in prioritizing the subareas and locations within subareas that might be prime candidates for land preservation. Altar Valley, especially in the Arivaca area, and Cienega-Rincon, especially along the Cienega Creek corridor rank high in resources and have relatively low land costs.

The Middle Santa Cruz subarea has the lowest resource value except on lands already protected and also the highest land cost and population levels. Its historical resources are very comprised, but there are still some valuable historical and archaeological sites deserving or protection

The Tortolita and Upper Santa Cruz subareas have some very important biological and historical resources and species that need preservation, but relative to the first two, these subareas have fewer resources and higher land costs. In these two subareas, protection of the remaining resources could include some land acquisition, but also depend less on land acquisition and more on improved land use management and density controls.



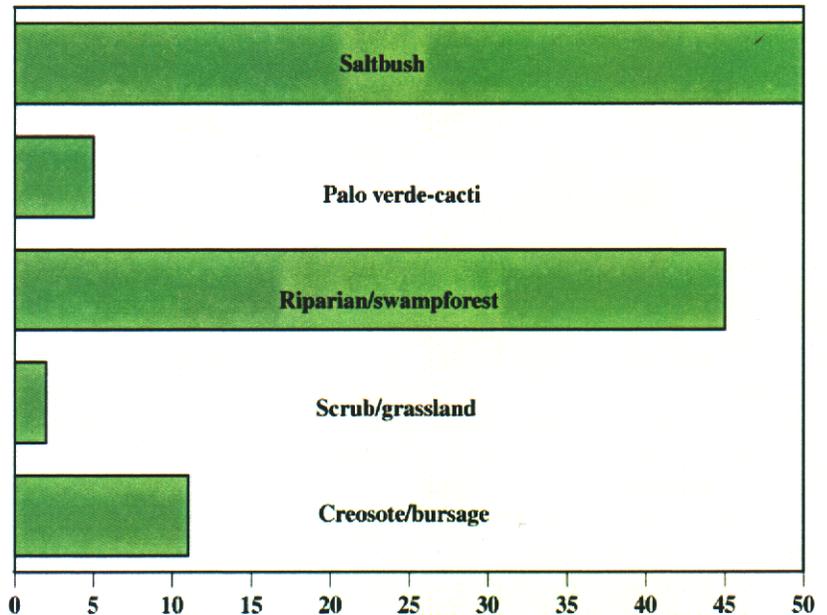
Comparison of Significant Elements in the Subareas.

## V. OPTIMIZING BENEFITS FOR PEOPLE AND WILDLIFE

Since time immemorial, water has been a focal point for living things in this region, although when humans first arrived in the area, the climate was cooler and wetter, so water supplies were more abundant. For at least 5,000 years, however, the climate has been pretty similar to what it is today and water sources have been prime spots for wildlife and humans alike. It is for this reason that watercourses and springs are so important in Southern Arizona. It is no coincidence that they are the areas near which we also find major archaeological and historic remains as well as the most abundant wildlife. Vegetation is often more lush along watercourses and some species can only grow where there is permanent water or water very near the surface.

In the past century humans have generally prevailed when there is competition for watercourses and there are many fewer places today where water-dependent wildlife can thrive. This has affected both the common species and those that have become increasingly rare, as most forms of wildlife need watercourses for some part of their life cycle.

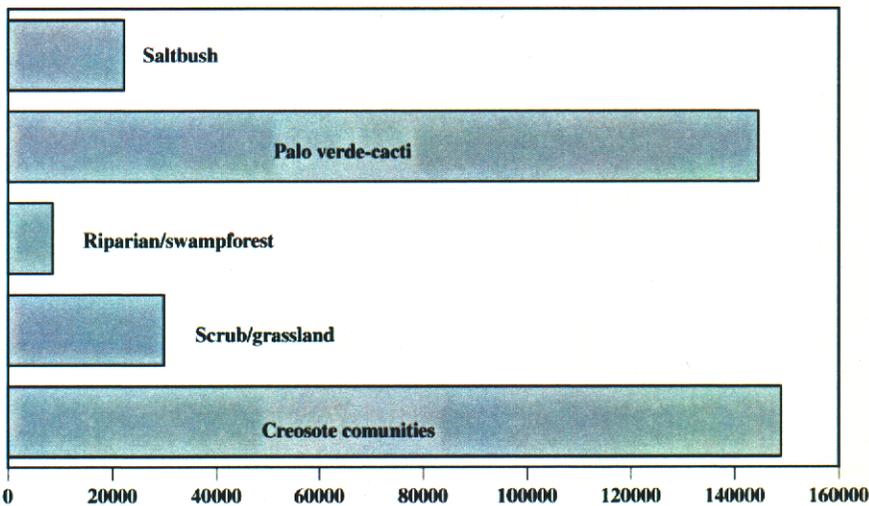
Because of the human demands, it is the watercourses that have changed the most as humans taken the water from them and built urban areas near them, further changing them. Even though people no longer need to live near surface water, their groundwater pumping has dried



Percentages of Vegetation Types Converted to New Land Uses in Pima County

up some streams and springs. The nature of flooding, too, has changed drastically since the last century, with floods being much more severe and damaging to human structures as well as the watercourses themselves because of human construction on the floodplain and on the watersheds.

Other natural areas of the region have also changed over the past century. The National Forests have preserved a high percentage of the upper elevations and much of the mid elevations, although overgrazing and over-recreation have taken their toll. Saguardo National Monument and Tucson Mountain Park have preserved large stands of saguaros and their companion species, although many thousands have been destroyed for urban development. Organ Pipe National Monument has preserved the organ pipe community and the new Ironwood National Monument will help preserve a significant part of the ironwood habitat, an important area for a whole range of species, but many acres of ironwood habitat have also been destroyed in the past decade and



Acres of Vegetation Converted to New Land Uses in Pima County.

more. The most changed habitats are the less spectacular ones - the grasslands and creosote flats which are important to many forms of life. These areas are relatively appealing areas for farming and for home building as well as being ideal areas for some rare plants and for birds and other wildlife.

In destroying and damaging plant communities, humans have often also destroyed archaeological and historic remains since humans also used the same areas in the past.

### **Developing Win-Win Scenarios**

Continued population growth inevitably has impacts on wildlife, scenic values, and availability of resources. Protecting certain lands from development or new laws to restrict development will, in turn, have impacts on availability and where people choose to live.

In this section we examine ways to minimize those impacts and still provide housing and services for people. We attempt to identify criteria needed to determine which areas the community may decide to prioritize for protection or rehabilitation and the areas where human population growth or other activities should be directed. We look at these questions from the perspectives of wildlife needs, human needs, fairness, and economic viability.

### **Historic Sites, Wildlife, and Tourism**

Many of the major archaeological and historical living areas were located in areas that are today occupied. Most of these sites have been lost, but some were at least partially studied before they were destroyed. There are many important sites, however, located in more remote

areas that for various reasons have not yet seen intense development, along Cienega Creek or the San Pedro subareas for example. Historic ranching sites are often still occupied by ranching families. A few remains of ghost towns associated with mining remain in places like the Altar Valley. Major undisturbed prehistoric sites are found in the Tortolita Mountains in areas where the many small washes were utilized for monsoon farming. The San Pedro Valley is rich in prehistoric and historic sites. Other examples abound. The county also has sites from prehuman times where fossils of creatures such as dinosaurs have been found. Others are surely there yet to be discovered.

Federal law requires public agencies to make archaeological studies before initiating major projects. Local laws require developers to provide for brief surveys of sites with probably archaeological value. If remains are found on a proposed building site, they must be repatriated to the appropriate tribe. Once these obligations are fulfilled, the site may be destroyed.

Historic sites are very popular destinations for tourism throughout the state. Pima County has few historic sites designed to attract the tourist and many of these are in the downtown Tucson-area. Ft. Lowell is the only site that has been made into a public park. This park contains both historic and prehistoric sites for the public to view. Additional sites preserved and made available to the public with educational information could benefit tourism greatly, as well as local residents.

Preserving and restoring historic sites can also benefit wildlife by assuring that the area maintains its open space values, rather than become a subdivision or commercial development. Many of these sites are in locations also



This ancient Hohokam village in Marana was recently destroyed in order to build a subdivision. A short time was allowed for archaeological investigation and a small part of the site was saved as a park.

favorable to wildlife.

If a site is to have multiple uses, care needs to be taken, however, that providing access to these sites does not itself have severe impacts either on the wildlife or on the current residents of the area. An popular historic site in the San Pedro subarea, for example, would have a severe negative impact on the area if road improvements were deemed necessary for the tourists. This, in turn, would impact the river, the wildlife, and the quiet lifestyle of current residents, and would attract commercial development to serve the tourists. Development of Kartchner Caverns, not very far away, has radically changed the surrounding area, for example.

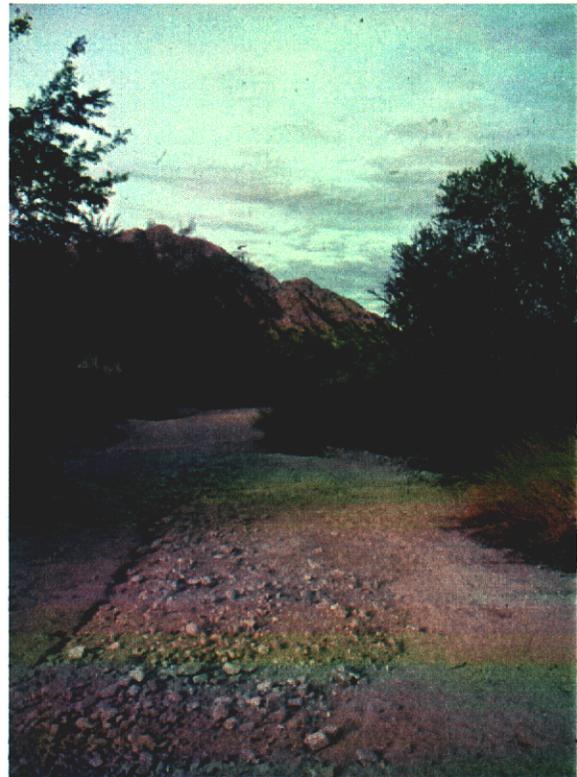
The historic Canoa Ranch, near Green Valley, offers an unusual opportunity to preserve open space and develop a popular historic site without severe impacts on the local area.

The City of Tucson has plans for historic museums and restored historic sites in the downtown area in the Rio Nuevo Project. This project also incorporates some rehabilitation of the Santa Cruz River. There are many other opportunities for this kind of project.

### Recreation and Wildlife

Humans tend to enjoy recreation in and near bodies of water, whether they are lakes, streams or swimming pools. Humans also enjoy recreation in other kinds of open space areas, whether skiing, camping, hunting, hiking, bicycling, watching wildlife, walking the dog, or driving off road vehicles (ORVs). Many of these activities are fully compatible with wildlife if done carefully. Others can be highly disturbing to wildlife.

The Cienega Creek Preserve, for example, offers people opportunities for hiking, walking the dog, watching trains, and wildlife viewing. The number of people



**A Natural Desert Wash**

visiting the area is limited by a limited number of parking permits so the impact on any day is small. Dogs must be on leash. ORVs are not allowed in the preserve. There are no picnic tables or campgrounds. This type of recreation management allows humans to enjoy the outdoors at a perennial stream while protecting wildlife.

