

# *Arizona Forest Legacy Program: Assessment of Need*

*June 2005*



Photo: Flagstaff, Arizona; The Nature Conservancy



# **Arizona Forest Legacy Program: Assessment of Need**

**Prepared By**

**The Nature Conservancy-Arizona Chapter  
1510 E. Fort Lowell Road  
Tucson, Arizona 85719  
520-622-3861**



**Under Contract (LAND-2004-01)  
with  
Arizona State Land Department  
Fire Management Division  
1616 W. Adams Street  
Phoenix, Arizona 85007  
602-542-4631**



## TABLE OF CONTENTS

ACKNOWLEDGEMENTS	4
EXECUTIVE SUMMARY	5
Introduction	5
Arizona’s Forest Resources	5
Trends in Forestland Conversion	5
Arizona’s Forest Legacy Program	6
Arizona’s Forest Legacy Areas	6
Prioritization Process	7
SECTION 1	9
I. Forest Legacy Program in Arizona	9
II. Arizona’s Forests and Woodlands	10
A. Historical Perspective	11
Pre-European Settlement	11
Post-European Settlement	13
B. Forest Types and Distribution	14
Mixed Conifer Forests	16
Madrean Oak Woodland	16
Pinyon-Juniper Woodlands	18
Riparian Forest	20
C. Forestland Owners	21
D. Timber and Wood Products	21
E. Insect Impacts	23
III. Arizona’s Forest Resources (non-timber)	24
A. Recreational, Cultural, and Scenic Resources	24
B. Geologic Features and Mineral Resources	25
C. Grazing	26
D. Watershed Resources	27
E. Fish and Wildlife Habitat	27
F. Forest Soils and Productivity	29
IV. Forest Trends and Threats	31
A. Demographics	31
B. Changes in the Economy and Forestland Conversion	33
C. Resources Most Vulnerable	34
V. Protection of Arizona’s Forestlands	35
A. Protected Forestland in Arizona	35
B. Conservation Easements in Arizona	36
SECTION 2	43
I. Eligibility Criteria for Forest Legacy Areas	43
II. Arizona’s Forest Legacy Areas	43
A. Project Eligibility Criteria	44
B. Goals and Objectives of Arizona’s FLP	48
III. Assessment of Need Information Gathering Processing	49
A. Spatial Information and Analysis	49

B. Field Validation	50
IV. Arizona's Forest Legacy Area Descriptions	51
A. Arizona Strip Forest Legacy Area	52
B. Arizona Highlands Forest Legacy Area	53
C. Sky Islands Forest Legacy Area	57
SECTION 3	60
Project Development Process	60
SECTION 4	62
Public Review and Comments	62
LITERATURE CITATIONS	64

## LIST OF APPENDICES

- Appendix A: Vegetation Communities Comprising Forest Types
- Appendix B: Complete List of Spatial Layers in AON
- Appendix C: Tree Species in Arizona
- Appendix D: Private Forest Acres by County for Each Forest Type
- Appendix E: List of All Endangered, Threatened, Special Concern and Sensitive Species in Arizona Private Forestland by County
- Appendix F: Private Forest Acres that Contain Environmentally Important Values By County
- Appendix G: Letter Sent to Arizona National Forest Supervisors
- Appendix H: Sample of Forest Land Program Featured in TNC Spring 2004 Newsletter
- Appendix I: Economic Data, Forest Descriptions and Demographics by County
- Appendix J: Membership Rosters of Review Committees
- Appendix K: Letters of Support for Forest Legacy Program

## LIST OF FIGURES

- Figure 1: Thousands of acres by forest type in Arizona
- Figure 2: National Forest Net Growth and Removals, Interior West
- Figure 3: Number of acres of known cultural resources on private forestlands
- Figure 4: Actual and projected percent population growth relative to 1980, by county
- Figure 5: Net income from farming and ranching in Arizona
- Figure 6: Personal income (millions of year 2000 dollars) by industry sector
- Figure 7: Forest Value and Threat Criteria Prioritization Process
- Figure 8: Description of road buffer widths used in the development spatial layer

## LIST OF MAPS

- Map 1: Forest Legacy Areas
- Map 2: Forest Cover Types
- Map 3: Environmental and Public Values
- Map 4: Developed Areas
- Map 5: Arizona Strip Environmental and Public Values
- Map 6: Arizona Strip Developed Areas
- Map 7: Arizona Highlands Environmental and Public Values
- Map 8: Arizona Highlands Developed Areas
- Map 9: Sky Islands Environmental and Public Values
- Map 10: Sky Islands Developed Areas

## ACKNOWLEDGEMENTS

We would like to thank the following people and groups for their assistance in the preparation of this document: Kirk Rowdabaugh and Al Hendricks with the Arizona State Land Department, Jim Payne, John Hinz, Marlin Johnson, George Martinez, and Larry Roybal with the United States Forest Service; the Arizona Forest Stewardship Committee; and Rob Marshall, Dave Gori, and Don Smith with The Nature Conservancy.

## EXECUTIVE SUMMARY

### **Introduction**

In 2003, Arizona expressed interest in participating in the U.S. Forest Service Forest Legacy Program. The purpose of the Forest Legacy Program is to identify and protect environmentally important private forest areas that are threatened by conversion to non-forest uses. Additional benefits of the program include the protection of important scenic, cultural, and recreational resources; preservation of traditional forest uses such as timber management, grazing, and hunting; and conservation of riparian areas, wildlife habitat, and other precious ecological values. Appropriated funds, with a mandatory 25% non-federal match, are used to administer the program and support conservation easements on both purchased and donated lands and interests in lands meeting the purposes of the Forest Legacy Program. The Forest Legacy Program is entirely voluntary and is based on the principle of willing sellers and willing buyers.

In order to participate in the Forest Legacy Program, the Arizona State Land Department, as Arizona's lead forestry agency, submits this Assessment of Need documenting the need for a Forest Legacy Program in Arizona, establishing eligibility criteria, setting selection guidelines, and identifying priority areas. Arizona's Assessment of Need was prepared under contract by The Nature Conservancy in conjunction with the State Land Department, Arizona Forest Stewardship Committee, and USDA Forest Service, Region 3 Arizona National Forests. This report is submitted to the USDA Forest Service by the Arizona State Land Department for approval into the Forest Legacy Program.

### **Arizona's Forest Resources**

The diversity of Arizona's forests range from semi-arid riparian gallery forests to sub-alpine and montane forests, spanning roughly 27% of the state and covering an area of 19.4 million acres. These forests are comprised of conifers and hardwoods with approximately 35 tree species and range in elevation from approximately 300 to 3,700 m. The majority of forestland is located above the Mogollon Rim with discrete patches in southeastern Arizona's mountain islands. Pinyon-juniper and pure juniper woodlands are the most abundant forest type in Arizona, occupying approximately 14.8 million acres or 20.3% of the state. The rarest and most significant in ecological terms is riparian forest, which occupies less than one half a percent of Arizona's land.

While timber production has historically been the primary function and most consumptive use of Arizona's forests, forestland serves other anthropogenic purposes such as recreation, tourism, mining, and grazing. More importantly, forestlands contribute to the overall functioning of ecosystems by playing a vital role in cycling water and nutrients, filtering pollutants, discharging oxygen, and providing habitat for humans and biological diversity, alike.

### **Trends in Forestland Conversion**

Explosive population and economic growth over the last 35 years have resulted in major changes for Arizona. From 1970 to 2000 Arizona's population grew by 3.37 million, a 188% increase. Growth has increased even more dramatically in the last four years with the current population

estimated at 5.44 million, making Arizona the second fastest growing state in the United States. Its population is expected to double again in the next 25 years.

Some impacts of this rapid population growth include ranch and forestland conversion to low-density development, increased demands on forest resources, fragmentation by roads and fences, and interruption or degradation of ecological services. In economic terms, net income from farming and ranching dropped from \$565 million in 1970 to \$377 million in 2000, while the services and professional industry which includes construction, real estate and trade, increased 48% during the same time period.

### **Arizona's Forest Legacy Program**

The primary goals for the Arizona Forest Legacy Program are: (1) protect important private forest from conversion to non-forest such as development and ex-urban growth; (2) maintain the ecological integrity of Arizona's forests with the purpose of protecting watershed functions, such as ground water recharge, as well as protect native plant and wildlife habitat; and (3) maintain forest integrity in order to protect cultural, public and economic values associated with traditional forest uses such as timber harvest, livestock ranching, and recreational opportunities.

To reach these goals several program objectives have been identified:

- ◆ Reduce forest fragmentation through protection of ecologically and publicly important private forestland by focusing on large forested blocks.
- ◆ Protect riparian forest habitat in large or small blocks. Resource values are independent of parcel size in riparian settings
- ◆ Maintain watershed functions and protect water supply by protecting forests in the upper watershed and streams.
- ◆ Protect wide ranging, rare, threatened, and/or endangered plant and wildlife habitat.
- ◆ Protect important historical and cultural sites.
- ◆ Promote forest stewardship through partnerships.

### **Arizona's Forest Legacy Areas**

Private forestland identified in the Assessment of Need for inclusion in a Forest Legacy Area under the Forest Legacy Program must meet the following minimum criteria:

- ◆ Environmentally important forest areas, which include areas important for scenic, recreational, riparian, ecological, cultural, or traditional forest uses, and
- ◆ Threatened by conversion to non-forest uses.

For the purposes of the Arizona Forest Legacy Program, forestland is defined as:

- Lands stocked with at least 10% tree cover of any size (at maturity, the trees must be greater than 8 feet in height). Ten percent stocked, when viewed from a vertical direction, equates to an areal canopy cover of leaves and branches of 25% or greater.
- The minimum area for classification is 5 acres, owned by an individual or by an organized group of individuals.

In accordance with the Forest Legacy Program Guidelines, the definitions of ‘threats of conversion’ and ‘important forests’ are further clarified. To this end, threatened forests are defined as any forest at risk of conversion to non-forest uses by roads and/or human developments. Important forests are defined as those forests that include one or more of the following values:

- ◆ Riparian Areas
- ◆ Fish and wildlife habitat and corridors
- ◆ Known threatened and endangered species
- ◆ Timber, and other forest commodities
- ◆ Scenic resources
- ◆ Public recreation opportunities
- ◆ Known cultural resources
- ◆ Other ecological values

Using the above definitions of forest, threatened forests, and important forests, it was determined that private forest within three Forest Legacy Areas is threatened and important and therefore eligible for inclusion in the Forest Legacy Program. The three Forest Legacy Areas are Arizona Strip FLA, Arizona Highlands FLA and Sky Islands FLA. These FLAs are depicted in Map 1.

### **Prioritization Process**

Six criteria were selected for use in the prioritization process for evaluating competing Forest Legacy Program projects. The criteria listed in *priority* order are:

- 1) Ecological and Environmental values,
- 2) Site viability
- 3) Threat immediacy
- 4) Local support and presence of partners and/or matching funding
- 5) Contribution to larger conservation strategy or importance to other protected forestlands
- 6) Public values

These criteria are included in an evaluation table entitled “Forest Value and Threat Criteria Prioritization Process” (Figure 7).