Other recreational areas are much more highly used and sometimes overused, to the detriment of wildlife. Areas on Mt. Lemmon, for example, are very popular, especially in the summer. Problems with interactions among people and wildlife occur and, in the case of bears, sometimes end with an injured human and the death of the bear. Water supplies, trash disposal, fire hazards, and other problems happen in the more popular areas such as Rose Canyon Lake, a fishing spot.

Saguaro National Monument offers people the opportunity to take scenic drives, picnic and take educational tours explaining the surroundings, history and wildlife. Guides show people the value of wildlife and what is needed to respect and preserve it. Overnight use is not allowed, nor is ORV use.

ORV use is popular, however, in some parts of the National Forest. This can be very damaging to vegetation and can stress wildlife.

Sometimes recreational opportunities on



Many urban washes have been channelized to remove floodwater quickly from the area.

public lands have been limited by lack of access to those areas as more and more of the lands along the preserve boundary are occupied by private homes or private golf resorts. A trail in the foothills of the Catalinas, for example, has an entryway lined with formidable fencing to separate hikers from homeowners. Washes in the Tucson Mountains that once were available for hiking may be marked "no trespassing" and fenced.

Design of preserves to protect vulnerable species or to provide areas for recovery of species can also incorporate compatible recreation, offering multiple benefits. It can also relieve pressures on landowners by providing alternate legitimate recreational opportunities.

Designing preserves for compatibility with wildlife involves considering the kinds of impacts that may be harmful to the plants and animals, and what limitations will be needed to minimize the impacts while maximizing recreational opportunities. Limiting the number of people who can visit at any one time can be done by limiting the number of parking spots, as was done at the Sweetwater Wetlands in Tucson. Permits can be required. Visits can be limited to prearranged tours, as they are at Pima County's Bingham Cienega.

Entrances can be designed to make it impossible to bring in ORVs. Paths can be designed so that hiking is within view of the stream, but not in it, as is done at many Nature Conservancy Preserves. Dogs can be prohibited in areas where they may chase wildlife or otherwise cause stress, or they may be allowed if kept on leash, as they are in Tucson Mountain Park.

Providing good outdoor recreation opportunities has not kept pace with population growth in eastern Pima County. Designating new preserves to protect wildlife can have the added benefit of providing recreation for people.

Providing some areas that have a low level of wildlife

to be used for recreation areas can also relieve pressures on the more vulnerable areas.

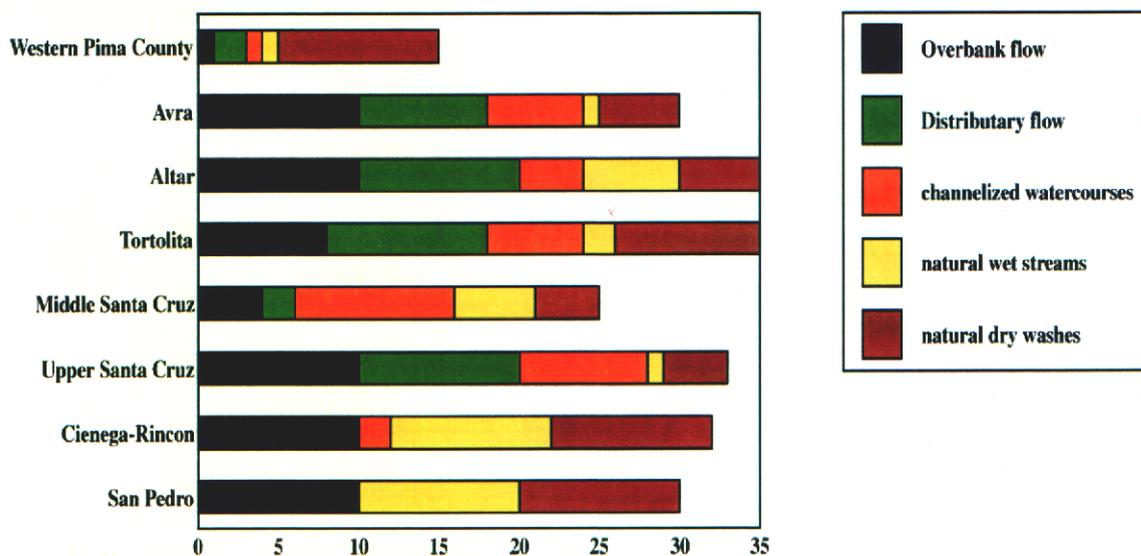
### Riparian Areas, Wildlife, and Flooding

Riparian areas usually provide habitat for wildlife, even if the washes are usually dry. They also serve the important functions of mitigating downstream flood problems, improving water quality, and promoting natural groundwater recharge. Traditional approaches to flood control, such as cementing and straightening watercourses to speed up floodwaters and prevent erosion have served that purpose for the immediate landowner, but have generally also increased flood problems downstream and reduced the amount of water that is recharged in the local area.

Preserving watercourses in a relatively natural state not only benefits wildlife, but also prevents downstream flood problems, improves water quality and promotes local recharge. The aesthetic values of vegetated washes is also high and can increase land values as many people would prefer to look at a natural area rather than a cemented one.

Pima County Flood Control District has acquired many acres of floodprone land to preserve the overbank storage areas, with all the added benefits for wildlife and people. The trade-off is that less land is available for human structures in floodprone areas.

Limits on structures, roads and pavement in the floodplains, and distributary flow areas, has multiple benefits for wildlife and the public and reduces public flood control and flood damage costs. Much of the Tortolita area has a complex flood situation. Many small washes come down from the Tortolita Mountains in shifting patterns that are difficult to predict - distributary flow. It is very expensive to provide adequate flood control for these areas. Not providing flood control can be

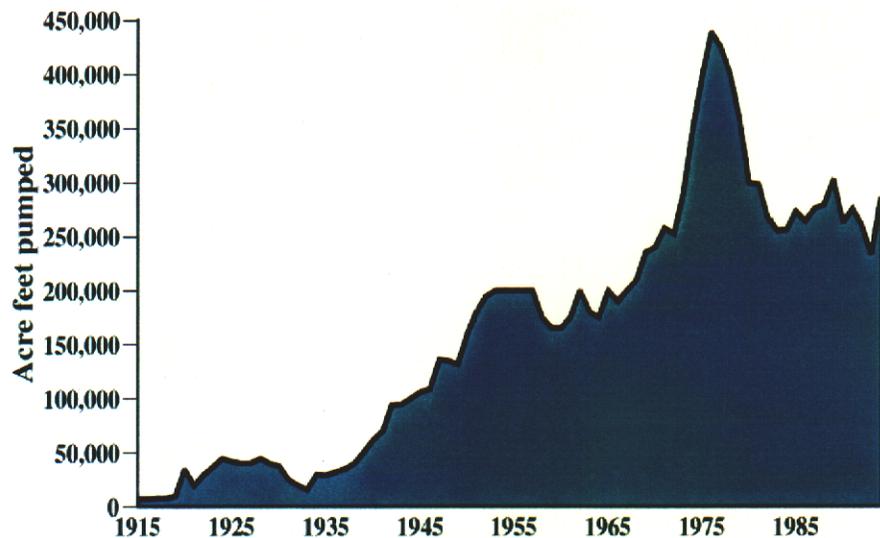


Schematic Representation of the Significant Floodplain Features in the Subareas.

(Each feature is ranked on a scale of 1 to 10.)

costly to people who live downstream. If these areas are left natural, the beauty of the area can be preserved, the saguaro-ironwood habitat can be preserved, and the costs and potential damages drastically reduced. Strict application of floodplain ordinances can be effective in this area, even without new legislation. Other places with large areas of this type of flow pattern are parts of the Avra Valley, and the section of the Upper Santa Cruz subarea north of the Santa Rita Mountains.

An important benefit for wildlife is maintaining wildlife corridors, an important function of watercourses. These wildlife corridors can also serve as hiking trails for people.



**Pumping of Water in the Santa Cruz Basin from Headwaters to the Pinal County line.**

### Water supplies, wildlife, and fairness

All new homeowners need to get their water from some source. They may be within the service area of Tucson Water and can then connect to that system. They may also be within the service area of a private water company or other water provider and use those facilities. They may also decide to drill their own wells, either because they are not within a water service area or because they choose to have their own well. Homeowners in Pima County currently depend on groundwater, but this will change in the next year as water from the Central Arizona Project (CAP) arrives to users within the Tucson Water Service area. Less than half the golf courses in the area use treated wastewater and the rest use groundwater. Most agriculture and all mines in the area also use groundwater, although in recent years some farms have switched to CAP. This means that there has been a severe drain on the groundwater supply which is far beyond the annual renewal from rain and snowmelt.

Pumping has affected water supplies for riparian areas in many locations, but there are still a few areas with shallow groundwater where pumping has not severely impacted the water supplies for riparian areas. Some of these areas are places, such as Arivaca or the Tanque Verde area, where new development may occur that could decrease the water supply for riparian areas. (See map). A loss of water for these areas would seriously impact wildlife, including some vulnerable species.

State groundwater law protects the aquifer to some extent, but is not designed to protect surface water supplies. Developers in the area are required to show that they have a 100-year water supply, but this can be

demonstrated in several ways, none of which are designed to save riparian areas. One method is for the developer to agree to help fund recharge projects somewhere in the region, although this does not have to be anywhere near the potentially impacted riparian area. Another method is for the developer to join up with a water provider that has CAP water. The developer may also drill a well as long as that well does not deplete the aquifer beyond a certain point, but that point is far below what is needed for the riparian area. Individual homeowners may drill wells for their own use with few restrictions and more than 20,000 homeowners have done so in the area. While this small scale drilling does not in itself have a major impact on the shallow groundwater areas, the cumulative effect of many such wells can have serious consequences.

The customers of Tucson Water and a few other water providers have taken on most of the burden of providing alternate water supplies to the area. The CAP is a major renewable supply which will help reduce the decline of the aquifer, but other users in the area who benefit from having an alternate supply do not significantly help pay for this expensive new water source.

Treated wastewater is another water source that can alleviate the aquifer decline, but building the pipelines to distribute the wastewater to outlying areas is expensive and again, the costs of prolonging the groundwater supply is not fairly distributed among all water users.

New construction in areas outside the areas of water providers that use CAP water can put pressure on riparian areas and increases the inequity of providing a long-term water supply for the area. These are some of the same areas where pressures on wildlife or rural life styles are the greatest.

## Endangered Species and Rural Life Styles

Some landowners have dreaded the discovery of endangered species as a threat to their lifestyle and what they can do with their property. Others welcome a great variety of species as an enhancement to their life style - in fact the very reason they choose to live away from the population centers. There are genuine concerns, however, that their income or expense will be severely affected if they must make changes because of the Endangered Species Act.

Designating certain areas as places for protection of wildlife or for recovery of declining species will limit what a landowner can do if the landowner wishes to retain the option of selling the land for residential or commercial uses in the future. It can, however, also offer real opportunities to the landowner who wishes to keep the land rural without government takeover of the land or loss of livelihood.

The most common private land conservation tools are:

- Purchase of development rights from willing landowners. The land remains under private ownership, but government buys the rights to develop all or part of the land in order to protect special areas from destruction.