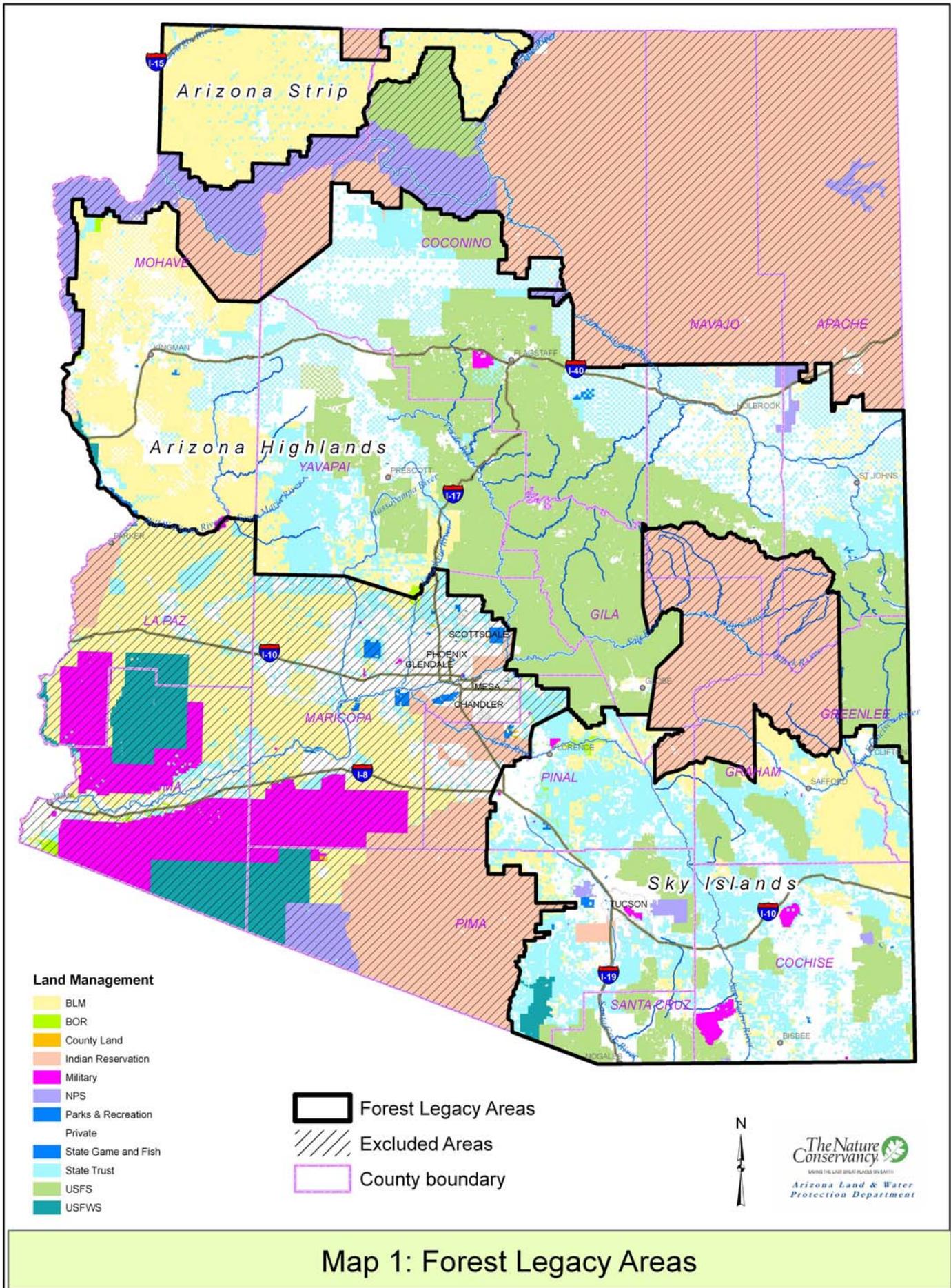
To aide the prioritization process for identifying environmentally important forests at risk of non-forest conversion, three spatially explicit data sets were created to identify areas of high public and ecological value as well as areas of road and development threats within private forestlands. The *public value* spatial layer evaluates private forestlands in the context of values that the general public may place on public lands and cultural resources. The two key components of public value are (1) presence of or proximity to areas with cultural and historical resources, and (2) proximity to public recreation opportunities. The *environmental value* spatial information was created to assess private forestland in the context of threatened, endangered, and common species locations and habitat requirements, as well as to evaluate their importance to ecological functioning of an area and overall biodiversity of the region. Finally, the *development threat* spatial layer represents the degree to which an area has been impacted by human development as well as identifies the boundaries of that impact. This spatial layer was a combination of road impacts and current housing density.

Field verification of these spatial layers was conducted for two weeks in April 2004, and was targeted to areas where *public value*, *environmental value*, and *development threat* intersected.

During field reconnaissance approximately 2,400 miles, 25 conservation areas, 6 National Forests, and 18 riparian areas were visited along with representatives from each of the four forest types and development threats.

Based upon the spatial analyses and field assessment, recommendations for private forestland priorities are as follows:

- ❖ Riparian forest along perennial water represents a small proportion of the total forest in Arizona, yet a disproportionately high number of species depend on them. Riparian forests are some of the most biologically diverse and rich communities in Arizona. Given their dwindling extent and high value, these areas should be the top priority.
- ❖ Areas classified as having rural housing density or only road impact near Kingman, Prescott, Chino Valley, Flagstaff, Heber to Show Low along Highway 260, Sonoita, Elgin, and Green Valley should be prioritized for Forest Legacy Program funds due to their imminent conversion by development.



**Land Management**

- BLM
- BOR
- County Land
- Indian Reservation
- Military
- NPS
- Parks & Recreation
- Private
- State Game and Fish
- State Trust
- USFS
- USFWS

- Forest Legacy Areas
- Excluded Areas
- County boundary



The Nature Conservancy  
 SAVING THE LAST GREAT PLACES ON EARTH  
 Arizona Land & Water  
 Protection Department

**Map 1: Forest Legacy Areas**

## SECTION 1

### **I. Forest Legacy Program in Arizona**

In 2003, Arizona expressed interest in participating in the U.S. Forest Service Forest Legacy Program. The Forest Legacy Program was authorized under Section 1217 of Title XII of the Food, Agriculture, Conservation and Trade Act of 1990 (P.L. 101-624:104 stat.3359; 16 U.S.C. 2103c), also referred to as the 1990 Farm Bill amended the Cooperative Forestry Assistance Act (CFAA) of 1978, as amended, (16 U.S.C. 2101 et. seq.). The CFAA provides authority for the U.S. Secretary of Agriculture (Secretary) to provide financial, technical, educational, and related assistance to states, communities, and private forestland owners. The 1990 Farm Bill further directs the Secretary to establish the Forest Legacy Program (FLP) to protect environmentally important forest areas that are threatened by conversion to non-forest uses. In 2003, Congress appropriated \$68.3 million towards 42 Forest Legacy projects, bringing the total number of projects funded by the FLP to 179.

The purpose of the FLP is to identify and protect environmentally important forest areas that are threatened by conversion to non-forest uses. The FLP seeks to promote forestland protection and other conservation opportunities on non-industrial privately-owned forests. Additional benefits include the protection of important scenic, cultural, and recreational resources; preservation of traditional forest uses such as timber management, grazing, and hunting; and conservation of riparian areas, wildlife habitat, and other precious ecological values. Appropriated funds are used to administer the program and support conservation easements on both purchased and donated lands and interests in lands meeting the purposes of the FLP program. The FLP is entirely voluntary and is based on the principle of willing sellers and willing buyers.

In order to participate in the FLP, the Arizona State Land Department (ASLD), as Arizona's lead forestry agency, submits this Assessment of Need (AON) documenting the need for a FLP in Arizona, establishing eligibility criteria, setting selection guidelines, and identifying priority areas. Areas identified for consideration under the FLP meet the minimum criteria based upon the FLP purpose and guidelines (USDA 2003a). The minimum criteria for establishing Forest Legacy Areas are as follows:

- Environmentally important forest areas, which include areas important for scenic, recreational, riparian, ecological, cultural, or traditional forest uses, and are
- Threatened by conversion to non-forest uses.

Although there is no land in Arizona that currently meets the definition of Industrial Private Forest (IPF) this may change in the future. For this reason all private forestland is considered for participation at this time in the FLP administered by the ASLD. Private forest is defined as:

- lands with existing tree cover and other lands including crop land, pasture land, surface-mined lands, and non-stocked forestlands that are scheduled for conversion to tree cover.

Further clarifications for by Arizona's Forest Stewardship Committee (AFSC) and in "Arizona's

Forest Resources” (O’Brien, R. A. 2002) include:

- ◆ "...lands with existing tree cover..." are defined as lands stocked with at least 10% tree cover of any size (At maturity, the trees must be "*tree form*" which is defined as greater than eight (8) feet in height).
- ◆ Ten percent stocked, when viewed from a vertical direction, equates to an aerial canopy cover of leaves and branches of 25% or greater (NRCS-NRI 2002 Annual Report).
- ◆ The minimum area for classification as forestland is 5 acres, owned by an individual or by an organized group of individuals. Strips of trees must have a crown width of at least 120 feet except for windbreaks, which must have a crown width of at least 60 feet at maturity.
- ◆ Riparian forestland is located within 100 year floodplains and includes cottonwood-willow forest, mixed broadleaf forest, mesquite bosque, willow forest, and hardwood swamps. There is no minimum width requirement for riparian forestland. The 100 year floodplain is defined in the standard FEMA floodplain maps.
- ◆ Unimproved roads and trails, streams, and clearings in forest areas are classified as forestland if less than 120 feet wide.
- ◆ "...other lands including crop land, pasture land, surface-mined lands, and non-stocked forestlands that are scheduled for conversion to tree cover" are eligible only if the trees that are naturally regenerated or planted are capable of survival without supplemental irrigation once they are established. Established is defined as three years after they are planted.

In order to assure program-wide success, each project budget will include a minimum nonfederal contribution of 25%. The nonfederal cost-share may consist of: (1) the value of land, or interest in land, dedicated to the FLP that is not paid for by the Federal government; (2) nonfederal costs associated with program implementation; and (3) other nonfederal costs associated with a grant or other agreement that meets FLP purpose (USDA 2003a). Non-federal costs can include both applicable in-kind contributions and cash.

Arizona’s Assessment of Need for the USDA Forest Service FLP, was prepared under contract by The Nature Conservancy. The ASLD submits this AON to the USDA Forest Service for approval into the FLP. Arizona’s AON was prepared in cooperation with the ASLD, AFSC, and Region 3 of the U.S. Forest Service.

## **II. Arizona’s Forests and Woodlands**

## A. Historical Perspective

### *Pre-European Settlement*

#### Climate

In order to place forests of today in context, a brief discussion of the history regarding Arizona's forests is presented. A paleoecological study in the Potato Lake area (approximately 2220 m in elevation) of the southern Colorado Plateau suggested that dramatic changes have occurred in the area's biota over the last 35,000 years (Anderson 1993, Anderson et al. 2000). From 35,000 to 21,000 years before present (B.P.) it appeared that the area was dominated by mixed conifer species suggesting the climate was cooler and wetter than it is today. Between 21,000 to 10,400 B.P., likely the coldest time during the last glaciation, Engelmann spruce (*Picea engelmannii*) formed almost pure stands, growing as low as 2,500 meters. Today, spruce is generally located above 3300 meters. The transition into the Pleistocene-Holocene and end of the glaciation period resulted in a major reorganization of southern Colorado Plateau vegetation. On Utah's Markagunt Plateau, species common to today's mixed-conifer forests moved upslope to their elevation range of present-day. The warmer climate likely resulted in the widespread establishment of ponderosa pine (*Pinus ponderosa*) across the mid-elevations of the area. At elevations between 1,600 and 2,100 m, pinyon-juniper woodlands dominated. In the period that followed (8,000 to 4,000 B.P.) pinyon-juniper woodlands migrated into the area and cold deserts were replaced by warm desert grasses.

In lower elevation regions of the Colorado Plateau, studies from the Chaco Canyon and San Juan Basins in Arizona (8,000 B.P.) showed that canyons were dominated by mixed conifer forests and the mesa tops were cold desert steppe (Betancourt et al. 1993)

#### Fire

In the Southwestern forests, lightning and human-caused fires could burn for several months and covered thousands of acres, burning until extinguished by rain or depletion of fuel (Swetnam 1990, Swetnam and Baisan 1996). Dendrochology research suggests that most Southwest forest stands, excluding spruce-fir, burned every 2 to 30 years as low-intensity fires. Having greater moisture yet heavier fuel loads, spruce-fir forests burned less frequently, on the order of every 35 to 150 years or more, but at higher intensities (Abolt 1997, Grissino-Mayer et al. 1995, and Veblen et al. 1994). Although native cultures used fire for a variety of purposes, lightning ignitions during periods of high fire hazard were sufficient to produce frequent fires (Schroeder and Buck 1970, Swetnam and Baisan 1996).

#### Demographics and Forest Resources

Humans have been an integral component of Arizona's forest ecosystems for more than 10,000 years although precise regional population estimates do not exist (Dean et al. 1994). Archaeological records from around 300 B.P. indicate human populations were developing more permanent settlements and shifting to greater reliance on domesticated plants (Dean et al. 1994). Impacts on forest resources were thought to have been minimal until around the 11<sup>th</sup> century when farming, fuelwood cutting, and hunting greatly increased around the larger settlements (Dahms and Geils 1997). The arrival of Europeans had a devastating impact on the native populations as well as regional environmental impacts such as intensive irrigation and introduction of diseases that threatened wildlife.

The prehistoric uses of timber resources were fuel, tools, and construction and were mainly used locally due to technology and transportation limitations. For these reasons the woodlands and riparian forests near areas of population growth were most affected (Dahms and Geils 1997). For example, along the Middle Rio Grande Valley, the riparian bosque had been essentially eliminated by Puebloan and Hispanic farmers before 1848 (Abert 1848a, Wozniak 1987). It was not until the 19<sup>th</sup> century with the introduction of commercial logging, mining, and railroads that the upper elevation forests were impacted.

#### Historic Forest Conditions

In the early 19<sup>th</sup> century, dense woodlands could be found, but forests were predominantly open with a diverse community of trees, shrubs, and perennial grasses and forbs (Abert 1848a, 1848b). The pattern of tree distribution is influenced by ecosystem condition as well as processes above and below ground. Historic ponderosa pine forests are often referred to as open and park-like with abundant herbaceous understory although descriptions and pictures of dense stands have also been documented (see Woolsey 1911, Covington and Moore 1994). Records and archaeological reconstruction of historic forest conditions suggest that the vegetation was characterized by individual, clumped, or stringers of ponderosa pine in various sizes with an understory grass-herbaceous matrix (Dahms and Geils 1997). The development of fire-dependent vegetation coupled with the typical climate of several centuries prior to 1848 reinforced a frequent fire regime of low-intensity burns (Covington and Moore 1994). Frequent surface fires, disease, insects, and other regulating mechanisms kept the ponderosa pine forest in balance.

Conditions of historic mixed conifer forests are variable and depend on time since and severity of the most recent burn. Historical conditions of mixed conifer forest as reported in *An Assessment of Forest Health in the Southwest* (Dahms and Geils 1997) describe the following:

“Lang and Stewart<sup>1</sup> describe the mixed conifer forest on the North Kaibab Plateau (Colorado Plateau Province) in 1909. They describe most mature Douglas fir (as well as white fir and blue spruce) as "deteriorating"; they probably mean these trees were decayed, had poor crown form, broken tops, and hollow bases typical of repeatedly fire-damaged trees. Lang and Stewart also note that Douglas-fir regeneration was "healthy and vigorous"; and often dense stands of pole-sized trees covered large areas, especially on more mesic sites and under aspen.”

Because historic spruce-fir forests had little impact from logging, grazing, or fire suppression, their historic conditions are fairly well known (Dahms and Geils 1997). Spruce-fir forests were susceptible to major disturbances (i.e. fire and insect outbreak) but they occurred relatively infrequently with 100+ years between major events (Baker and Veblen 1990, Schmid and Frye 1977, Veblen et al. 1994).

---

<sup>1</sup> An unpublished report titled Reconnaissance of the Kaibab National Forest, unpublished survey report circa 1910 on file Williams, AZ: U.S. Department of Agriculture, Forest Service, Kaibab National Forest.

Riparian forests once formed continuous corridors of lush vegetation covering hundreds of miles and are also found as components of montane communities. They stretch from the headwaters of rivers and streams down to the lower elevation deserts. Many species in the riparian communities depend on flooding for seed transportation and establishment. Riparian communities provided resources necessary for early human settlements as well as permanent wildlife habitat and migratory routes for birds and mammals.

### *Post-European Settlement*

The period following the Mexican-American War of 1848 marks a significant transition from Hispanic to American sovereignty in the Southwest and a time of rapid settlement. With the increasing settlers came cattle herds; by 1890, more than 1.5 million head of cattle were in the Southwest (Baker et al. 1988). By the early 1900s, livestock grazing pressures had reached the mountainous and timbered areas resulting in vegetation cover loss and increased erosion. Since the peak in the numbers of cattle and sheep in Arizona, around the time of World War I, livestock numbers have been declining (Dahms and Geils 1997).

Historic fire regime was dramatically changed because livestock removed much of the fine fuel needed to carry surface fires and fire suppression increased because of the growing number of inhabitants who viewed fire as a threat. Ultimately, the frequency and size of fires were altered by roads and trails, fragmented forest continuity, the suppression of fire, and low fuel loads. Fire exclusion began altering forest structure and fire regime in the early 1900s (Covington and Moore 1994). Over the last century, the combination of fire suppression and fuel accumulation has led to the occurrence of large and intense fires such as those experienced in the last several decades in the Southwest.

With the arrival of the railroad to the Southwest, new industries appeared, human population grew, natural resource exploitation accelerated, and the commercial economy replaced the subsistence economy. Some other concurrent changes included altered land use patterns, depletion of forage for livestock, degradation of riparian areas, and changes in forest communities and wildlife habitat (Bahre 1991, DeBuys 1985). Arizona has continued to grow since this time, further stressing natural systems and resources.

Small scale logging for local-use shifted to larger efforts around the 1870s with the construction of the railroad and harvesting of railroad ties. During these early years, large volumes (70-80%) needed to be removed from the forests to make the operation feasible (Schubert 1974). Later, when trucks were available lighter cuts could be made - typically 30 to 60% of the available volume (Myers and Martin 1963). Over time, harvesting methods have been variable with some practices more sustainable than others. Removal of the 'large quality' trees have resulted in some dense stands of younger trees thus reducing understory herbaceous cover and increasing fire danger.

The transcontinental railroad also provided increased opportunities for tourism. Arizona's mild climate, striking archaeological ruins, and majestic scenery all led to a tremendous increase in recreation during the mid to late 1900s. Arizona became a favorite destination for hunting, fishing, sightseeing, and bird watching. Preservation and conservation of forests and other natural communities became a focal point for public land managers. Higher visitation to

wilderness areas and forest communities led to the overuse and exploitation of resources, introduction of non-native plants, increased human-caused fires, and unauthorized use of motorized vehicles.

These and other interrelated widespread changes in Arizona have also altered the hydrologic regime of most every watershed. Soil compaction, road construction, and reduced ground cover have led to increased erosion and flooding, often resulting in deeply cut incised channels. Water diversions and impoundments on the larger rivers have significantly modified channel dynamics and altered native habitat and vegetation establishment. To address bank stabilization and other ecological problems, species not native to the ecosystems of the Southwest, like salt cedar (*Tamarix* spp.) were introduced to help “solve” these issues. Some of these introduced species are quite aggressive, competing with native plants for resources and are currently having detrimental impacts on ecosystem processes.

## B. Forest Types and Distribution

The diversity of Arizona’s forests range from semi-arid riparian gallery forests to subalpine and montane forests, spanning roughly 27% of the state and covering an area of 19.4 million acres (O’Brien 2002). Several of these forested communities have international importance because of their outstanding biological diversity and are part of the greater geographic region referred to as the Madrean Archipelago, which has recently been added to Conservation International’s list of the world’s hotspots for biodiversity (Andrew Smith, personal communication). The great biological diversity stems from the convergence of subtropical and temperate climate zones that create forest corridors for many migratory animals.

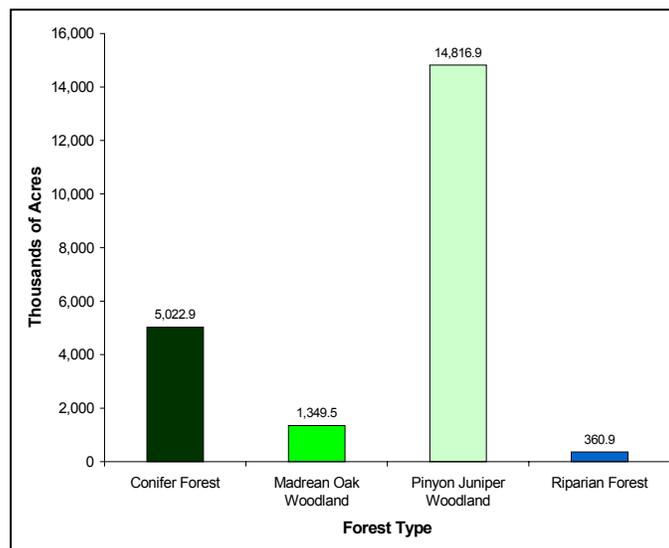
In the most general sense the USDA Forest Inventory and Analysis Program classifies forestlands into two major categories – timberland or woodland – based on levels of stocking. Timberland is forestland with tree species such as ponderosa pine (*Pinus ponderosa*) and Douglas-fir (*Pseudotsuga menziesii*) traditionally used for industrial roundwood products, that make up at least 10% of the stocking. Only 20% of Arizona’s forestland meets this definition (O’Brien 2002). The remaining portion is woodland, comprising all other forestlands where timber species are not present at the minimum stocking level. Woodland tree species such as pinyon (*P. edulis*) and juniper (*Juniperus* spp.) are used primarily for fuelwood, fence posts and in some cases, Christmas trees. Forestlands are further differentiated into forest types and are often identified by the predominant tree species.

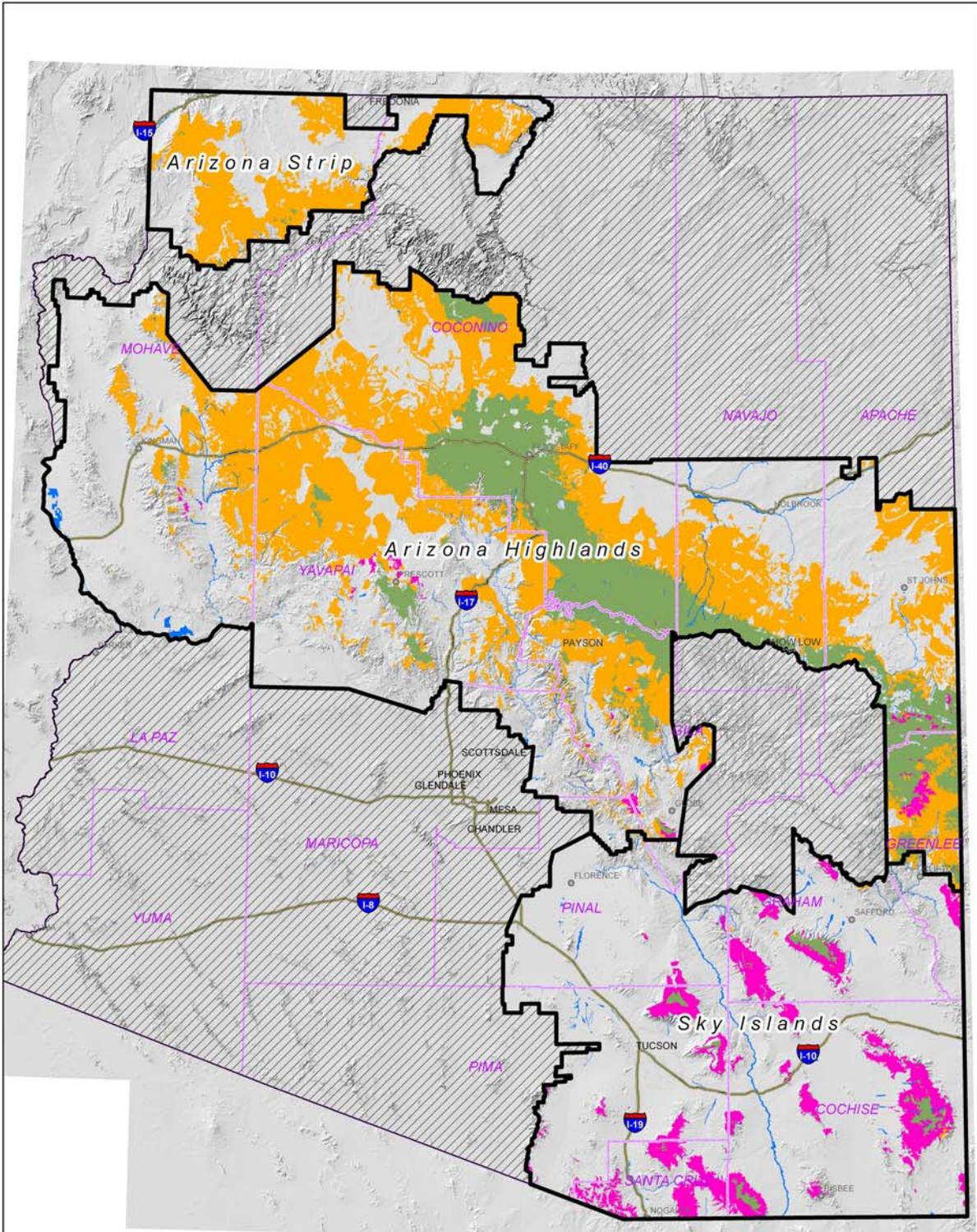
Throughout time, vegetation communities have been described using a variety of classifications and at different geographical scales. Because planning and management objectives differ, the framework to identify ecological units is different, as are the resultant classifications. Most of the forestlands in Arizona are within the Arizona – New Mexico Mountains Semi-Desert – Open Woodland – Coniferous Forest – Alpine Meadow Province (Bailey et al. 1994). Southwestern ecosystems are grouped into life zones (Carleton et al. 1991) which are characterized by biotic community types and can be cross-referenced to the biotic communities described by Brown and Lowe (1977, 1980) and Brown (1994). For Arizona’s Assessment of Need purposes, forestlands have been aggregated into four major forest community types – mixed conifer forests, pinyon-juniper woodlands, riparian forests, and Madrean oak woodlands.

It is important to note that forest statistics can vary depending on the source of the information, sampling method, accuracy of the data, and the definition of forestland. Therefore, the Arizona AON will report state-wide figures based on information obtained from the Forest Inventory and Analysis (FIA) Program and documented in *Arizona's Forest Resources, 1999* (O'Brien 2002). While all Forest Legacy Area and forest type (conifer, pinyon-juniper woodland, Madrean oak woodland, and riparian forest) figures are based on our spatial analyses. The discrepancy in data reporting is because the geospatial data to accompany the FIA report was not available at the time the AON was developed, therefore, Arizona GAP vegetation data (1998) was used as the primary source in our spatial analyses for identifying forestlands in Arizona. Appendix A identifies the aggregation of the forest vegetation types that comprise the mixed conifer forests, pinyon-juniper woodlands, riparian forests, and Madrean oak woodlands and crosswalks them with biotic communities (Brown 1994). Identification of riparian forest was enhanced with spatial data from the Arizona Game and Fish Department (AZGFD 1994). Again, county level and forest type statistics will be based on the information generated from spatial analyses using the combined GAP and AZGFD vegetation data. For a complete list of geospatial information used in developing the AON see Appendix B.