- Conservation easements and deed restrictions. These, too, are voluntary and leave the land in private hands. The landowner transfers rights to part of the land to a qualified easement holder in a way chosen by the landowner, often with compensation. These are legally binding agreements and must be adhered to by subsequent buyers. In some situations there is a property tax or estate benefit to be derived from this status.

Agreements with landowners can offer a win-win situation. Landowners in the San Rafael Valley in Santa Cruz County have taken this approach. Rather than see the valley gradually turn into ranchettes or subdivisions, they have chosen to adopt several alternatives including a new State Park, to maintain their rural lifestyle. Most landowners in the area of the new Ironwood National Monument recognized the role that such a designation

could play in preserving their ranching lifestyle and supported the Monument.

Incentives offered to ranchers, however, need to be coupled with agreements to manage their land in ways that will benefit the habitat and wildlife. They may mean fencing riparian areas, providing alternate water sources, rotating grazing, limiting cattle numbers, especially in drought years, or exotic species management. Many responsible ranchers are already doing these things for economic reasons to keep their ranches healthy. Sometimes government tax or grazing regulations restrict what they can do as described in Chapter III. The County can work with the state and federal land management agencies to find solutions to these problems and seek changes in the tax laws as described in Chapter VI.

## Affordable housing, infrastructure, and open space

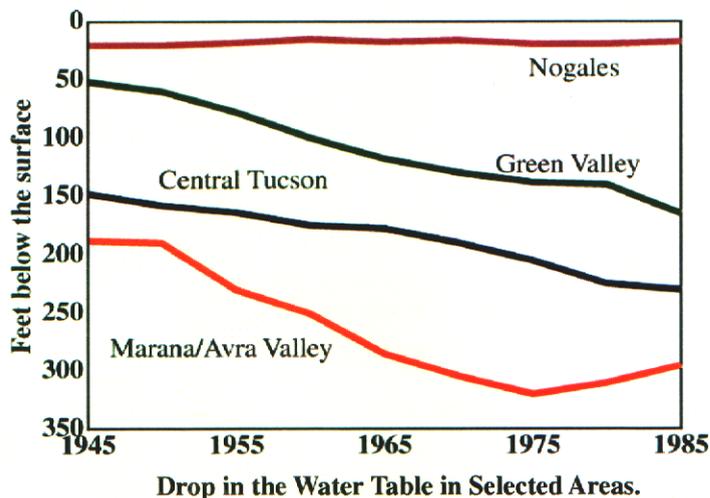
Affordable housing has become more scarce as the community has grown. One reason often given for building new subdivisions in outlying areas is that the land is cheaper and thus the cost of the home will be lower than if it is built near town. In addition, the builder argues that the density must be high in order to keep the costs down.

While these arguments are valid, there are other considerations for the home buyer, the other residents of the area, and for scenic and wildlife values. The new subdivision may be built near scenic areas, but those scenic areas are liable to be destroyed when the next subdivision arrives.

The cost of providing services in outlying areas is usually higher than it is when the homes are built closer to town. New home owners need water, wastewater treatment, roads, power, gas, schools, flood control, and services such as law enforcement. The more spread out the community, the greater the cost generally to provide many of those services. Sheriff's response time, for example, increases greatly so that more people must be hired to keep up with demand. These costs are often borne not by the homebuyer, but by the taxpayer or rate payer, so are hidden costs.

School districts are especially hard hit when a large new subdivision is approved within a small school district without a good tax base. It is difficult for the district to raise funds quickly enough to provide adequate education for the growing population. There are no provisions for either the developer or the county to pay for the new schools, although some state funds may be available some months after time for application and design.

Another cost to the homeowner in remote areas is the costs of transportation to work. Some homebuyers spend what they saved in the costs of the home when they have to buy and maintain a second or even a third car. Social services are



usually not easily available in the outlying subdivisions. Really affordable housing for lower income people is better put close to public transportation and other services.

Another type of affordable housing is possible for people who buy a lot that is not within a planned subdivision and put a trailer on the lot or build a home themselves. This approach keeps the cost to the homeowner down, but often transfers many of the costs of providing services to the taxpayers. Rather than have the developer pay the cost of flood control, for example, the taxpayer may end up bailing out the unfortunate homeowner or the nearby homeowner whose flooding problems increase because of a piecemeal approach to flood protection. In practice few truly "affordable home subdivisions" are actually built in outlying areas.

If development is directed to areas adjacent to where services and infrastructure are in place, public and private costs of providing those services will usually be reduced at the same time preserving open space areas away from the community and defining a clear urban edge. This kind of predictability not only benefits the homebuyer in keeping the costs of services low and the availability of services high, but also minimizes impacts to the taxpayer by reducing the "hidden costs" of services, as well as preserves landscapes and wildlife habitat.

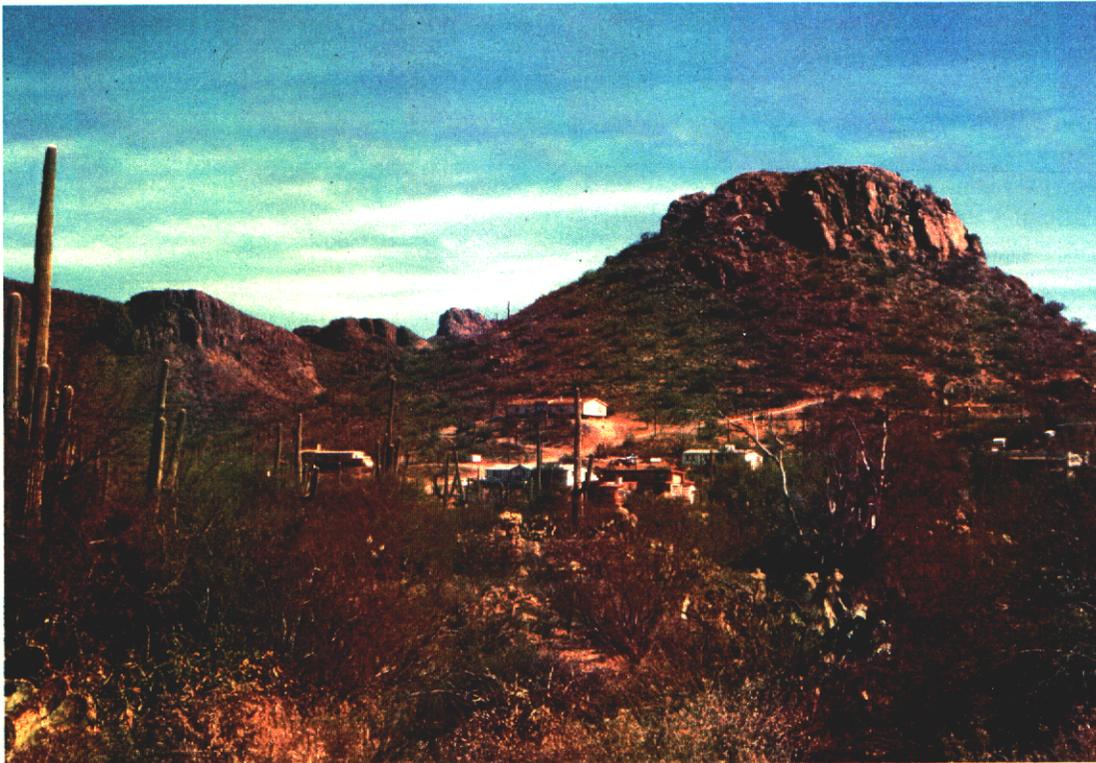
### Transportation, Air Quality, and Public Costs

Transportation is one of those services that gets much more costly, the farther away from the urban center people live. Long distance driving also adds to the air pollution problem. It has become very inefficient to provide public transportation in this community and homes and even shopping and work have sprawled in all directions. While developers and homebuyers pay for the cost of streets within their subdivisions, they do not pay for the main roads leading to and from the subdivision or freeway expansion. Homeowners in the Catalina Foothills area near First Avenue, for example, have had to deal with major road work for more than a year as the County widens First Avenue to accommodate expected growth in the Pima Canyon area and anticipated shopping at a proposed new shopping center. A controversy developed over widening the intersection of Campbell and River Road where a significant historic church is located. The widening was deemed necessary to accommodate heavy traffic going to new subdivisions on River Road and development in the foothills. Commuters in the northwest part of town have dealt with traffic congestion to and from new subdivisions in Marana and other parts of that area.

If subdivisions and shopping centers were designed with the regional traffic picture made part of the planning effort, such problems would be minimized and public

	Surface water	Groundwater	CAP	Reclaimed Wastewater
San Pedro	MINOR	YES	NO	NO
Cienega-Rincon	MINOR	YES	PLANNED	FUTURE
Upper Santa Cruz	NO	YES	YES	FUTURE
Middle Santa Cruz	NO	YES	PLANNED	YES
Tortolita	NO	YES	PLANNED	YES/FUTURE
Altar	MINOR	YES	NO	NO
Avra	NO	YES	YES	MINOR
Western Pima	NO	YES	NO	NO

**Water Supplies in the Subareas.** Key: CAP water is currently recharged in two subareas, and is planned for introduction in three subareas in the near future. Reclaimed water is primarily used in the Middle Santa Cruz Subarea, but is also used or recharged along the Santa Cruz River in Avra and Tortolita subareas, but may in the future be used in areas such as Oro Valley.



Urban sprawl increases the costs of services and infrastructure.  
Very low density development increases those costs even more.

costs drastically lowered. Better urban design would also make it appealing for people to use modern types of public transportation as they do in San Francisco, California or Calgary, Alberta. Impact fees for road improvements outside the subdivision would also make more evident the real costs of building in outlying areas.

Design of efficient transportation could in some areas have the added benefit of preserving open space and wildlife habitat in certain areas.

### **Preserves, Wildlife, and Economics**

One way to preserve land is to buy it and turn it into a preserve. This usually provides the maximum amount of protection for the future. Preserves can have multiple uses, protecting wildlife, scenic vistas, and providing recreation opportunities and destinations for tourists. Preserves are, however, usually expensive to acquire and manage. Some nonprofit groups have acquired preserves through private donations. The Tucson Audubon Society, for example, owns a preserve in an ironwood-saguaro rich area on the northwest side. The group uses the land for environmental education purposes. The land was donated by the owner who wished it to be preserved for all time. The Nature Conservancy acquires land on a larger scale through donations of sensitive land and financial contributions.

The preserves benefit wildlife and in many cases benefit people through recreation, environmental education opportunities for children, and preservation of

vistas enjoyed by all. Acquiring land by local government can also be very cost effective. While the total purchase price of the land may seem to be high, in some situations removing the land from development may actually cost less than allowing the subdivision and providing services forever to the residents. More cost-benefit studies need to be conducted before deciding to approve subdivisions that mean extending services into remote areas. Even if the homebuyer pays an impact fee, the county still has the obligation to maintain and provide the services into the indefinite future. Buying the land might be cheaper in the long run.

Imagine what the Tucson Mountains would be like if foresighted people had not in the 1920s worked to keep the land free of homesteads. Tucson would have lost the chance to maintain the unspoiled views, to have an important hiking and wildlife viewing and hunting area so close to town, and would be paying to send the sheriff out to remote areas and to maintain the roads. Wildlife and native plants would be greatly reduced.