Arizona forests are comprised of conifers and hardwoods with thirty-seven tree species (Appendix C) ranging in elevation from approximately 300 to 3,700 m. The majority of forestland is located above the Mogollon Rim with discrete patches in southeastern Arizona's mountain islands (see Map 2 and Figure 1). Pinyon-juniper and pure juniper woodlands are the most abundant forest type in Arizona, occupying approximately 14.8 million acres or 20.3% of the state. The rarest and most significant in ecological terms is riparian forest, occupying less than one-half a percent of the land in Arizona. Ground water pumping and conversion to non-forest uses currently threaten the riparian forests and habitat they support.

**Figure 1: Thousands of acres by forest type in Arizona (based on Gap vegetation and AZGFD data).**





**Forest Cover Type**

- Conifer Forest
- Madrean Oak Woodland
- Pinyon Juniper Woodland
- Riparian Forest

- Forest Legacy Areas
- Excluded Areas
- County boundary



The Nature Conservancy  
WHERE THE LAND DOES THE TALKING  
 Arizona Land & Water  
 Protection Department

May 2005

Map 2: Forest Cover Types

### *Mixed Conifer Forests*

In Arizona, ponderosa pine forests comprise the largest portion of the mixed conifer forest, approximately 86%. Ponderosa pine (*Pinus ponderosa*) is the most widely distributed pine in North America, extending from British Columbia, Canada to Durango, Mexico. Throughout its range, ponderosa pine can be found at elevations from sea level to about 2,750 m. In Arizona, most of the ponderosa pine forest is between 1650 and 2,760 m. At slightly higher elevations (above approximately 2400 m) a variety of conifer species are present. At elevations between 2,400 and 3,100 m forests are dominated by Douglas-fir (*Pseudotsuga menziesii* var. *glauca*), white fir (*Abies concolor*), and blue spruce (*Picea pungens*). In the cooler regions and areas receiving more than 635 mm of annual precipitation, the spruce-fir forest is predominantly Engelmann spruce (*Picea engelmannii*), with co-dominant species of subalpine fir (*Abies lasiocarpa*). Other species that are present in mixed conifer forests include corkbark fir (*A. lasiocarpa* var. *arizonica*), Southwestern white pine (*P. strobiformis*), Gambel oak (*Quercus gambelii*), juniper, Arizona cypress (*Cupressus arizonica*), and aspen (*Populus tremuloides*). Aspens occur in small, transient patches in mixed conifer forests and because they are shade intolerant, they eventually succumb to competition as conifers close the canopy.

The mildest climate in Arizona is found in mixed conifer forests, with average annual precipitation from 430 to 760 mm (USDA 2004b) and as high as 1100 mm in the higher elevations (USDA 2004a). More than half of the precipitation falls as snow and the mean annual temperature ranges from 5 to 8 degrees Celsius (USDA 2004b).

### *Madrean Oak Woodland*

Evergreen oak woodland, characterized by wet summers and mild winters, extends from the Sierra Madre of Mexico into southeastern Arizona and Southwestern New Mexico and ranges in elevation from 880 to 2,300 m (Brown 1994) and up to the top of Mount Graham at 3,260 m (USDA 2004b). The Madrean oak woodlands in Arizona generally include evergreen oak species as well as conifer species. Most of the woodlands are found primarily in “sky islands” of southeastern Arizona at an elevation gradient (1,200 to 2,700 m) above the desert shrub and grassland communities at low elevations but below the coniferous forests at the higher elevations. At the lower elevations, the woodlands are typically open with bunch grasses as the major understory component. At the higher elevations they are denser forests with oak and pine species intermixed. Madrean oak woodland’s northern range is in central Arizona where it occurs above or within the drier interior chaparral, and below and along drainages within the drier and cold tolerant Great Basin conifer woodland (Brown 1994).



Madrean Oak Woodland

In Arizona, a variety of oak species such as Emory oak (*Quercus emoryi*), Arizona white oak (*Q. arizonica*), Mexican blue oak (*Q. oblongifolia*), gray oak (*Q. grisea*), silverleaf oak (*Q. hypoleucoides*), and netleaf oak (*Q. rugosa*) are found at higher elevations in conjunction with Madrean pine species such as Apache pine (*Pinus engelmannii*), Chihuahua pine (*P. leiophylla* var. *chihuahuana*), and Arizona pine (*P. arizonica*). Arizona cypress, endemic to the woodlands, is confined mainly to north-facing canyon slopes and drainages. If there is sufficient moisture, epiphytic bromeliads (*Tillandsia recurvata*) can be found on tree branches. Some of the common understory grasses include muhlys (*Muhlenbergia* spp.), cane beard grass (*Bothriochloa barbinodis*), wolftail (*Lycurus setocus*), plains lovegrass (*Eragrostis intermedia*), and several of the grama grasses (*Boutelous* spp.). There are also several shrubs (i.e., *Salvia*, *Artemisia*), forbs (i.e., *Penstemon*, *Lupinus*) and cacti (i.e., *Ferocactus wislizeni*, and *Opuntia* spp.) commonly found in the understory of many of these forests (Brown 1994).

The abundance of scrub land species from the interior chaparral community such as pointleaf manzanita (*Arctostaphylos pungens*), Wright's silktassel (*Garrya wrightii*), and Arizona rosewood (*Vauquelinia californica*) can be occasional or frequent within the Madrean oak woodland. These and other indicative plants of chaparral are typically prominent on thin eroded soils, limestone, and near the eastern and northern range of the Madrean oak woodlands (Brown 1994).

Annual precipitation ranges from 400 to 750 mm at the higher elevations. There is both snow and rain precipitation with winter-summer ratios about equal (USDA 2004b). Snow seldom persists more than few days at the lowest elevations.

### *Pinyon-Juniper Woodlands*

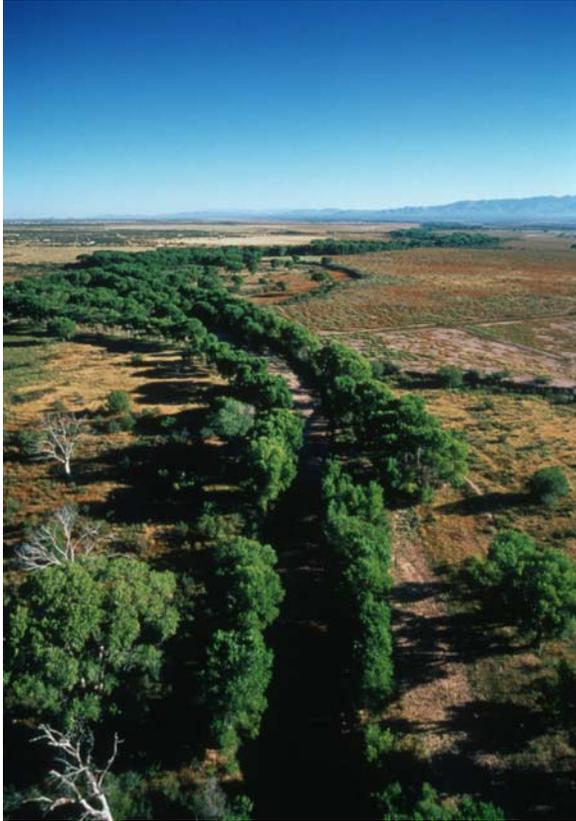
Pinyon-juniper woodlands constitute the largest forest type in Arizona, both on public and private land. These coniferous woodlands exist in a gradient of juniper dominated woodlands to pinyon dominated woodlands with pinyon pines and junipers present throughout the range. Specifically, they are found at elevations ranging from approximately 1,370 to 2,300 m (USDA 2004a). Pinyon (*Pinus edulis*) is the most common species in the complex with other pines including border pinyon (*P. discolor*) and Arizona single-leaf pinyon (*P. californarium* subsp. *fallax*). Juniper species are typically found at lower elevations than pinyons and at sites with deeper soils (Dahms and Geils 1997). One-seed juniper (*Juniperus monosperma*) is the most common juniper below the Mogollon Rim. Other juniper species that are found in Arizona include Rocky Mountain juniper (*J. scopulorum*) and Utah juniper (*J. osteosperma*) in northern Arizona, and alligator juniper (*J. deppeana*) in southern Arizona which is also associated with Madrean oak woodlands (Brown 1994, Gottfried 1992).



Pinyon-Juniper Woodlands

Understory vegetation is dependent primarily upon rainfall and soil type. Herbaceous vegetation is the main understory component consisting of cool and warm season grasses and forbs such as several of the grama grasses (*Bouteloua* spp.), vine mesquite (*Panicum obtusum*), Arizona fescue (*Festuca arizonica*), squirrel tail (*Elymus elmoides*), buckwheats (*Eriogonum* spp.), and globemallows (*Sphaeralcea* spp.). These and other grasses provide the necessary forage for livestock and wildlife. Important shrubs in the understory include cliffrose (*Cowania mexicana*), Mormon tea (*Ephedra* spp.), and mountain mahogany (*Cercopcarpus* spp.).

Annual precipitation varies from 300 to 600 mm with occasional snow precipitation. With a few exceptions the topography of the pinyon-juniper woodlands are gently rolling hills with slopes not likely to exceed 25% (USDA 2004a).



### *Riparian Forest*

Arizona's riparian ecosystems range from sea level to 3,050 m. Riparian forests exist as a component of the forest and woodlands previously discussed in addition to other vegetation communities at lower elevations like the semi-desert grasslands and Sonoran desert. The vegetation found along riparian corridors is dependent upon availability of water throughout the year or at least during the growing season. Some riparian forests are sustained by regulated water from dam release or reservoirs.

Due to elevation gradient, upland community, soil type, and precipitation, riparian vegetation is highly variable. At the higher elevations, typical overstory species of narrowleaf cottonwood (*Populus angustifolia*), maple (*Acer grandidentatum*), boxelder (*Acer negundo*), and willows (*Salix* spp.) will occur along with montane coniferous species, white fir and blue spruce. The understory is comprised of various shrubs such as thin-leaf alder (*Alnus tenuifolia*), shrub willows, and choke cherry (*Prunus virens*).

Upper San Pedro River © Adriel Heisey

San Pedro Riparian National Conservation Area © Hal Malde



In the mid- to lower elevations, a mixture of deciduous broadleaf species such as Arizona sycamore (*Platanus wrightii*), Arizona walnut (*Juglans major*), Goodding willow (*Salix gooddingii*), Fremont cottonwood (*Populus fremontii*), and velvet ash (*Fraxinus velutina*) dominate the forest canopy. Many of the riparian forests at the mid to lower elevation have been taken over or are in part invaded by introduced tamarisk (*Tamarix*

spp.). Mesquite (*Prosopis* spp.) woodlands or bosques occupy many of the upper terraces at lower elevations. The climatic characteristics of riparian ecosystems exhibit a wide range of conditions due to large elevation differences and distributions of associated mountain

ranges, highlands, and desert valleys. Riparian ecosystem topography can vary from narrow, deep, steep-walled canyon bottoms, to intermediately exposed sites with at least one terrace or bench, to exposed, wide valleys with meandering streams.

### C. Forestland Owners

The majority of forestlands (42%) are administered by USDA Forest Service, 6% by the ASLD, 10% are private, 31% are tribal lands, and the remaining 10% are other public. Ownership of the riparian forests and pinyon-juniper woodlands are almost equally divided between public and private whereas the mixed conifer forest and Madrean oak woodlands are primarily in public ownership.

Arizona does not report any industrial private forests (IPF) which are forestlands owned by timber-industry corporations. Non-industrial private forests (NIPF), which are held by individuals or private corporations, account for 10% of the state's timber and woodlands. The NIPF land is primarily used by landowners for cattle ranching. Based on state, organization, and agency records, it is difficult to quantify the number of private forestland owners in Arizona. It can be inferred based on Arizona's growing population and demand for development, that a reduction in private forestland acres has occurred over the last half century. Additional information regarding trends in forestland can be found in the Forestland Conversion section below.

### D. Timber and Wood Products

Today, Arizona's forestlands comprise an estimated 19.4 million acres with an estimated 1.8 million acres, or 9%, reserved from utilization for wood products (O'Brien 2002). Reserved forests have been set aside as wilderness areas, National Parks and Monuments, and other similar areas. Timber management is permitted on the remaining 17.6 million acres of non-reserved forestlands of which all state and private forestlands are considered.