### **Land Use Controls, Open Space, and Economics**

Land preservation does not have to be entirely through purchase. Much land in places like the Tortolita area or the Rincon foothills is already zoned for relatively high urban uses. The chart below shows which lands are already built upon or are in the process of development in the cities and Pima County. The next category is land that

is zoned at a density of 1 or more residences per acre or for commercial use. The third category is zoned at a density of less than 1 residence per acre. The final category is public land. The areas that are zoned at a density of less than 1 residence per acre are the areas where the greatest potential exists for land preservation and where land costs are liable to be lowest. This is in the Altar, upper Santa Cruz, Cienega Rincon, and San Pedro subareas. The least low density land is in the Middle Santa Cruz and Tortolita subareas.

The county has already lost a battle to be allowed to downzone property - change its zoning to a less dense category for conservation purposes. Developers have right to build on that land up to the allowed density. The

public, however, does not have the obligation to provide the services to those areas free of cost. Floodplain and riparian protection laws can be strengthened and implemented to keep development out of floodplains and distributary flow areas. Restrictions can be placed on new golf courses requiring that they be very water efficient and use a renewable supply. Impact fees can reflect the true cost of providing infrastructure. Agreements can be made with developers to leave significant parts of the land natural, provide funds for historic or environmental preservation, or to cluster the homes in a less sensitive part of the property. All of these approaches benefit wildlife while preserving things humans value and saving public costs. These options are discussed in Chapter 6.



Rancho Vistoso, looking west toward Honey Bee Canyon (top)

File No. 302b 1/2 © Adriel Heisey

**Rancho Vistoso. Photo by Adriel Heisey.**



## VI. THE SONORAN DESERT CONSERVATION PLAN PRELIMINARY RECOMMENDATIONS

Two years ago the Pima County Board of Supervisors chose to develop the Sonoran Desert Conservation Plan which was to include the Multi-Species Habitat Conservation Plan (MHCP) and other elements including historic preservation and recreation. The actual MHCP and draft permit will be written in coming months. In order to satisfy the federal requirements for an MHCP under the Endangered Species Act (ESA), minimize costs, and also gain other community benefits, the following proposals are offered for community consideration. The SDCP and the MHCP are separate documents, but closely intertwined. In order to be really effective, all local jurisdictions should participate in the plan. Many public meetings will be held throughout the comment period which ends January 1, 2001.

The recommended preliminary plan is multifaceted, including land purchase, change of designation of federal land, preservation of significant private ranch land through an incentives program, preservation and restoration of prime habitat, especially riparian areas, reintroduction of native species and attempts to control nonnative species, and certain changes in laws, regulations, and management practices to further enhance the program. The preliminary plan calls for cooperative efforts with other local, state, tribal, and federal jurisdictions. It also calls for continuing research and monitoring so that programs reflect the latest information and so that the impact of programs can be assessed. The U.S. Fish and Wildlife Service will soon publish a proposed Recovery Plan for the Cactus ferruginous pygmy-owl that will define the parameters for permitting in the light of both direct and cumulative impacts on the owl.

The preliminary recommendations offered for community discussion envision a comprehensive integrated program throughout the county, targeting the areas with the greatest potential for protecting vulnerable species, preserving cultural resources, preserving and enhancing habitat, providing recreational opportunities, and allowing for orderly provision of housing and services in less sensitive areas. The community also has the option of taking no action, which would leave Eastern Pima County with a fragmented set of public land that would increasingly fail as a reserve for imperiled species and leaving developers with the need to go through a complex permitting process for each project in affected areas. Other options include adopting portions of the proposals.

### **The Multi-Species Habitat Conservation Plan**

The permit application must include provisions for protecting threatened and endangered species and their habitats, facilitating the recovery of those species where feasible, and mechanisms for implementing the plan, including financing. Many of the elements discussed

below will be part of the formal MHCP permit application. The County will also propose numerous land use and management practices as part of the permit application. These proposals will go through an extensive public participation process.

### **Reserve Design and Priority Setting**

Extensive scientific studies are leading to a way of prioritizing the areas most valuable for species and habitat preservation. The most vulnerable species needed to be protected, the size of the preserve had to be large enough to be effective, had to be unfragmented and close enough to other preserves to provide high quality habitat with maximum opportunity for connectivity, and have as few roads as possible. In addition, the reserves had to be diverse and not seriously damaged by invasive species or other human impacts, and thus needed minimal restoration efforts. The preserves should be realistic, take existing land uses into account, and build on and connect to existing preserves where possible. Areas with perennial or intermittent stream flow and shallow groundwater had to have a high priority because of their value for so much wildlife. When the biological factors were combined with the cultural resources most in need of protection, certain areas clearly emerged as the optimal choices.

If we were to acquire all the preserves needed to completely protect the vulnerable species and all historical and archaeological sites, the cost would be extremely high.



*The Western Yellow-billed cuckoo is under consideration for endangered species listing. It migrates from northern Arizona to nest in Southern Arizona. It is seldom seen in Pima County. The County has resolved to allow no net loss of its habitat.*

### Factors to consider when setting priorities for preserves

- Does the area have unfragmented and roadless areas?
- Is the area connected to other preserves or to ranching areas where agreements with landowners can promote preservation?
- How disturbed is the area by human activities?
- If the area to be considered is riparian, does it have a secure water supply and intact watercourse functions? Would preservation also serve a downstream flood control function?
- Does the area have several vulnerable species?
- If invasive exotic species are present, can they be controlled?
- Does the area include archaeological and/or historic sites that should be preserved?
- Can and should the area also serve recreational needs of residents and tourists?
- Does the area have scenic value?
- Is the area threatened by development or other pressures?
- Does the area contribute substantially to the tax base and would significant tax revenue be lost by public acquisition?
- Can the land be acquired from willing sellers at a reasonable price or protected through voluntary agreements?
- Is the area eligible for a federal preserve designation?

Some choices have to be made. It is probably only feasible to raise a portion of that money through local bonds, sales taxes, federal grants, land trades, voluntary measures, and other sources described at the end of this section. Choices, then have to be made. The reserves described below represent ways to protect the maximum amount of resources in an affordable way. Some areas will only be partially protected. Some historical resources will be lost. The proposals described below protect the maximum amount of prime habitat and cultural resources at the lowest cost, while leaving adequate areas for humans to live. Many of the prime locations are in areas where the costs of land are still relatively low and the tax revenue from those lands also low, so the cost impact is less than if preserves were to be acquired in areas where land costs and tax revenues are high. In addition, if preserves were located in areas that need extensive rehabilitation, the costs will also rise. The areas chosen are also, for the most part, areas where it would be costly to build infrastructure and provide government services if those areas were used for subdivisions or other development.

Major efforts will have to be made to secure the funds for the preserves and rehabilitation projects described below. If the community chooses to protect additional areas, especially those where the cost of land is higher, ways will have to be found to pay for those options.

### Proposed New Reserves

New preserves are proposed for three areas that are quite distinct from each other, but adjacent to existing preserves. All three areas are proposed as natural areas with a minimum of

development for public use. All the parks have great potential for preserving vulnerable species and for preserving corridors between existing preserves. The largest unfragmented landscapes in Eastern Pima County - the Altar Valley, the Cienega-Rincon Valley and the Middle San Pedro areas hold the richest riparian and aquatic resources base and are the home to the greatest number of priority vulnerable species. Combined, these areas cover more than 1.2 million acres (including federal land). The Altar Valley alone covers 713,807 acres (including federal land), making it the largest subarea in Pima County. The total acreage proposed for preservation as discussed below is about 250,000 acres. When the existing preserves are considered and the opportunity to maintain open space through

agreements with landowners, the total potentially preserved acreage is many times that.

### Cerro Colorado Mountains

The Cerro Colorado Mountains cover about 13 square miles north of Arivaca Road and rise to a height of 5,319 feet. (See map in Chapter 4). The proposed Cerro Colorado Ranch Conservation Area includes 10,863 acres of State Trust Land, 1,980 acres of BLM land and 1,411 acres of private land. This is grassland and has been used for ranching for more than 100 years. The range supports an abundance of wildlife including deer, javelina, and coatimundis, and raptors. Vulnerable species in the area include the masked bobwhite quail, jaguar, gray hawk, desert tortoise, pineapple cactus and bats. Biologists consider this and the surrounding parts of Altar some of the best pygmy-owl habitat in Pima County. The western face of the mountain is highly picturesque and has a largely unspoiled view. The proposed Sierrita Ranch Conservation Area to the north has similar characteristics and is largely federally owned.

### Arizona-Sonora Desert Museum

#### Recommendations for Ironwood Preservation

Assessments are needed to determine the extent of ironwood destruction during permitting processes.

Ironwood trees should be salvaged and relocated where land clearing is allowed.

The areas of highest ironwood density should be protected.

A corridor should be developed of preserves within ironwood habitat for the benefit of species that use ironwood trees, including the pygmy-owl.

Protection strategies should be developed for ironwoods in wash, rocky slope and valley-plains habitats.

One important reason for saving these areas is to link them with the Buenos Aires National Wildlife Refuge, using a combination of State Trust Land and BLM land. The Penitas Wash flows out of the northwestern slopes of the range and its 3,183 acres is virtually a small natural preserve unto itself. The area offers opportunities for hiking, wildlife viewing and horseback riding.

### **Santa Rita Mountain Park**

This proposed new Mountain Park would occupy 10,703 acres of land in the foothills of the Santa Rita Mountains south of Sahuarita Road and adjacent to the Cienega-Empire Preserve described below. The area encompasses 8,876 acres of State Trust Land and 1,826 acres of private land. This is an area which is urbanizing and preserving the northeastern slopes of the Santa Rita Mountains would protect a view that can be seen from much of the Tucson area. This region also has an important part of the watershed for Davidson Canyon, a tributary of Cienega Creek. Urban development would adversely affect the flow and vegetation of Davidson Canyon and Cienega Creek. This preserve would also provide important recreational opportunities for Tucsonans. A segment of the planned cross-state Arizona trail may go through this area.

This preserve is an important link between the Santa Rita Mountains and the Cienega Creek system and would help protect the many vulnerable species in that area as discussed below. An interesting feature of this area is the presence of numerous old mine shafts and drilling areas, some of which provide habitat for bats which would be protected under the proposal. Pima County would work with existing ranchers in the area to preserve traditional uses in the area consistent with resource preservation.

### **Proposed Expansion of Existing Reserves**

#### **Cienega Preserve and Empire Cienega Resource Conservation Area**

Pima County's 4,015 acre Cienega Creek Preserve, the 366 acre Empirita Ranch, and BLM's 31,884 acre Empire-Cienega Resource Conservation Area form an almost continuous protected area centering on Cienega Creek. To the north is Saguaro National Park and to the north and west, Coronado National Forest. The County, the Forest Service, and BLM have worked closely to protect this watershed and its creek which has significant perennial reaches and at least 26 vulnerable species, including native fish, bats, and birds. There are 16 priority streams in the area and 55 springs, most on National Forest land. There are, however, some gaps in the preserve system that should be filled in order to protect the water supply of the creek



**The Cerro Colorado Mountains**

and assure that the watershed is left intact and that the vulnerable species are as protected as possible.

Much of the remaining land is State Trust Land which can be sold to private owners, thus jeopardizing both the health of the watershed and the life styles of the ranchers in the area. Davidson Canyon is especially vulnerable as discussed above. Population pressures are approaching the area from the east, with the growth of the Tucson area, and from the west, with the growth of the Benson area which has a major tourist attraction in Kartchner Caverns. The possibility of further depletion of the water supply makes acquisition of certain parcels of land vital.

Residents of the area have been meeting for many months to have the area declared as the Las Cienegas National Conservation Area. This area would be in both Santa Cruz County and in Pima County. Such a designation must be approved by Congress.

The recommendations for this area include a Natural Reserve in Davidson Canyon, designation of the Las Cienegas National Conservation Area, and expansion of the Cienega Creek Preserve, as well as programs to acquire additional surface water rights to Cienega Creek.

#### **Colossal Cave Mountain Park**

This natural preserve occupies 2,037 acres near the Saguaro National Park. The Coronado National Forest is nearby, including the Rincon Mountain Wilderness. The Cienega Creek Preserve is to the southeast of the cave. The cave itself is an important tourist attraction, while the surrounding park area is used for hiking, picnicking, and habitat preservation. The area is very similar to that in the Saguaro National Park and includes caves, upland habitat and riparian habitat. It is home to vulnerable species of bats, birds, and reptiles. Two major creeks are in the area, Agua Verde Creek and Posta Quemada Wash.

The proposal is to acquire an additional 4,814 acres, of



The new Ironwood National Monument is the first of the proposed reserves established in Pima County.

which 3,319 acres are State Trust Land, 1,477 are private property, and the rest is federally owned. This would link the preserve with the National Park and the Cienega Creek Preserve.

The Rincon Institute has proposed further expansion of 14,160 acres into the Rincon Valley. The benefits include protection of large tracts of highly scenic land on the periphery of the National Park. This would also preserve a major link for wildlife and would keep the location of the proposed cross-state Arizona trail in an undeveloped state. Population pressures in this area are expected to accelerate and the scenic and wildlife values could easily be lost forever if action is not taken soon.

If all three proposals were implemented - the Santa Rita Mountain Preserve, the Cienega Creek-Empire Conservation Area, and the Colossal Cave expansion - a continuous corridor would be maintained from the Santa Rita Mountains to the Catalina Mountains.

North of this area are several smaller locations also proposed for preserve expansion. These are at Agua Caliente Creek, Sabino Creek, and Tanque Verde Creek where the county proposes to buy more land for flood control purposes. There is also land at the base of the Mt. Lemmon Highway where land purchase by the County will extend the existing preserved area.

#### **Buehman-Bingham Preserve**

Pima County's 284 acre Bingham Cienega Natural Preserve and the Nature Conservancy's 2,796 acre Buehman Canyon Preserve are in the Upper San Pedro Valley and in the proximity of the Saguaro National Park and the Coronado National Forest. Also in the area is the 42,000 acre A-7 Ranch of which the City of Tucson owns about 7,000 acres and the rest is leased state and federal

land. This area provides a grass bank for the Redington Conservation District and the community. Residents in the area are committed to preserving their land, wildlife, heritage, and life style.

This area includes native grasslands, riparian woodlands, streams, and cienegas, 70 springs, and 15 vulnerable species. Part of the area is designated critical habitat for the Cactus ferruginous pygmy-owl, although the owl has not been recorded in the region recently. The problem nonnative species in the area include feral hogs, exotic fish, and exotic frogs as well as exotic grasses. The area has numerous historic sites.

The main concerns in the area center around the potential for additional groundwater pumping that could affect the surface water,

new mining on National Forest land, and population growth. The presence of thousands of acres of State Trust Land which can be sold is a constant threat to preservation of the area. Threats to this area are currently very low.

The proposal here is to expand and connect the Buehmann and Bingham preserves to create a 7,489 acre Buehman-Bingham Natural Preserve. This would assure a permanent viable link between the Catalina Mountains and the San Pedro River Corridor and the native species in the area. A link to Redfield Canyon will further enhance the value of the preserve.

The primary ways that the land can be preserved are through acquisition of State Trust Land through purchase or trade, or purchase of private land with bond funds. The 1997 Open Space Bond Program included \$1 million for the purpose of expanding Bingham Cienega.

#### **Tortolita Mountain Park**

The Tortolita Mountain Park currently occupies 3,001 acres in the Tortolita Mountains. This is a natural park which currently has virtually no public access because the access roads are on private land.

This is within critical habitat for the Cactus ferruginous pygmy-owl and contains valuable ironwood-saguaro habitat. There are at least fifteen vulnerable species that use the Tortolita area. Within the general area are six priority streams and fifteen springs in the National Forest. The area is also rich in archaeological sites, especially of the Hohokam period. Population growth in the nearby towns of Marana, Oro Valley, and Catalina threaten to drastically reduce the amount of habitat and endanger the archaeological sites.

A master plan for the park sets a formal expansion boundary and identifies acquisition strategies and funding

sources. Oro Valley and Pima County both endorse the plan. In the spring of 1999, Pima County submitted an Arizona Preserve Initiative application to reserve 25,744 acres of State Trust Land for the park expansion. In addition, Pima County is working with BLM for coordinated management of 1,400 acres of BLM within the expansion boundary. Pima County has already purchased one ranch in the area for open space purposes. If all efforts succeed, the park will expand to 37,782 acres and have public recreational access.

**Catalina State Park**

Catalina State Park currently occupies 5,515 acres on the western side of the Catalina Mountains. This is a well-used recreational area and tourist attraction. It includes a portion of Sutherland Wash and the Canada del Oro which are left natural. There is, however, a major gap in protection and the county proposes to acquire another 2,320 acres north of the park to protect the scenic values and wildlife habitat and corridors. The target land is State Trust Land and \$1 million was authorized in the 1997 Open Space Bond Election for acquisition of this land. The county filed an Arizona Preserve Initiative application to reserve these acres, but for technical reasons the application was refused. Pima County will resubmit the application in 2001 if the results of the census show that Oro Valley's population has increased to the point that the technical problems will be eliminated.

**Ironwood National Monument**

The original SDCP proposals included a Mountain Park in the Ragged Top Mountain region. In the spring of 2000 Pima County requested, instead, that President Clinton declare the area a National Monument. Many more acres were included than in the original park proposal, including land in Pinal County. The President made the declaration in May 2000 with the intention of adding more land when arrangements could be worked out to include some State Trust Land and private land. The present and proposed boundaries are shown on the map below.

**Tucson Mountain Park**

Tucson Mountain Park is Pima County's oldest natural park. The combination of the park and Saguaro National Monument West protect most of the Tucson Mountains and some of Avra Valleys to the West. There are places, however, where development pressures threaten views and habitat next to the preserves. The county proposes to acquire several land parcels, preserve significant habitat, protect noteworthy scenic resources on the periphery of the park, protect cultural resources, and assure adequate public access to the park. The 1997 Open Space Bond Program authorized \$6.65 million for this purpose, including \$3 million for parcels along Gates Pass Road and other locations as shown on the map. Under the Arizona Preserve

Initiative the county made application to acquire 100 acres of State Trust Land adjacent to the park.

Land also needs to be made secure for open space at the base of Tumamoc Hill where the University has received approval to designate the land under API for conservation purposes. Pima County proposes to use \$1.4 million authorized under the 1997 Open Space Bond Program to acquire land to buffer the site and help preserve a corridor between Tucson Mountain Park and Tumamoc Hill.

**Proposed Wildlife Corridors**

In the past, wildlife could move throughout the valley from the Tohono O'odham Nation to the Catalina Mountains and east to the Graham Mountains and south all the way to Mexico. Much of this area has been fragmented so wildlife has become increasingly isolated, sometimes in areas too small to support a thriving, reproducing population. Part of the new and expanded preserves proposals include corridors between areas. The map below shows the major corridors proposed.

Part of the Tucson Mountain Park proposal above includes preserving wildlife corridors along significant washes, as shown on the map. These will connect Greasewood Park, Tumamoc Hill, and the Santa Cruz River corridor as well as corridors on the northeast side of the Tucson Mountains connecting to the Tortolita Mountains and the Catalina Mountains.

An important element of all of the Cienega Creek

**Vulnerable species that can sometimes be found in medium to high density urban areas**

<i>Lasiurus ega</i>	Southern yellow bat*
<i>Macrotus californicus</i>	California leaf-nosed bat*
<i>Melospiza melodia</i>	Song sparrow subspecies
<i>Aimophila carpalis</i>	Rufous-winged sparrow
<i>Buteo swainsoni</i>	Swainson's hawk
<i>Accipiter gentilis apache</i>	Apache Goshawk
<i>Glaucidium brasilianum</i>	Cactus ferruginous pygmy-owl
<i>Falco peregrinus anatum</i>	American peregrine falcon
<i>Athene cucularia</i>	Burrowing owl
<i>Cnemidophorus burti stictogrammus</i>	Giant spotted whiptail
<i>Thamnopsis eques megalops</i>	Mexican garter snake
<i>Sonorella sabionensis tucsonica</i>	Tucson Mountains talussnail
<i>Agave schottii</i> var. <i>treleasei</i>	Trelease Agave
<i>Tumamoca macdougalii</i>	Tumamoc globeberry
<i>Coryphantha scheeri</i> var. <i>robustispina</i>	Pima pineapple cactus
<i>Metastelma mexicanum</i>	Wiggins milkweed vine
<i>Penstemon discolor</i>	Catalina beardtongue

\* If suitable roosting areas available  
 These species are generally not found in urban areas where extensive land grading has occurred.

proposals is to maintain connectivity between the Rincon Mountains and the Santa Rita Mountains as well as mountain ranges to the east outside Pima County. Similarly, efforts in the San Pedro area provide important connections between the Catalina Mountains and the mountain ranges to the east.

### Ranch conservation

Conservation of existing ranches with high habitat value is an important element of the Plan. Ranching areas in the Altar Valley, the San Pedro, and the Empire-Cienega Valleys currently preserve a great deal of open space and valuable wildlife habitat. More vulnerable species today thrive in ranchlands than in urban areas. Intense pygmy-owl research in the past few years indicates that the Altar Valley is one of the prime habitat areas for the owl. These areas on the urban periphery face development pressures as the community expands, but currently form a clear open-space boundary. The Cerro Colorado and Sierrita Ranch Conservation Areas, the Ironwood National Monument, the Las Cienegas Conservation Area, the proposed changes in laws and procedures, and the development of voluntary incentives programs for good open space and habitat management are important elements of the SDCP.