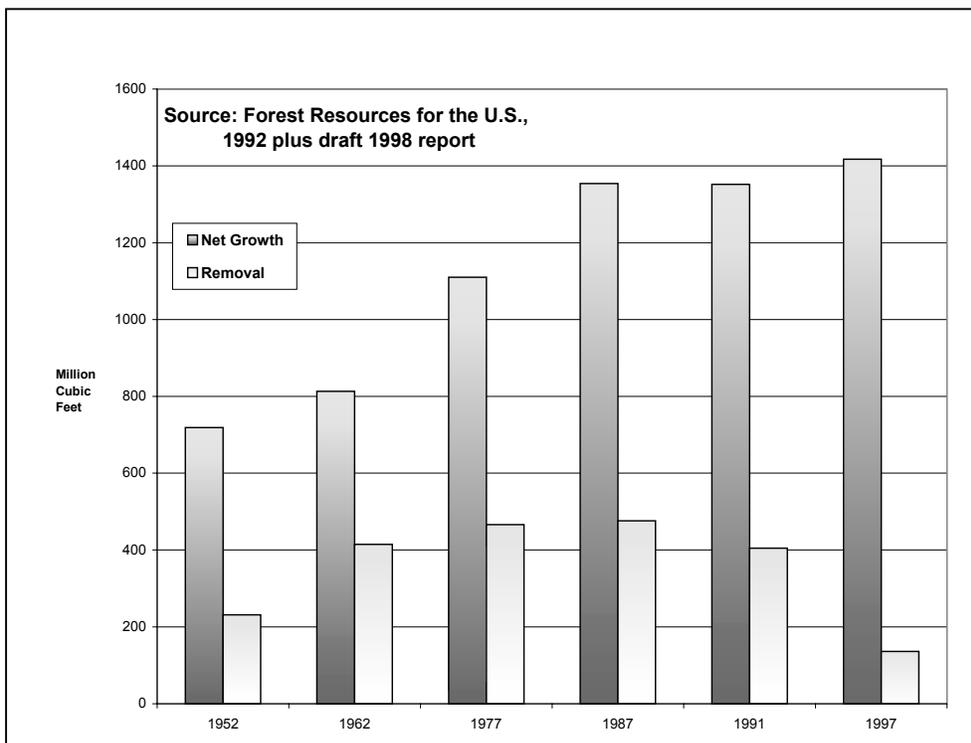
The earliest Southwest forest inventory was conducted by Woolsey in 1910, however, these and other early inventories were not comprehensive of the southwest thus it is difficult to make comparisons in acreage, densities or productivity prior to the 1950s when the U.S. Department of Agriculture, Forest Service began conducting inventories. An inventory of tree density conducted in mixed conifer forests in Arizona and New Mexico found 20.8 trees/acre in 1962 and 93.6 trees/acre in 1985/1987. These changes coincided with an increase in mixed conifer forests and a decrease in ponderosa pine and aspen forests (Johnson 1994). However, having more trees is not necessarily good from a natural resource manager's perspective. As forests grow more dense and homogenous, forest fire characteristics change as does wildlife habitat. With fire largely eliminated from western forests in the last century and harvests far below growth levels, these fire-adapted ecosystems have become at risk to stand replacing fires as well as forests dominated by vegetation in the mid-succession stages (Johnson et al. 2000).

Under the Resource Planning Act, the FIA Units of the U.S. Department of Agriculture, Forest Service gathers and reports forest statistics and data. Reports by the FIA indicate that Arizona does not have any private forest industry (USDA 2003b). Moreover, the state of Arizona

(Department of Commerce) does not identify forest industry as an economic sector but rather, includes any forestry figures in the agriculture sector. Thus, accounting for forestry contributions to the economy or reporting forest-related wages is not possible.

Because of the importance of wood products in the economy, the FIA Program of the Forest Service provides additional summary information for 3.6 million acres of non-reserved timberland in Arizona (O'Brien 2002). The FIA includes statistics on biomass, volume, and growth of forestland, which is necessary to consider when discussing harvest, removal, and mortality. As an example of forest growth and removal (timber harvest) figures for the Intermountain West (includes Arizona, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, South Dakota, Utah, and Wyoming), Figure 2 depicts the decreasing trend in removals while net growth continues to increase. While these figures are not readily available for Arizona, the trend is similar. The following discussion includes additional details that are Arizona specific.

Figure 2: National Forest Net Growth and Removals, Interior West - 1952-1997.



Reproduced with permission from M. Johnson, U.S. Forest Service (Johnson 2000).

To give an idea of Arizona's overall stand structure, 71% of the forest area is characterized as sawtimber, which are large tree stands with at least 10% stocking of live trees in which more than half of the stocking is from live trees with a diameter 127 mm (5.0 inches) or greater (O'Brien 2002). Relatively few stands (4%) are composed of saplings and seedlings. This pattern is consistent across land ownership. For both public and private forestlands, the pinyon-juniper woodlands is the greatest contributor to sawtimber. When considering timberland and woodland collectively, most stand characteristics are skewed toward the dominant forest type – pinyon-juniper (see O'Brien 2002).

Current timber product information is also collected by the FIA Units. For Arizona, the total volume of roundwood produced for 2002 is 12.6 million cubic feet of which 8.0 million cubic feet is from private land (this figure includes tribal forestlands) (USDA 2002). One third of Arizona's timberland, is dominated by ponderosa pine sawtimber stands and is NIPF (this figure includes tribal lands). Ponderosa pine accounts for 76% of the total sawtimber volume as well as a majority of the poletimber and sapling/seedling stand types. Tree removals were primarily for timber products (92%) with the remainder split between fuelwood and logging residue. Sawlogs accounted for the largest component (69%) of the growing stock removed, followed by pulpwood (22%). The remainder is categorized as miscellaneous wood products (O'Brien 2002). Other lands, primarily Indian Tribal Trust lands, supplied 59% of the volume removed and National Forests contributed 41%. Although ponderosa pine contributed to over 84% of the volume, overall, each individual species such as Douglas-fir, true fir, and spruce contributed proportionally to its share of the total inventory.

#### E. Insect Impacts

Numerous species of insects, fungi, and parasitic plants have co-evolved with trees of Southwestern forests. However, trees that are closer together tend to be more susceptible to disease and insect attack than trees more widely spaced (Sartwell and Steven 1975). Some of these species have the ability to cause widespread tree mortality, defoliation, decay, or deformity thus acting as natural disturbance agents. These agents along with fire are some of the most important regulators of forest condition. In turn, forest condition affects the distribution and reproduction of forest insects and pathogens (Dahms and Geils 1997).

In Arizona, the species of particular interest include the numerous species of bark beetles and defoliating insects, dwarf mistletoes (*Arceuthobium*), and root decay fungi. Bark beetles are generally host specific and are present usually in low numbers but will periodically increase to outbreak levels. Rapid tree mortality is the result of successful bark beetle attacks unless the damage is restricted to only a portion of the bole (Stark 1982). Western spruce budworm (*Choristoneura occidentalis*) and western tent caterpillar (*Malacosoma californicum*) are the two main defoliating insects in Arizona. Spruce and fir trees are the principle host for western spruce budworms and can become completely defoliated when outbreaks persist for several years (Linnane 1986). The western tent caterpillar feeds on Aspen foliage and can result in extensive defoliation, growth loss, top kill, or mortality (Jones et al. 1985). Moreover, research has demonstrated that bark beetles, mountain pine beetle, Douglas-fir beetle, spruce budworm, and dwarf mistletoe are pests that tend to increase in denser forests (see Johnson 1994).

### **III. Arizona's Forest Resources (non-timber)**

Timber production has historically been and likely will always be the primary function and definitively the most consumptive use of Arizona's forests. However, forestland serves other anthropogenic purposes such as recreation, tourism, mining, and grazing. Perhaps more importantly, forestlands contribute to the overall functioning of ecosystems by playing a vital role in the watershed. Arizona's forestlands, often surrounded by semi-arid landscapes, provide critical habitat to a suite of forest obligate wildlife.

#### **A. Recreational, Cultural, and Scenic Resources**

Recreation and tourism use of forestlands has been steadily increasing for many western states, Arizona in particular. Recreation is one of the primary uses of Arizona's forests, offering opportunities such as sightseeing, hiking, cross country skiing, bird watching, hunting, horse-back riding, and fishing. Most any place in Arizona (non-tribal areas) is within 8 km of land open to the public for a variety of recreational activities. There are over 3.8 million acres designated as wilderness within Arizona (a portion of this would be classified by the U.S. Forest Service as reserved forestland) and several thousand more acres managed specifically for resource protection (i.e., Area of Critical Environmental Concern, National Conservation Areas).

Not only do the forests draw many out of town visitors, many Arizonians use the forests for cool retreats in the summer. The Arizona State Parks recently released data showing that two-thirds of Arizonians consider themselves trail users. Millions of out-of-state visitors also use Arizona's trails each year. In April 2004, Arizona Senators McCain and Kyl, introduced the Arizona Trail Feasibility Study Act. This bill would authorize the Secretaries of Agriculture and Interior to conduct a joint study to determine the feasibility of designating the Arizona Trail as a National Scenic or National Historic Trail. The trail covers 790 miles of public lands, mountains, canyons, deserts, forests, historic sites, and communities. The Trail begins at the Coronado National Memorial on the U.S.-Mexico border and ends in the Bureau of Land Management's Arizona Strip District on the Utah border. The corridor for the Arizona Trail encompasses the wide range of ecological diversity in the state, and incorporates a host of existing trails into one continuous trail.

The Southwest is an area rich in history and culture. Hundreds of landmarks throughout Arizona document the lives and traditions of Native Americans including some of the larger tribes such as the Navajo, Hopi, and Zuni. Once a part of Mexico, Arizona has many roots in Hispanic cultures and descendents. In the more recent past, historical records and artifacts from the pioneer days, gold rush, and dust bowl are documented throughout the state.

Cultural resources have been recorded through systematic surveys by the Arizona State Museum, the State Historic Preservation Office and others. Other resources have been recorded without a formal or recorded survey. These resources can encompass such items ranging in magnitude from a bone fragment, pottery shard, or bead to a well, wall foundation, or village. Cultural resources are recorded in a multitude of ways across the landscape. Details to the specific location and resource content is confidential. As one might expect, there is a greater likelihood that archeological artifacts will be found near (historic) permanent water sources. Based on

information provided by the Arizona State Museum (ASM), the number of acres where cultural resources have been identified forestlands is provided in Figure 3. Environmental and Public Values are depicted in Map 3.

Figure 3: Number of acres of known cultural resources on private forestlands (ASM 2004).

Forest Type	Forest acres with cultural resources
Mixed Conifer Forest	3,298,616
Madrean Oak Woodlands	989,876
Pinyon-Juniper Woodlands	8,066,582
Riparian Forest	307,377

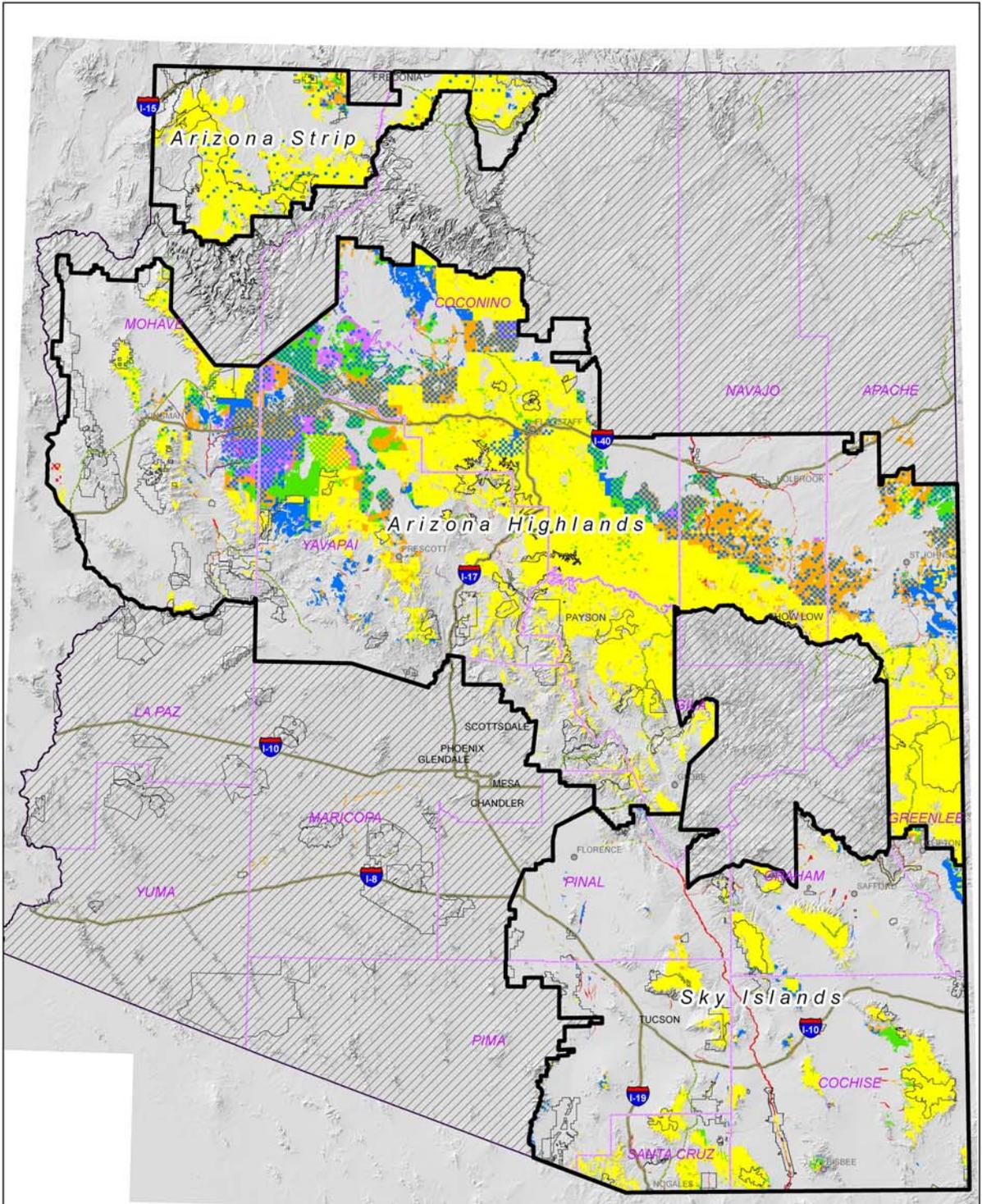
Visual resources include scenic roads, wild and scenic rivers, and national parks, forests, and trails. These select designations focus on not only the actual feature themselves but also include thousands of acres in the viewshed<sup>2</sup> of these scenic roads. Arizona Department of Transportation reports 22 designated parkway, scenic, or historic roads. Just under half of these special designation roads pass through forestlands. Outstanding examples include the Kaibab Plateau-North Rim Parkway which begins at Jacob Lake and traverses thorough pine, fir, and aspen forests or the Historic Route 66 which tells a tale of an emerging state and nation. The White Mountain Scenic Road passes through dense ponderosa pine forested mountains, stretching across the Mogollon Rim while the Dry Creek Scenic Road offers spectacular panoramic views of Red Rock Country.