*The screwbean mesquite once grew along the Santa Cruz River, but now is not found in the wild in eastern Pima County. One proposal is to reintroduce it along some watercourses.*

### Proposed Rehabilitation Projects

#### Riparian protection and rehabilitation projects

Pima County staff have prioritized the streams that have the greatest potential for rehabilitation and where rehabilitation would most benefit a variety of species, both vulnerable and more common ones. In addition, the County proposes to continue its floodprone land acquisition program which involves reducing potential flood damage and lowers the cost of building flood control structures and paying for flood damage while preserving riparian habitat

### Vulnerable Species that Are Found in Ranching Areas

<i>Leptonycteris curasoae yerbauena</i>	Lesser long-nosed bat**	<i>Athene cunicularia</i>	Burrowing owl
<i>Peromyscus merriami</i>	Merriam's mouse**	<i>Vireo bellii</i>	Bell's vireo
<i>Plecotus townsendii</i>	Pale Townsend's big-eared bat**	<i>Colinus virginianus ridgwayi</i>	Masked bobwhite
<i>Lasiurus ega</i>	Southern yellow bat**	<i>Sonorella ambigua ambigua</i>	Ambiguous talussnail
<i>Lasiurus borealis</i>	Western red bat**	<i>Sonorella baboquivariensis baboquivariensis</i>	Baboquivari talussnail
<i>Choeronycteris mexicana</i>	Mexican long-tongued bat**	<i>Sonorella magdalensis</i>	Magdalena talussnail
<i>Leptonycteris curasoar yerbabuena</i>	Lesser long-nosed bat***	<i>Sonorella baboquivariensis depressa</i>	Sierrita talussnail
<i>Macrotus californicus</i>	California leaf-nosed bat**	<i>Sonorella xanthenes</i>	Kitt Peak talussnail
<i>Rana chiricahuensis</i>	Chiricahua leopard frog*	<i>Sonorella sitiens sitiens</i>	Las Guijas talussnail
<i>Rana yavapaiensis</i>	Lowland leopard frog*	<i>Sonorella baboquivariensis berryi</i>	Roskrige talussnail
<i>Thamnopsis eques megalops</i>	Mexican garter snake	<i>Amsonia kearyneana</i>	Kearney's blue star
<i>Sonora semiannulata</i>	Ground snake	<i>Tumamoca macdougallii</i>	Tumomoc globeberry
<i>Terrapene ornata luteola</i>	Desert box turtle	<i>Coryphantha scheeri</i> var. <i>robustispina</i>	Pima pineapple cactus
<i>Gila intermedia</i>	Gila chub*	<i>Metastelma mexicanum</i>	Wiggins milkweed vine
<i>Poaliposis occidentalis occidentalis</i>	Gila topminnow*	<i>Amsonia grandiflora</i>	Large-flowered blue star
<i>Falco peregrinus anatum</i>	American peregrine falcon	<i>Echynomastus erectocentris</i>	Needle-spined pineapple cactus
<i>Pipilo aberti</i>	Abert's towhee	var. <i>erectocentris</i>	Nichol's turk's head var. cactus**
<i>Buteo swainsoni</i>	Swainson's hawk	<i>Echynomastus horizonthalonius nicholii</i>	Huachuca water umbel*
<i>Glaucidium brasilianum</i>	Cactus ferruginous pygmy-owl	<i>Lilaeopsis schaffneriana</i> var. <i>recurva</i>	
<i>Coccyzus americanus occidentalis</i>	Western yellow-billed cuckoo		
<i>Accipiter gentilis apache</i>	Apache Goshawk		
<i>Aimophila carpalis</i>	Rufous-winged sparrow		
<i>Melospiza melodia</i>	Song sparrow subspecies		
<i>Empidonax</i>			
<i>trillii extimus</i>	Southwestern willow flycatcher		

\* Where suitable aquatic habitat is available

\*\* Where suitable soils are available

\*\*\* Where suitable roosting areas are available

Most of these species are not found in over-grazed areas.

### Some Important Historic Sites

#### Archaeological

Tumamoc Hill  
 Romero Ruin  
 Zanardelli and fields  
 Coyote Mountain  
 University Ruin  
 Los Morteros  
 Honeybee Village  
 Marana Mound  
 Robles Mound  
 Punta del Agua  
 Tanque Verde Ruin  
 Sutherland Wash site  
 Sunset Mesa Ruin

#### Historical

Binghamton rural area  
 St. Phillips in the Hills  
 Temple of Music and Art  
 C.O. Brown house  
 Steinfeld mansion  
 El Tiradito  
 Santa Cruz Church  
 Esmond Station

A more complete list is in the Cultural Resources report.

### Species reintroduction projects

Pima County has already begun reintroduction of native plant species at the Cienega Creek Preserve and at Bingham Cienega Preserve. Species involved include sacaton grass, mesquite, and acacia. While these species are not rare, their reintroduction in certain areas may assist in the recovery of some vulnerable species. These projects were partially funded with Heritage Fund and Water Protection Funds grants. Revegetation projects in some areas will be irrigated with reclaimed wastewater or CAP water. STAT developed guidelines to assure that introduction of water for this purpose be done in a way that does not introduce new problems through introduction of nonnative species. Experience gained with these projects should facilitate reintroduction projects in other locations.

Native fish are so endangered throughout the state that any successful reintroduction projects could significantly increase populations. Potential locations for reintroduction of native fish and frogs is proposed for the areas shown on the map below. Reintroduction is usually contingent both upon establishing the proper water conditions and upon eliminating or reducing harmful nonnative species. The U.S. Army Corps of Engineers has already agreed to provide \$100,000 to fund an initial project at Agua Caliente Park. The U.S. Fish and Wildlife Service is a possible source of additional funds. Success of this project should provide a source of the native species for projects in other locations in the area.

### Nonnative species management

Since invasive species tend to spread more rapidly in disturbed areas than in natural desert, management of disturbed areas is especially important. Removal of the disturbance may be essential. The spread of nonnative grasses poses fire hazards for plants such as the saguaro and barrel cactus. Prevention is much easier than eradication, so vigilance should be practiced in areas such as the Tucson Mountain Park to keep buffelgrass, for example, from becoming invasive in areas where it has not yet spread.

Pima County proposes adoption of an exotic species management program for county lands, including parks and roadsides. The County must determine the potential for control of invasive plant species and prioritize locations where control will be most effective.

Reexamination of landscaping policies on county land, including parks, sewer line rights-of-way, and roads so that invasive native species such as *Rhus lancea* (African sumac) are not planted. The County will encourage other jurisdictions to participate in this program and will work with nonprofit groups to develop educational programs.

Bullfrogs and nonnative fish can be highly detrimental to native fish. Again, priorities must be established and eradication programs developed for areas where they are liable to be successful and where elimination of the creatures will help recovery of native species. An effective program for educating the public about the danger of activities such as releasing aquarium species into lakes is needed, as is interagency cooperation about species to cause problems.



When nonnative grasses invade areas not adapted to fire, many native plants often cannot survive.

## **Historic Preservation**

Cultural resources are fragile and finite. There are only so many, and every one we lose is one less we can learn from. These resources cannot be replaced. In many parts of the county these treasures are threatened by development pressures. Gaps in the data should be filled as much as feasible.

Pima County and the cities should inventory archaeological, cultural, and historic sites on private land to determine which sites are so important to the history and culture of Pima County that their loss would adversely affect the opportunity of citizens to learn from and appreciate the past and proposes to preserve the most important ones.

Pima County and the cities should inventory sites on county and city land and develop management plans for them to assure their preservation. The county also proposes to promote the listing of private property on the national and state Registers of Historic Places and to register its own historical places.

## **Proposed Changes in Laws, Regulations, and Procedures**

The following are ways that changes in policy and law would compliment the land acquisition elements of the recommendations. Full recommendations for these changes will come at a later date. Other jurisdictions would be encourage to participate in a region-wide approach to these policies.

### **Urban land use Ordinances and Management**

The County Administrator would initiate a major Comprehensive Plan Amendment to reflect the concepts in the Draft Preliminary Sonoran Desert Conservation Plan and any new requirements that may be passed by the voters in the November statewide election. Pima County could revise the ordinances discussed below either separately or as part of a new comprehensive ordinance dealing with environmentally sensitive lands, habitat conservation, and historic preservation. In addition, the towns of Marana and Oro Valley are looking at developing or enhancing ordinances dealing with many of these issues.

### **Upzoning and Conditional use Permits**

All such requests to change zoning to more intensive uses will be deferred in areas of federally designated Critical Habitat, Ranch Conservation, or where riparian habitat will be lost unless the proposal substantially protects at least 65 percent of the resources and a substantial part of the property is set aside to preserve habitat and open space.

### **Rezoning and Permitting Procedures**

A one-stop process will be developed in cooperation with federal and state agencies to streamline the process

while assuring that all applicable environmental laws are followed.

### **Environmentally Sensitive Land Ordinance**

Consolidate environmental performance elements of the land use code into an Environmentally Sensitive Land Ordinance.

### **Native Plant Preservation Ordinance**

Expand the ordinance to include ironwood and riparian communities and species.

### **Buffer Overlay Zone**

Amend this ordinance by eliminating golf courses as a method of achieving the 50 percent open space requirement and implement other necessary measures.

### **Protected Peaks and Ridges**

Only a few peaks and ridges are currently protected by ordinance. There are many other peaks and ridges where the county could limit development to preserve viewsheds, and protect watersheds and habitat. Similarly, additional measures are needed in the Pima County Slope Ordinance to limit development on hillsides.

### **Golf Courses**

Amend the Golf Course Overlay Zone to require that all new golf courses be irrigated with renewable water supplies with they open. Recharge and recovery schemes that are not directly hydrologically connected would no longer be allowed.

### **Water Conservation**

Expand water conservation requirements in new landscaping and develop and enhance incentives programs for retrofitting of all development with water conservation plumbing fixtures at any change in property ownership.

### **Cultural Preservation**

Require cultural resource assurance bonds for subdivision development to ensure that requirements for survey, testing, and mitigation are properly implemented. Include new historic preservation protection in the grading ordinance.

### **Proposed Changes in State Laws**

The County will support creation of new state laws and amendment of existing state laws to achieve the goals of the Plan. These include:

### **Unregulated (Wildcat) Development**

Grant counties the right to regulate lot splitting by creating a small subdivision ordinance wherein provision of basic infrastructure would be required for public safety and health.

Create a State-funded grant program to finance the improvement of private and public dirt roads and easements in existing areas of intensive unregulated development to improve air quality.

Create a State lot split public improvement infrastructure bank.

### **Zoning Procedures**

Allow counties to downzone any property when the approved zoning is inconsistent with the adopted Comprehensive Plan of the County and the zoning has not been used for at least 15 years.

### **Impact Fees and Surcharges**

Expand county impact fee authority to include all public facilities and services provided to growth areas, including schools, parks, solid waste, public transit, and police facilities.

Authorize the levy of a countywide real estate transaction surcharge to fund open space acquisition and conservation activities.

### **Incentives Programs**

Create incentives for private property owners to voluntarily establish permanent conservation easements on their land by allowing such property to be reclassified for property tax purposes to the existing historical classification, lowering the tax.

Create a statewide mitigation bank to provide loans at discount interest rates to counties or other jurisdictions to finance acquisition of lands deemed essential to mitigate the adverse impacts of growth on federally-declared critical habitat.

### **Water Supply**

Amend the laws to allow protection of designated shallow groundwater areas and riparian areas from groundwater pumping, with emphasis on protecting isolated shallow groundwater basins such as Arivaca.

### **Implementation Methods**

Full implementation of the plan will require developing partnerships with a wide range of community organizations, university departments, and local, state, and federal government agencies. The work of volunteers will continue to be essential in developing and implementing the proposals. Educational programs must be an important component.

### **Continuing Research and Monitoring**

The county will continue its

partnership with government agencies, the universities, and private consultants to assure that the decision-makers have the latest research on which to base their decisions. Monitoring of the effectiveness of programs will also be needed to assure that projects are accomplishing their goals or to determine what changes are needed.