Streams in the desert Southwest and the riparian communities they support are a unique and important resource in Arizona. Although there are only a few free-flowing rivers remaining in Arizona, many stretches support mixed deciduous and cottonwood-willow gallery forests, offering a distinct contrast to the surrounding uplands. These relic communities are adapted to early Tertiary climates and have retreated to pockets where the warm temperate climate persists together with suitable water regimes. Even though 980 miles of river segments have been identified as suitable for wild and scenic river designation in the last decade, only the Verde River, designated in 1984, has been officially named a scenic river area (22.2 miles classified as wild and 18.3 miles as scenic). In addition to the scenic beauty of these lush areas, rivers and lakes (primarily manmade) they provide ample recreation activities such as rafting, kayaking, tubing, jet skiing, boating, and fishing.

#### B. Geologic Features and Mineral Resources

Arizona has some of the most impressive and striking geologic landscapes. From the Basin and Range Province in southern Arizona, up the Mogollon Rim to the mountainous Central Highlands, and across the Colorado Plateau Province in the north, 2 billion years of geologic events are evident. In each province, geology has played the dominant role in the character and structure of mountains, canyons, valleys, and cliffs. In the Basin and Range Province, desert valleys are surrounded by mountain ranges of different structural patterns and rock composition.

<sup>2</sup> The landscape which can be seen from the vantage of a particular viewpoint.



- Federal and state conservation areas
- Private riparian forests
- Private forest within TNC Conservation Areas
- Cultural and recreational resources on private forests
- Other private forest
- Protected federal and state forests
- State Trust Land forests
- Scenic Roads
- Historic Trails
- Forest Legacy Areas
- Excluded Areas
- County boundary



The Nature Conservancy  
MAKING THE LAST GREAT PLACES ON EARTH  
 Arizona Land & Water  
 Protection Department

May 2005

Map 3: Environmental and Public Values

Several “mountain-building episodes” occurred through cracking and jointing, and crushing and upward thrusting as a result of continents colliding (Chronic 1983). The Central Highlands, a diagonal swath through the middle of the state is a transition zone between the southern and western Basin and Range and the Colorado Plateau provinces and exhibits features of both. Ranges in the Central Highlands are typically clustered, narrow, shallow, with few basins. The Colorado Plateau resembles a layering of flat-topped strata separated by cliffs and steep slopes.

The geological history of Arizona is described over four eras, the Proterozoic, Paleozoic, Mesozoic and Cenozoic History, in several excellent resources (see Chronic 1983, Smiley et al. 1984, Nations and Stump 1996). Common sedimentary rocks of Arizona include sandstone, shale, conglomerate, limestone and caliche; common igneous rocks include granite, monzonite, basalt, andesite, dacite, and rhyolite; metamorphic rocks common to Arizona are marble, quartzite, greenstone, gneiss, and schist. The Colorado Plateau reveals a coherent geological history of 600 million years and more. The Grand Canyon through which the Colorado River runs, is the most popular and famous geological feature in the Colorado Plateau. Others include Sunset Crater, Painted Desert, Kaibab Plateau, Marble Canyon, and the Vermilion Cliffs. One of the most distinctive features of the Central Highlands is the Mogollon Rim. Other interesting geological features include Oak Creek Canyon, Verde Valley, Superstition Mountains, and the Salt River Canyon. The Basin and Range Province is where most of the copper mining occurs. Some noteworthy geological features in this province include Sand Tank Mountains, Dos Cabezas Mountains, Chiricahua Mountains, the lower Colorado River floodplain, Black Mountains, San Pedro River Valley, Hualapai Mountains, and Kartchner Caverns (Chronic 1983).

Mining in Arizona began in earnest during the 1870s and 1880s. Arizona led the nation in value of non-fuel minerals produced for many years, primarily because of the abundance of copper and copper-related minerals (AZGS 2004). About 65% of the nation's copper is mined in Arizona. While copper mining dominates the mineral output, precious metals (gold and silver) contributed 2% of the state's total mineral production (Goerold 1989). In 1998, Arizona produced \$3.03 billion worth of energy and mineral commodities (Phillips et al. 2000). The mining industry in Arizona is dominated by the following five companies: ASARCO, AZCO, Cambior, Grupo Mexico, and Phelps Dodge. Other metallic commodities produced, listed in order of decreasing value, include gold, silver, molybdenum, and lead. Non-metallic (industrial or construction related) minerals produced include sand and gravel, crushed stone, clay, cement, gypsum, lime, perlite, pumice, and salt. Arizona's turquoise, peridot, petrified wood, azurite, and malachite are world-famous (AZGS 2004). Arizona produces energy resources such as coal and small quantities of petroleum and natural gas. Uranium output is extracted from several underground mines near the rims of the Grand Canyon. There are also several thousand thermal springs and wells throughout the state with a higher concentration south of the 20°C ground-water isotherm (Witcher et al. 1982).

### C. Grazing

Nearly all of Arizona's woodlands -- pinyon-juniper, juniper, Madroan oak, and mesquite woodlands -- are also considered rangelands. All forest and woodland communities were historically or are currently used for grazing (Conner et al. 1990). Grazing occurs on private land

as well as public land under a fee permit system. Cattle are the primary livestock grazers but sheep, goats, horses, and burros are also found in smaller herd sizes throughout the state.

The woodlands are primarily used for grazing during the winter and cattle are moved to higher mixed conifer forests during the summer. Numerous studies have documented the impact of grazing in riparian areas (see Kauffman et al. 1983, Elmore and Kauffman 1994, and Ohmart 1996) thus, a concerted effort has been made to reduce the number of livestock and the time in which cattle graze in these fragile habitats.

#### D. Watershed Resources

Arizona's forestlands, whether it is in large landscapes across the Mogollon Rim or in the isolated mountain islands of Southeastern Arizona, are of critical importance to the economy, wildlife, and watershed resources. As the population of Arizona increases, the demand for water also increases. Over the last several decades, water has become the most *significant* and fragile resource in Arizona.

Many of the streams in Arizona have their headwaters in mixed conifer forests and these higher elevation streams are often perennial with associated values for wildlife and native fisheries. These streams rely substantially on storm runoff and snowmelt to provide a significant source of their water. Thus management of this forest type is essential to maintaining watershed condition and the economical and ecological resources that are related to dependable water sources. Lower in elevation, particularly in the Madrean oak and pinyon-juniper woodlands, there are few perennial streams, and most flow only during snow melt and following heavy monsoon rains as groundwater in the woodlands is typically deep and in limited supply (USDA 2004b). However these forest types cover extensive areas and are often the site of aquifer recharge that ultimately supply groundwater resources that support baseflows in major water supply rivers such as the Salt, Verde and Gila Rivers. The Southeastern Arizona watersheds of the oak woodland are important for municipal and domestic water for communities such as Safford and Tombstone (USDA 2004b). Much of the runoff from the pinyon-juniper woodlands around the Mogollon Rim contributes to the Salt and Verde Rivers, which supply much of the Phoenix basin.

Healthy public and private forests are the key to providing high quality water in sufficient quantities to support Arizona's burgeoning population.

#### E. Fish and Wildlife Habitat

Wildlife communities tended to be more diverse prior to European settlement (Covington et al. 1994). Changes in community structure and composition as well as size have lead to some species being extirpated, others have declined, and some have even increased. Species that prefer open forests such as Grace's warbler (*Dendroica graciae*), Western wood-pewee (*Contopus sordidulus*), and chipping sparrow (*Spizella passerina*) may have declined (Finch et al. 1977).

From information provided by the Arizona Game and Fish Department, 391 federal and state threatened and endangered species and agency sensitive species have been identified on private

forestlands. Of the threatened, endangered, and sensitive species, there are 230 plants, 131 vertebrates, and 40 invertebrates. Thirty-two different federally listed endangered species occur on private forestland, 14 federally listed threatened, and 10 species are proposed as candidates for federal listing. Cochise County has the highest diversity and number of occurrences of these special status species and Yuma County the lowest.

#### *Mixed Conifer Forest*

The more open canopies in woodland, ponderosa pine, and mixed conifer forests favor wildlife species such as deer, bighorn sheep (*Ovis canadensis*), songbirds, and small rodents. Game animals occurring in mixed conifer forest include elk (*Cervus elphus*), mule deer (*Odocoileus hemionus*), black bear (*Ursus americanus*) and wild turkey (*Meleagris gallopavo*). Some raptors such as the Northern goshawk (*Accipiter gentilis atricapillus*) prefer forests with more closed canopies; others such as the Mexican spotted owl (*Sirix occidentalis lucida*) prefer habitats with vertical structure, as provided in steep canyons or tall, diverse forests. Other birds on upper elevation forests include bald eagles (*Haliaeetus leucocephalus*), great horned owl (*Bubo virginianus*) Northern three-toed woodpecker (*Picoides tridactylus*), and Williamson sapsucker (*Sphyrapicus thryoideus*). The listing of Mexican spotted owl and other threatened species such as the Northern Goshawk, curtailed timber harvesting in the early 1990s.

#### *Madrean Oak Woodland*

In Arizona, the principle habitat for white-tailed deer (*Odocoileus virginianus*) and coati (*Nasua nasua*) is Madrean oak woodlands. Indicative mammals of the Madrean oak woodland include yellow-nosed cotton rat (*Sigmodon ochrognathus*), Southern pocket gopher (*Thomomys umbrinus*), and Apache squirrel (*Sciurus nayaritensis*). Other characteristic fauna include Montezuma quail (*Cyrtonyx montezumae*), Mexican jay (*Aphelocoma ultramarina*), blue grouse (*Dendragapus obscurus*), ridgenose rattlesnake (*Crotalus lepidus*), and Clark's spiny lizard (*Sceloporus clarkii*).

#### *Pinyon-Juniper Woodland*

Several native ungulates -- deer, elk, and pronghorn antelope (*Antilocapra americana*) -- depend on the understory grasslands of this forest type for forage. Small mammals characteristic of the pinyon-juniper woodland include several species of skunks, badgers (*Taxidea taxus*), pinyon mouse (*Peromyscus truei*), Arizona grey squirrel (*Sciurus aruzibebus*), and grey fox (*Urocyon cinereoargenteus*). The open spaces between trees makes excellent hunting areas for numerous raptors like the Cooper's hawk (*Accipiter cooperii*), Northern harrier (*Circus cyaneus*), and red-tailed hawk (*Buteo jamaicensis*). Only a few bird species are closely associated with the pinyon-juniper woodland they include pinyon jay (*Gymnorhinus cyanocephalus*), gray flycatcher (*Empidonax wrightii*) and gray vireo (*Vireo vicinior*).

#### *Riparian Forest*

Perennial sources of water in the semi-arid Southwest are vital to Arizona's biological richness. In Arizona and New Mexico, over 65% of the animals depend on riparian habitats during all or part of their life cycles (Dahms and Geils 1997). Some riparian obligate species include beaver (*Castor canadensis*), leopard frogs (*Rana* spp.), and numerous waterfowl.

Many mammals (i.e., coati, ring-tailed cat (*Bassariscus astutus*), and deer use protective cover of riparian forests as migratory corridors. Several species of bats, particularly myotis, inhabit riparian forests. Most of Arizona's native fish depend on the overstory canopy to keep water temperatures and dissolved oxygen optimal. Some common native fish include several species of dace (*Rhinichthys* spp.), suckers in the genus *Catostomus*, and several species of chub (*Gila* spp.).

Arizona Partners In Flight reports that approximately 238 of the more than 500 species of birds found in Arizona are neotropical migrants (AZGFD 2004). While not all bird migrants in Arizona use riparian corridors as migratory routes, this is the predominant pathway for some of the more illusive species such as the federally listed endangered Southwestern willow flycatcher (*Empidonax traillii extimus*) and Abert's towhee (*Pipilo aberti*) and familiar birds such as hummingbirds, swallows, warblers, and orioles.

#### F. Forest Soils and Productivity

Volcanic basalt and cinders are the most common soil parent materials in Arizona (57%), although sedimentary soils (43%) are also found throughout Arizona's forests. The topography of Arizona's forests are characterized by extensive flat, rolling mesas, intermixed with steeper, mountainous terrain, and a diversity of slope and aspect combinations (USDA 2004a).

##### *Mixed Conifer Forest*

Mollic Eutoboralfs are the most extensive soils in mixed conifer forests. These soils are moderately deep to deep, stony to cindery, vary in origin, well drained, and have textures ranging from loam to clay (USDA 2004b). The deep soil materials allow for deep water penetration and storage. The physical properties of the soil, and thus its moisture-retaining capacity, play an important role in the development of ponderosa pine, possibly more than the chemistry of the soil itself (USDA 2004a). Increased water at a site and high water tables associated with springs tends to increase site productivity regardless of the soil type and landform (USDA 2004a).

##### *Madrean Oak Woodland*

Ustolls, ustalfs, and aqualfs are the common soils in the Madrean oak woodland mesic temperature regime. The Ustolls can be very shallow to moderately deep, have a medium to fine texture, and be gravelly and cobbly. Ustalfs tend to be deep, fine textured and range in percent composition of gravel. Aqualfs are also deep but very gravelly and fine textured (USDA 2004b).

##### *Pinyon – Juniper Woodland*

The soils in the pinyon-juniper woodlands are mostly Haplustalfs and Argiustolls with a smaller portion covered by Haplustolls (USDA 2004b). Soils are derived from basalt, limestone, and sandstone parent material and vary in texture, depth, and mineralogy (USDA 2004a).

##### *Riparian Forest*

The surrounding uplands, parent material, and soils influence the riparian soils. At the higher elevations riparian soils generally consist of consolidated or unconsolidated alluvial sediments from parent materials of the surrounding uplands. Soil depths are variable and depend upon stream gradient, topographic setting, and parent materials. Soils on the flood plains at lower

elevations consist of recent depositions, tend to be uniform within horizontal strata, and exhibit little development (USDA 2004a).

## **IV. Forest Trends and Threats**

The USDA Forest Service has been providing figures for forest area since 1953 with estimates back to 1630, which are based on partial inventories, or estimates from surveyors' data (see Smith et al. 2001 p. 65 for further details on forest area information resources). It is important to note that the figures reported here are based on gross estimates and make comparisons over time difficult because of the variety of sampling design and intensity, and survey standards and definitions used over time. In 1938, an estimated 20.1 million acres of total forest area were reported by the U.S. Congress and in 1997, the USDA Forest Service estimated 19.4 million acres; a loss of 3.4% in forestland (USDA 2003b). An estimated 1.3 million acres of private timberland was reported in 1953 (36.4% of all timberland in 1953) and by 2002, the area declined by 18.2% to 1.1 million acres. This loss far exceeds the loss of 2.6% in total timberland for all owners (USDA 2003b).

During this same time period (1953-2002), the net volume of all growing stock on private timberland grew from 148 to 1,941 million cubic feet, an increase of over 1,200% (USDA 2003b). When comparing this to the increase of 29.7% in net volume of growing stock for all land owners, it becomes evident that forestland is being cleared for timber products and most likely development. Map 4 depicts areas most impacted by development and road construction at high densities.

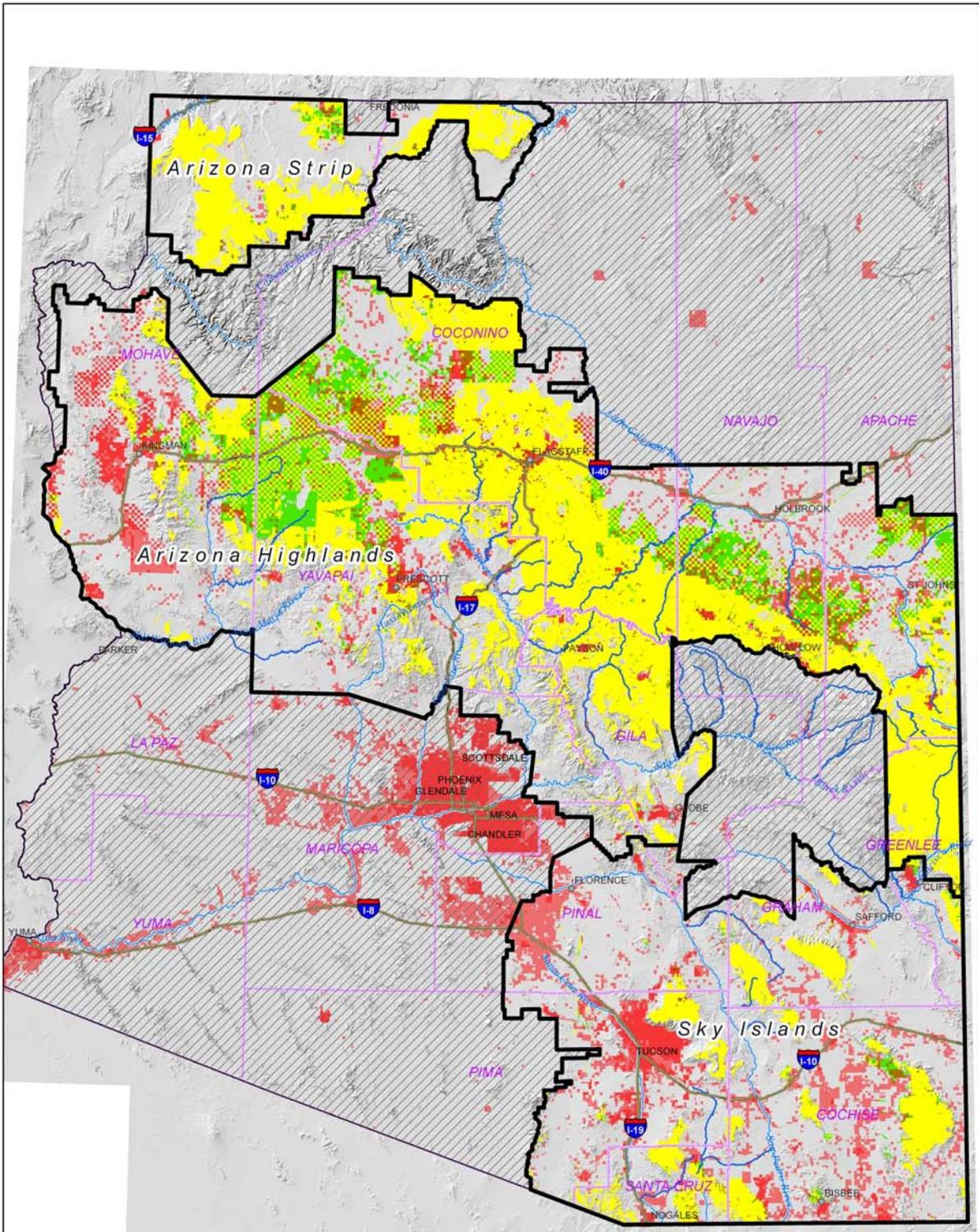
In the 2002-2003 Annual Report, the ASLD documents over 4 million acres in state forestland. These lands are managed to maximize and sustain income but also to enhance wildlife, watershed, range and open space values. The ASLD also provides technical, educational, and financial support to private landowners in the management of their forestlands. Arizona participates in several of the cooperative forestry programs and assisted 1,112 landowners during the 2002-2003 fiscal year bringing the total acres of private forest with cooperative forestry management plans to 1,136,800 (ASLD 2003).

The National Association of State Foresters summarizes information for all state and private forests across the United States. Arizona's forestry funding support for 2002 was a fraction of the other four-corner states, totaling under \$4 million dollars compared to 25.6 million average for the other three states (NASF 2002). In Arizona, like most other western states, fire control, prevention, and management are the largest expenditures for forestry programs.

### **A. Demographics**

Increasing population and economic growth over the last 35 years has had, and will continue to have consequences for natural ecosystems in Arizona. Unless profound efforts are made to conserve lands of strategic importance to biodiversity and environmental sustainability rather than plowing them under for housing and paving them over for commercial development projects, the wild and scenic landscapes that support wildlife and the human spirit will cease to exist.

From 1970 to 2000 Arizona's population grew by 3,370,362 people, a 188% increase (U.S. Census Bureau 2000). That growth has increased even more dramatically in the last four years



- Developed areas
- Private forests already heavily impacted by development
- Private Forests
- Federal and State Forests
- Forest Legacy Areas
- Excluded Areas
- County boundary



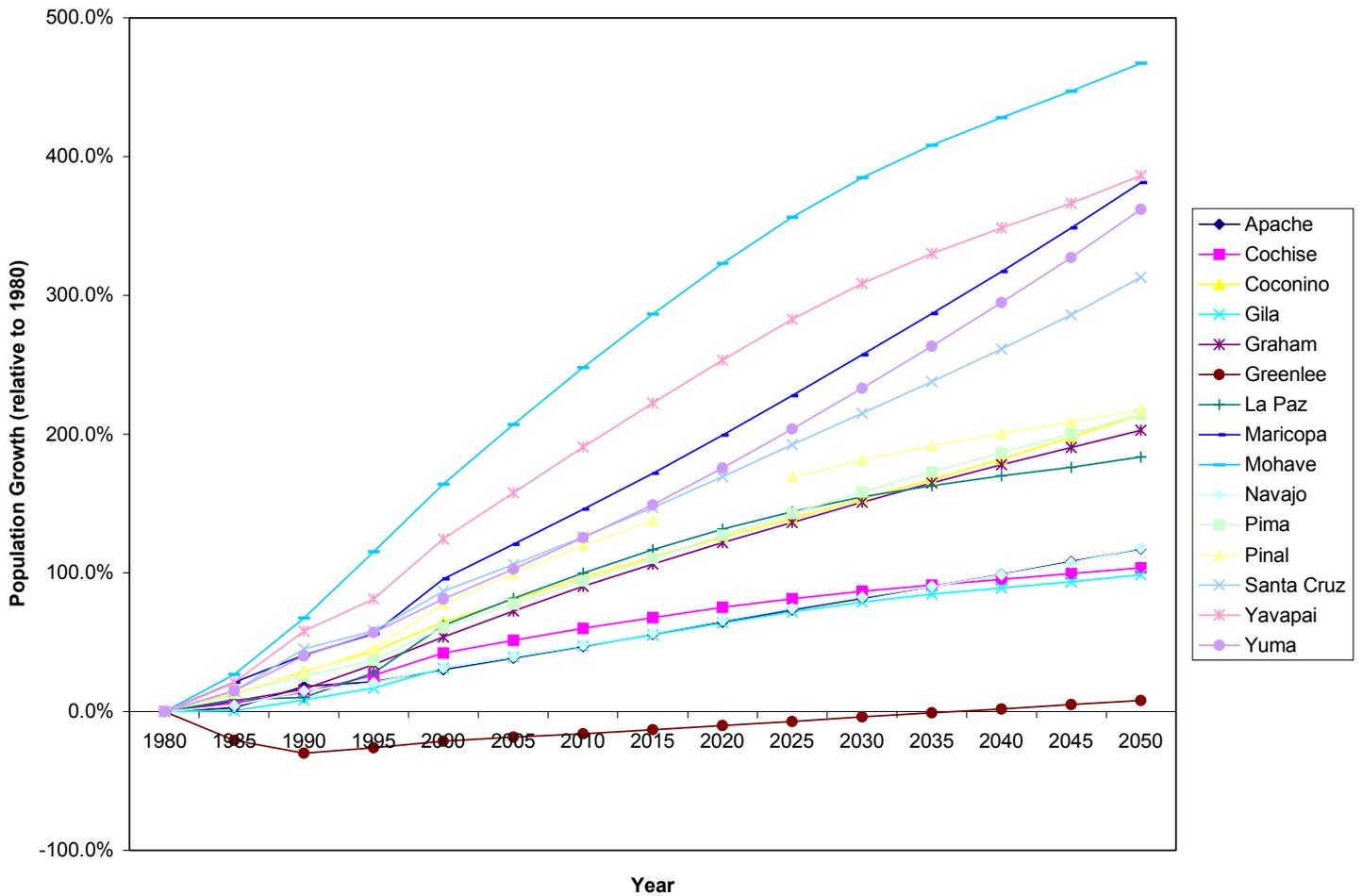
The Nature Conservancy  
 BRINGING THE LAND AND WATER PLACES TOGETHER  
 Arizona Land & Water Protection Department

May 2005

Map 4: Developed Areas

with the current population now estimated at 5,435,675 people, making Arizona the second fastest growing state in the U.S. behind Nevada. Based on current rates of population growth, Arizona's projected population for 2050 is 11.2 million people; see Figure 4 (U.S. Census Bureau 2000).

Figure 4: Actual and projected percent population growth relative to 1980, by county (1980-2050)\*



## B. Changes in the Economy and Forestland Conversion

The previously mentioned report by the American Farmland Trust, *Strategic Ranchland in the Rocky Mountain West Mapping the Threats to Prime Ranchland in Seven Western States*, found that over 1.3 million acres of Arizona's best ranchland is at risk of being converted to low-density development in the next 20 years (AFT 2004). This land is not only economically important to Arizona, but is ecologically and culturally important as well. Net income from farming and ranching dropped from \$565 million in 1970 to \$377 million in 2000 – a decrease of 33% (Figure 5). Compared to other industry sectors, the farming and agriculture industry has had a net loss of new income between 1970 and 2000 while the services and professional industry which includes construction, real estate and trade has increased new income during this same time period by 48% (Figure 6). And while all other segments of Arizona's economy have been booming, the farm sector has lost nearly 5,000 jobs in the last 30 years.