### **Partnerships**

#### **Partnerships with community organizations**

Partnerships have been and will continue to be developed with nonprofit organizations including The Arizona-Sonora Desert Museum, Tucson Botanical Garden, Tucson Audubon Society, Arizona Native Plant Society, Arizona State Museum, the Santa Cruz River Alliance, Sonoran Institute, and others. These partnerships will play a wide variety of roles. In some cases, expertise in the organization will be used to help develop educational materials, monitor the health of watercourses, conduct clean-up campaigns, and organize community meetings.

Some of these partnerships have already developed. The Arizona-Sonora Desert Museum, for example, played a major role in the declaration of the Ironwood National Monument by providing expertise and writing the Ironwood Primer. The Sonoran Institute provided very useful materials on voluntary ways of preserving open through methods such as conservation easements.

#### **Partnerships with university departments**

Several university departments provided essential assistance in developing the Preliminary plan. The School of Renewable Natural Resources provided faculty and students who worked hard on the scientific aspects of the



Areas like this where the groundwater is still shallow enough to support a thriving Cienega can be protected through changes in the state law or through purchase of land where new pumping is liable to occur

plan. Dr. Philip Rosen for example, developed the proposed native aquatic vertebrates recovery plan. University scientists volunteered many hours of biological and ecological expertise on the STAT. The Arizona State Museum was vital to development of the archaeological reports. The Water Resources Research Center provided expertise on the physical attributes of watercourses. These partnerships will continue and will be expanded.

#### **Partnerships with government agencies**

The Arizona Game and Fish Department, U.S. Fish and Wildlife Service, and other government agencies have been vital to providing important information needed for developing the plan. State and federal agency staff were crucial in the STAT. The U.S. Army Corps of Engineers has provided important information about watercourse restoration. These partnerships will continue and additional partnerships will be developed, especially with local governments, school districts, and water providers

which will be essential for successful implementation of a countywide plan.

### **How the Plan Will Be Funded**

Implementing the SDCP will require money from a combination of funding sources, cooperative agreements with federal, state, and local agencies, and local funding and action. The sources below are all parts of the complete package that Pima County may use.

#### **Federal Sources**

##### **Congressional designation/appropriation**

In order to obtain other federal designations for land, such as a National Conservation Area, an Act of Congress and appropriations of funds are required. Appropriations would also have to be approved by Congress for enlargement of existing preserves, such as the Saguaro National Park. Pima County proposes to be proactive in appropriate projects.

##### **Army Corps of Engineers**

The U.S. Army Corps of Engineers has funds and expert assistance available for river or wetlands-related projects. Pima County has already reached an agreement with the Corps to begin work on reintroduction of endangered fish and frogs. Tucson and Pima County have been working with the Corps for many years on flood control funding and studies. The Corps is actively involved in planning projects along the Santa Cruz River south of the downtown area. The County will continue to work with the Corps.

##### **Bureau of Reclamation**

The U.S. Bureau of Reclamation also provides expert assistance and funds for projects related to river restoration. The Bureau provided funds to the San Xavier District of the Tohono O'odham Nation for a flood control/restoration project along the Santa Cruz River. The County will continue to work with the Bureau on appropriate projects.

##### **Land and Water Fund**

Funds are available from the Department of Interior under the federal Land and Water Fund. This program funds open space land with some recreational value. In the recent past this program has been underfunded, but recently more money has been made available. Pima County proposes to apply for funding.

##### **US Fish and Wildlife Service**

The Service provides funds for preservation and recovery of threatened and endangered species. Once the MHCP is approved, funds are liable to



Agua Caliente Park could be one of the first native fish and frog reintroduction sites thanks to funding from the U.S. Army Corps of Engineers.

be available to implement some of the features. Pima County proposes fully utilizing this source.

### **DOT wildlife corridors funds**

The U.S. Department of Transportation provides funds for establishing wildlife corridors under or over highways. Innovative approaches to corridors are especially liable to receive funding. Pima County proposes applying for funding under this program.

### **State sources**

#### **Arizona State Land Department**

The Land Department owns thousands of acres of land in Pima County which must be managed according to legal requirements. The Arizona Preserve Initiative allows some of that land to be reserved for conservation purposes for a limited time period. Local governments can petition to have the land so designated, but must then eventually find its own funding to actually acquire the land but the land will not be sold to private interests in the meanwhile. Pima County has petitioned for some lands to be so designated. Under the Growing Smarter Initiative, if approved by the voters in the November 2000 election, up to three percent of State Land may be reserved for conservation purposes. Proposals for such designation have been made for a number of areas in Pima County and additional proposals will be submitted.

#### **Heritage and Water Protection Funds**

The Heritage Fund provides money from the State Lottery for a variety of conservation studies and projects. Arizona Game and Fish Department and Arizona State Parks administer these funds. Pima County has benefitted greatly from this fund, as have many local researchers. Lottery revenues have declined in recent years, so this fund has less money than it had in previous years, but this is still an important source of support. These funds may not be granted for land acquisition, but may fund restoration projects on land already owned by the County.

The Water Protection Fund is designed to fund projects for riparian restoration projects and is funded by appropriations from the legislature. Pima County has benefitted greatly in the past from this source and will continue to apply for this type of funding. The San Xavier District, the Redington Natural Resources Conservation District and other groups have also received funding from this source.

#### **State Parks**

The Legislature may designate new State Parks to provide recreation and protect natural and historic resources. Pima County's only State Park now is Catalina State Park. Creation of a new State Park, especially one with historic value is an option for Pima County.

#### **Local funds**

Much of the funding for land acquisition and environmental enhancement will come from local sources.

**Open space bonds** would be requested of the voters every five years. In past years voters have enthusiastically approved bond issues for open space purposes, including establishment of Catalina State Park and purchase of floodprone land for both flood control and conservation purposes. The amount of bonds that would be requested would be determined by an analysis of the growth in assessed value over the prior five-year period. Future open space acquisitions would largely be financed by new development.

**Mitigation payments** would be collected from developers for rezoning in Critical Habitat, where appropriate under the Endangered Species Act and the Multi-Species Habitat Conservation Plan. Payments would be designated to purchase alternative property containing high resource and habitat value to offset the loss of habitat caused by rezoning of the property in question.



*The only known Pima County location of the very rare Kearney's bluestar is in the Baboquivari Mountains where it is protected.*

**Major development endowment funds** would be collected for any major development larger than 320 acres. This surcharge will be based on a specific percentage of the economic activity or sales, with the funds being used to set aside larger portions of the property or surrounding property than would normally have been set aside in the development process or used to enhance the natural resources associated with the property.

**Increased county transportation impact fees** would be dedicated to critical transportation capacity improvements where air quality is problematic and needs improvement. Regional transportation impact fees could benefit the area even more, if other local jurisdictions adopt a uniform fees with all funds deposited in a single regional account and the funds distributed to resolve the most severe congestion problems in the region without regard to jurisdiction boundary.

**Regional water conservation fees**, based on a sewer impact fee, would be dedicated to water conservation programs.

## Other ways to preserve land

### Nature Conservancy, Land Trusts

Land can also be preserved through nonprofit groups who purchase the land on a temporary basis until a government agency can fund permanent purchase. In this way land can be acquired quickly, often at an attractive price, and transferred to a public agency who must necessarily act much more slowly.

The Nature Conservancy also purchases land for preserves which it owns and manages. These preserves must meet strict criteria for having special habitat or endangered species. It was the Nature Conservancy that purchased the Buehman Preserve in the San Pedro subarea. The Arizona Open Land Trust and the Tucson Audubon Society also have provisions for purchasing land for open space and habitat preservation purposes.

## Closing Thoughts

The entire plan is extremely broad in its sweep and, if fully implemented could protect threatened and endangered species and help in the recovery of some of them, as required under federal law. It could also do much more in preserving scenic vistas, providing new open space recreational opportunities, preserving rural lifestyles, and in bringing some order to the development process increasing predictability for developers and residents alike.



*At least thirty species of talus snail live in Pima County, some occurring only in parts of one mountain range. The populations here are considered to be relict ones descended from widespread populations in ancient times when the climate was very different.*

## APPENDIX A GLOSSARY

**ADEQ** - Arizona Department of Environmental Quality. State agency that regulates water and air quality

**ADWR** - Arizona Department of Environmental Quality. State agency responsible for water supply planning and enforcement.

**Aquifer** - One or more geological formations containing enough saturated porous and permeable material to transmit water through a spring or well.

**Biodiversity** - A multiplicity of species in a given area, representing various interdependent life forms.

Biodiversity usually refers to native species only.

**Biological stress** - Any activity that puts pressures on living things and threatens to reduce their numbers or range. Although most biological stresses are human-caused, natural activities such as earthquakes or drought are also biological stressors.

**BLM**- Bureau of Land Management. Federal agency that manages land.

**Candidate species** - A species that is possibly declining and that is being considered for threatened or endangered status.

**CAP**- Central Arizona Project

**Central Arizona Project** - A water supply project that brings water from the Colorado River to Central Arizona and the Tucson area.

**Cienega** - A perennially wet area supported by a spring or other water source, also called "wetland," "marsh," or "swamp."

**Committed lands** - Lands which are already occupied, zoned, platted or for which there are land use plans that can be developed without further government approval. This includes lands owned by local, state, and federal agencies for various specific purposes.

**Conservation easement** - A legally binding agreement not to develop part of a property, but to leave it "natural" permanently or for some designated very long period of time. The property still belongs to the landowner, but restrictions are placed both on the current landowner and on subsequent landowners.

**Constructed wetland** - A wetland created by humans, usually supported by wastewater.

**Cultural landscape** - A landscape created by people and their culture, simultaneously the product of nature and of human interaction with nature.

**Distributary flow** - Flow that occurs on the surface in ill-defined, changing channels.

**Effluent-dominated riparian area** - A stream with perennial flow supported mostly by wastewater from a municipal wastewater treatment plant.

**EIS** - Environmental Impact Statement. A study required under the National Environmental Policy Act before certain federally sponsored actions can be taken.

**Effluent** - Wastewater that has been treated in a wastewater treatment plant.

**Endangered Species Act** - A federal law that is designed to protect species that are in danger of becoming extinct.

**EPA** - Environmental Protection Agency. Federal agency that regulates water and air quality.

**Ephemeral stream** - A stream that only flows right after a rain. These streams may only flow for a short time in any year, yet they support more vegetation than surrounding drier areas.

**Exotic species** - A species that has evolved in a location other than the local area and moved by humans to a place where it would not naturally have arrived, usually a species brought by humans from another continent. The terms "introduced" and "non-native" mean the same thing.

**Extinction** - Complete disappearance of a species from existence anywhere.

**Extirpation** - Loss of a species from a specific area, although the species still lives elsewhere.

**Floodplain** - The part of a stream through or over which water may flow at some time.

**GAP** - Gap Analysis Program. A project whose goal is to catalog the range of vertebrates or their habitat in every state and compare them to land ownership.

**GIS** - Geographic Information System. A computer-based system for mapping.

**Groundwater** - Water under the surface of the ground away from streams.

**Habitat** - The total environment in which species live, including vegetation, animals, water supply, soils, and air.

**Habitat Conservation Plan** - A legally binding plan, agreed to by the U.S. Fish and Wildlife Service, to protect a specified area as habitat for a threatened or endangered species.

**Hydroriparian area** - A riparian area with a steady water supply that supports vegetation that needs more water than the surrounding desert.

**Intermittent stream** - A stream that flows part of the time because of a connection with groundwater or because of season snow melt.

**Invasive species** - Species, usually exotic, that take over an area, crowding out native species.

**Listed species** - See "candidate species."

**Mesoriparian area** - A riparian area with an intermittent water supply that supports vegetation that needs more water than the surrounding desert, but not vegetation that requires constant water.

**Mitigation banking** - A procedure whereby damage done in one location can be mitigated by the purchase of equivalent land elsewhere.

**Multispecies habitat conservation plan** - A habitat conservation plan that protects habitat for more than one threatened or endangered species.

**National Register of Historic Places** - A listing of places that meet the criteria of the National Historic Preservation Act as sufficiently old and of sufficient historic interest to rate notice and preservation.

**Native species** - A species that has evolved locally over a long period of time.

**Overbank storage** - The area next to a stream where floodwaters can spread out to recharge the water supply and slow down flood waters.

**Perennial stream** - A stream that flows all the time because of a steady water supply.

**Piedmont** - Foothills, the area between a mountain and a valley.

**Platted land** - Land that has gone through initial stages of the zoning process and has met certain requirements.

**Recharge** - Addition of water to the aquifer by natural or artificial means.

**Rehabilitation** - The act of revegetating an area or otherwise repairing a damaged environment.

**Restoration** - The act of returning an environment to conditions which it naturally had at some time in the past.

**Riparian Area** - An area associated with a stream that includes vegetation, wildlife, and other natural features of the habitat.

**Shallow groundwater** - Groundwater that close enough to the surface to support riparian vegetation.

**State Trust Land** - Land managed by the Arizona State Land Department. State law sets requirements for managing or disposing of the land to maximize benefits to the state trust which is earmarked largely for education.

**Subdivision** - A group of ?? or more homes constructed in one coordinated project. Subdivisions are subject to various kinds of city or county requirements dealing with wastewater, water, floodplain management, roads, and other amenities.

**Surface water** - Water that flows on the surface of the ground or is directly underneath a lake or stream.

**Threatened and endangered species** - Species that have declined so drastically that the U.S. Fish and Wildlife Service has determined that federal action is necessary to protect them. Threatened species are considered slightly more at risk than endangered species, but both are usually treated with similar caution.

**Traditional Cultural Place** - A place that is eligible for inclusion in the National Register because of its association with cultural practices or beliefs of a living community that are rooted in the community's history and are important in maintaining the cultural identity of the community.

**Unregulated development** - Housing that occurs on a small scale and is not subject to the regulations that govern development on a larger scale, such as a subdivision.

**USFS** - United States Forest Service

**USFWS** - United States Fish and Wildlife Service.

**Vulnerable species** - Species that are in danger of declining in an area, including threatened and endangered species as well as other species that may be vulnerable, but not listed by the U.S. Fish and Wildlife Service.

**Water table** - The top level of the aquifer, the highest point in the aquifer from water can economically be obtained.

**Wetland** - See "ciénega."

**Wildcat development** - See "unregulated development."

**Wildlife corridor** - A area which allows animals to move with relative safety from one region to another.

**Xeroriparian area** - A riparian area that has only ephemeral flow, but has more vegetation than the surrounding desert.

# APPENDIX B. THE SONORAN DESERT CONSERVATION PLAN REPORTS

## **Habitat, Wildlife, and Corridors Reports**

Pygmy Owl Update 11-99  
Ironwood Primer (May 2000, Arizona Sonora Desert Museum)  
Review of the Vulnerable Species List (April 2000, RECON)  
Biological Stress Assessment (April 2000, RECON)  
Priority Vulnerable Species: Data Compilation and Synthesis (June 2000, RECON)  
Priority Vulnerable Species: Habitat Data Analysis ( June 2000, RECON)  
Draft Reserve Design: Guidelines, Goals, Opportunities, and Constraints (September 2000, RECON)  
Cactus Ferruginous Pygmy-Owl Investigations in Pima County (July 2000, AZ Game and Fish Dept.)  
Cactus Ferruginous Pygmy-Owl Habitat Selection (July 2000, AZ Game and Fish Dept.)  
Issues of Non-native Species in Public Reserves (June 2000, County staff)  
Potentially Problematic Species in Pima County (September 2000, SWCA)

## **Riparian and Water Reports**

Paseo de las Iglesias (April 1999, U.S. Army Corps of Engineers)  
Water Resources and the Sonoran Desert Conservation Plan (July 1999, staff)  
Focus on Riparian Areas, SDCP Update (July 1999, County staff)  
Environmental Restoration (December 1999, County staff)  
Evaluation of Riparian Mapping (December 1999, County staff)  
Perennial Streams, Intermittent Streams, Shallow Groundwater (January 2000, PAG)  
Resources of Arivaca (March 2000, AWET)  
Prioritization of Streams for Conservation (April 2000, Science Team, County staff)  
Pima County's Watersheds and Watercourses (April 2000, Barbara Tellman, Clint Glass & John Wallace)  
Cocio Wash and the Gila Topminnow (April 2000, County staff)  
Riparian Vegetation Mapping Pilot Study (May 2000, Harris Environmental)  
Pima County Riparian Vegetation Mapping Pilot Study (May 2000, County staff)  
Springs in Pima County (May 2000, County staff, Science Team)  
Water Usage Along Selected Streams in Pima County (July 2000, PAG)

Aquatic Vertebrate Conservation in Pima County (July 2000, Dr. Philip Rosen)  
Preliminary Riparian Element — Riparian Protection, Restoration and Management (September 2000, County staff)

## **Ranching Reports**

Ranching in Pima County (November 1999, County staff)  
Conservation Tools for Ranching (September 2000, Ranch Team)  
Our Common Ground: Ranch Lands in Pima County (September 2000)

## **Cultural Resources Reports**

Preserving Cultural and Historic Resources (May 1999, County staff)  
History of Archaeological, Historical and Ethnographic Research (April 2000, SRI)  
People of Southern Arizona, Past and Present (May 2000, SRI)  
Cultural Resource Sites Depicted on Early Maps (May 2000, SRI)  
Cultural Landscapes, Relationships Between Land and People (May 2000, SRI)  
Overview of Traditional Cultural Places (May 2000, SRI)  
Cultural Landscapes of History in Southern Arizona (May 2000, SRI)  
Cultural Landscapes of Prehistory (July 2000, SRI)  
Cultural Resources — The Classic Period (August 2000, SRI Consulting)  
Mapping and Modeling Cultural Resources (Arizona State Museum, County staff)  
Preliminary Cultural Resources Element — Saving the Past for the Future (August 2000)

## **Land Use and Fiscal Reports**

Sonoran Desert Conservation Concept Plan (October 1998)  
Comparison of County Expenditures Per Capita, Other Govts (June 1999)  
History of Land Use in Pima County (January 2000, County staff)  
Impact of Unregulated Development, Service Demand (February 2000, County staff)  
Impact of Unregulated Development, Community Level (March 2000, County staff)  
Proposal in Support of the Ironwood Preserve (March 2000, County staff)  
Committed Land (April 2000, County staff)  
Mining Interests in the Ironwood Preserve Area (April 2000, County staff)

GIS Primer (August 2000, County staff et al.)  
Map Atlas (In preparation, County staff)  
Growth Management Study (September 2000, County Staff)  
Draft Regional Analysis of Land Use (September 2000, County Staff)  
Mountain Parks, Reserves and Biologically Significant Resource Lands (September 2000, County staff)  
Land Use, Legal, and Fiscal Considerations (September 2000, County staff)

### **Subarea Reports**

Resources of the Altar Valley Subarea (May 2000, County staff et al.)  
Altar Valley: History, Resource Assessment, Environmental Assessment (Nathan Sayer et al.)  
Resources of the Avra Valley Subarea (April 2000, County staff et al.)  
Resources of the Cienega Rincon Subarea (May 2000, County staff et al.)  
Resources of the Middle Santa Cruz Subarea (May 2000, County staff et al.)  
Resources of the Tortolita Subarea (May 2000, County staff et al.)  
Resources of the Upper San Pedro Subarea (May 2000, County staff et al.)  
Resources of the Upper Santa Cruz Subarea (May 2000, County staff et al.)  
Resources of the Western Pima County Subarea (May 2000, County staff et al.)  
Importance of the Cienega Watershed Area (July 2000, County staff)  
Importance of the Altar Valley Watershed Area (August 2000, County staff)

# APPENDIX C: SONORAN DESERT CONSERVATION PLAN COMMITTEES

## **SDCP Steering Committee**

Ken Abrahams  
Stan Abrams  
Neale Allen  
Bill Arnold  
Peter Aronoff  
Charles Award  
Ellen Barnes  
Dan Beckel  
George Bender  
Robyn (Louis) Benson  
Laurence Marc Berlin  
Tim Blowers  
John Bordenave  
Carolyn Campbell  
Joe Cesare  
Sue Chilton  
Ernest Cohen  
Hector Conde  
Vicki Cox Golder  
William Crosby  
Richard Daley  
Mary Darling  
Carl Davis  
Carol Duffner  
Jonathan DuHamel  
Andra Ewton  
Richard Genser  
Gay Lynn Goetzke  
David Goldstein  
Mike Grassinger  
Bruce Gungle  
William Hallihan  
Richard Harris  
Lynn Harris  
Heather Fox  
Gayle Hartmann  
Duff Hearon  
Deborah Hecht  
David Hogan  
Donald (Carolyn) Honnas  
Babrara Huffstetler

Jan Johnston  
Gerard Juliani  
Pat & Macaela King  
Guy Kirkpatrick  
Rob Kulakofsky  
Teresa Leal  
Alan Lurie  
Lance MacVittie  
Teresita Majewski  
John Martin  
Mitch McClaran  
Andrew McGibbon  
Christina McVie  
Doug McVie  
John Menke  
Mary Miller  
Mike Milroy  
Chris Monson  
Joe Murray  
David Naugle  
Joe Parson  
Luther Propst  
Jud Richardson  
Patricia Richardson  
Barbara Rose  
Chris Sheafe  
Jim Shiner  
Victoria Sikora  
Quinn Simpson  
Lisa Stage  
Tim Terrill  
Dale S. Turner  
Lucy Vitale  
Dick Walbert  
Sally Wegner  
Frances Werner  
Michael Winn  
Carl Winters  
Nancy Young Wright  
Michael Zimet  
Nancy Zurenberg

## **GIS Technical Oversight Group**

Rick Church  
Ross Gerrard  
Michael Gilpin  
Peter Stine

## **Science Technical Advisory Team**

William Shaw, Chair  
Doug Duncan  
Mima Falk  
Natasha Kline  
Steve Prchal  
Sherry Ruther  
Cecil Schwalbe  
Robert Steidl

## **Ranch Team**

Thomas Sheridan, Chair  
Wally Alexander  
Mette Brogden  
Mac Donaldson  
Carl Jones  
Kitty Knepper  
Bart McGuire  
Dan Robinett  
Jon Rowley  
George Ruyle  
Nathan Sayre

## **Cultural Resource Team**

Paul Fish, Chair  
Mary Farrell  
Beth Grindell  
Joe Joaquin  
Jerry Kyle  
Marty McCune  
Peter Steere  
Sue Wells  
Max Witkind