Furthermore, due to a variety of circumstances including drought, fire suppression, climate change, and falling beef prices, ranching as a livelihood has been declining in the latter half of the 20<sup>th</sup> century. Consequently, many ranchers are selling their land to others who often subdivide the land into smaller parcels for development.

Agriculture has a long history in Arizona. In fact, cattle, cotton, and citrus make up three of the “Five C’s” that have long been considered the driving force behind Arizona's economy. As the top industry in Arizona, agriculture (which includes ranching and forestry) produces over 18% of the nation's lettuce crop; in fact agriculture and related industries contribute over \$4.5 billion dollars to state reserves (AFT 2004). Despite these impressive numbers, however, some of the best agricultural lands in Arizona are being lost to urban residential development. A similar pattern is reflected in the higher elevation forestlands.

The Grand Canyon State faces many problems typical of states with a successful economy: an influx of new citizens building primary and secondary homes in and near fast growing cities such as Phoenix and Tucson. As urban areas grow and sprawl, city dwellers seek cooler forest elevations for reprieve from the desert heat as well as for the recreational opportunities. Many of these second homes are built upon subdivided forestland parcels, offering low-density rural development with roads and fences fragmenting the landscape. In the American Farmland Trust report, *Strategic Ranchland in the Rocky Mountain West Mapping the Threats to Prime Ranchland in Seven Western States* (2004), Pinal County was identified as 1 of 25 counties in the seven western Rocky Mountain states with strategic ranchlands most at risk.

Private forestland near smaller communities found at higher elevations are also quickly being subdivided, sold, and developed. Open space in the White Mountains and Verde Valley are selling at a premium price. From Century 21 listings in the White Mountains, land is ranging in price from \$10,000 to \$30,000 per acre. Residential building permits for the City of Show Low were 174 in 2001 compared to the surrounding towns of Snowflake with 46 permits and Pinetop-Lakeside with 56 permits (White Mountain Regional Development Corporation 2004). In the Prescott area, construction of new single-family homes has been steadily increasing; in 1996 there were 241 permits granted and by 2002, that number increased to 636 permits issued (City Data.com 2004). Similar trends are occurring in Prescott Valley and Chino Valley. Information from these sources also indicates that the average cost of new single-family homes has more than

doubled over this six-year time frame. Based upon site visits and real estate searches, areas around Heber and Overgaard are actively growing but because these towns are unincorporated, accessing building permit records was not feasible. Other small towns such as Sonoita and Elgin are also growing by converting open space into low-density housing yet approximate figures are not available.

Figure 5: Net income from farming and ranching in Arizona, 1970-2000\*.

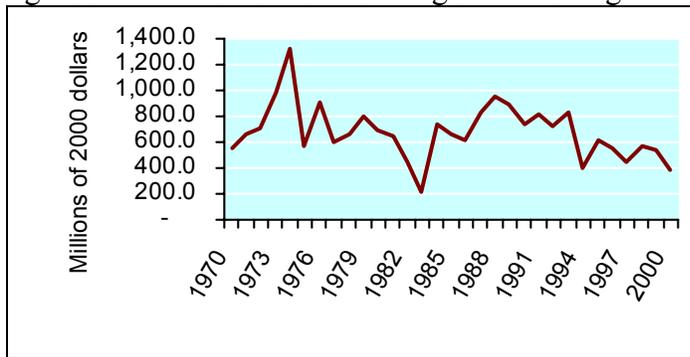
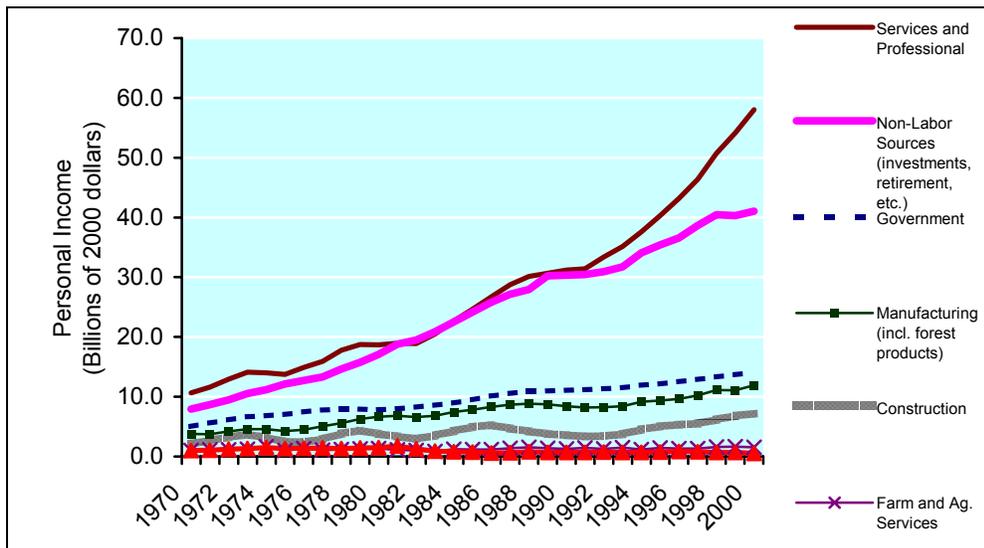


Figure 6: Personal income (millions of year 2000 dollars) by industry sector, Arizona\*.



\* Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

### C. Resources Most Vulnerable

Many natural and cultural resources are at risk of degradation, destruction, or elimination. Some of the resources most vulnerable to forest conversion or fragmentation include forest obligate animals and their vegetation community habitats, ecosystem processes such as decomposition

and infiltration, and archeological sites in riparian forests. Numerous other ecological and economical resources in private forestland are also susceptible to damage or depletion once conversion of forestland to non-traditional forest uses commences.

Regular economic and environmental analyses point to the diminishment of Arizona's natural resources and scenic lands:

“The State of the Environment for 2002 published by the Sierra Club reports that development consumes one acre an hour in Maricopa County and one acre every two hours in Pima County. As we continue this pace of conversion of land from natural habitat to the built environment we threaten the natural resources we value”

– Arizona Open Land Trust

“The American West is undergoing rapid land use change, especially on the 170,000 square miles of grazed grasslands and woodlands in private ownership. These lands, rather than the higher elevation public lands managed by federal agencies, hold most of the biodiversity of our region. And yet, as they are rapidly developed and fragmented, their value as large intact wildlands is being immeasurably diminished. A recent study of land subdivision and habitat fragmentation in northern Arizona – commissioned by the Arizona Cattle Growers' Association – reveals just how much is currently being lost. Since 1959, 2.2 million acres of private lands in northern Arizona along the I-40 corridor have been platted or sold.”

– Center for Sustainable Environments, Northern Arizona University

## **V. Protection of Arizona's Forestlands**

### **A. Protected Forestland in Arizona**

Almost half (46%) of Arizona's forestland is managed by the Department of Agriculture or Interior and has some level of natural resource conservation. The Gap Analysis Program (available online at <http://www.gap.udaho.edu/handbook>) assigns a management status category to the land units irrespective of land ownership. The ranking system consists of four categories (Scott et al. 1993) that relate to the strength of designation with respect to maintenance of biodiversity values. These categories range from areas having permanent protection and managed as a natural area to no protection and no management mandate whatsoever.

Based on a spatial analyses of the Arizona Gap management status, 2.3 million acres of forestlands are identified as offering protection status. As a forest type, pinyon-juniper woodlands represent 69.3% of the acres with protection status of Gap 1 and 2. Within any given forest type, Madrean oak woodlands has the largest percent of total forestland in protection status Gap 1 and 2 (19.9%), and mixed conifer forest has the smallest (7.6%) amount of land afforded Gap protection status 1 and 2.

In Arizona, The Nature Conservancy (TNC) identified over 8.1 million acres of forest habitat for conservation during their ecoregional assessments. Of this forest habitat identified, 23% (1.85

million acres) have Gap status 1 or 2. Of this selected forest habitat, 9.0% is in private ownership.

### B. Conservation Easements in Arizona

Numerous conservation easements are held by a variety of land trust organizations, local, state, and federal agencies, and other interested parties concerned with preservation of open space and natural ecosystems. Through various means, land trusts have conserved over 3.2 million acres in the United States (Land Trust Alliance 1998). While each entity holding conservation easements may have information regarding the total number of acres conserved, there is no statewide clearinghouse of such information nor would this information be partitioned according to the forest types identified within the AON, thus, only a few examples are provided below.

According to the latest records for The Nature Conservancy's (TNC) Arizona chapter, 42,000 acres of private land have conservation easements held by TNC. The Malpai Borderlands Group holds conservation easements on 75,000 acres of private land in southeastern Arizona and southwestern New Mexico. Grand Canyon Trust holds conservation easements on 12,500 acres, primarily in northern Arizona. While the Trust for Public Land is active in Arizona, they work primarily with local land trusts, which in turn hold the conservation easements. Thirteen percent of Arizona is State Trust Lands and information regarding conservation easements on this land is not available.

Land trusts are nonprofit organizations, as described in 501(c) of the Internal Revenue Code of 1986, that protect land by working with landowners who wish to donate or sell fee title or conservation easements to maintain conservation values associated with the land (USDA 2003a).

The following are some of the land trusts and conservation organizations working individually and collectively to preserve land for the protection and sustainability of Arizona's rich biodiversity, wildlife habitats, scenic and recreational areas, and economic diversification:

#### **Arizona Open Land Trust**

1915 E Camino Miraval  
Tucson, AZ 85718-4950  
Phone: (520) 577-8564  
Founded: 1978  
[www.aolt.org](http://www.aolt.org)

The Arizona Open Land Trust (AOLT) protects Southern Arizona's vanishing western landscapes and wildlife habitat by acquiring and managing sensitive lands, and supporting their mission through appropriate legislation, public education, and outreach. The trust operates in Pima, Pinal, Santa Cruz and Cochise counties

#### **Black Mountain Conservancy**

PO Box 7192  
Cave Creek, AZ 85327-7192  
Phone: (480) 575-5835

Founded: 2000  
[www.blkmtnconservancy.org](http://www.blkmtnconservancy.org)

The Black Mountain Conservancy is a nonprofit, 501(c)(3) volunteer organization dedicated to preserving, in perpetuity, the undeveloped land on and around Black Mountain. The vision of the Conservancy is to protect, preserve, and restore for the public benefit, a unique mountain for current and future generations.

**Cascabel Hermitage Association**

6146 N Canyon Road  
Benson, AZ 85602-8333  
Phone: (520) 212-2473  
[www.cascabelhermitage.org](http://www.cascabelhermitage.org)

The Cascabel Hermitage Association (CHA) acquires and holds real property in trust under the Saguaro-Juniper Covenant, makes the land available for solitary meditation, and holds conservation easements. It thereby provides a Sonoran desert wildlands habitat for fully interfaith solitary contemplation, as well as other solitary educational and creative activities that require sustained concentration and stillness.

**Central Arizona Land Trust**

PO Box 1050  
Prescott, AZ 86302-1050  
Phone: (928) 445-7790  
Founded: 1989  
[www.centralazlandtrust.org](http://www.centralazlandtrust.org)

The Central Arizona Land Trust is a private, non-profit organization established in 1989. They seek to preserve ranchlands, open space and the scenic and wildlife values of central Arizona in partnership with landowners who wish to protect their land in perpetuity.

**Desert Foothills Land Trust**

PO Box 4861  
Cave Creek, AZ 85327-4861  
Phone: (480) 488-6131  
Founded: 1991  
[www.dflt.org](http://www.dflt.org)

The Desert Foothills Land Trust was established to protect and preserve the unique and sensitive land areas of the Sonoran desert foothills containing the Carefree, Cave Creek, New River and far North Scottsdale communities. As a non-profit, volunteer organization, the Trust protects land through gift, purchase, bequest, and conservation easement for the edification and enjoyment of current and future generations. The Trust works to ensure the survival of the unique plant and wildlife of the fragile Sonoran desert.

**Diablo Trust**

PO Box 31239  
Flagstaff, AZ 86003-1239  
Phone: (520) 523-0588  
Founded: 1993  
[www.diablotrust.org](http://www.diablotrust.org)

The Diablo Trust, a not-for-profit 501 (c) (3) corporation, is an Arizona Land Management Team and National Reinventing Government Laboratory. Covering 426,000 acres of mixed ownership property, the Trust began in 1993 when two long-time Arizona ranches, the Bar-T-Bar and the Flying M Ranch, asked people for ideas to assist them in the protection of open spaces and healthy habitats. Today the Trust provides a forum for the community to actively participate in a land stewardship process. Additionally, the ranch lands provide "hands-on" proving grounds for new, collaborative land management ideas.

**Grand Canyon Trust -Flagstaff - Headquarters**

2601 N. Fort Valley Road  
Flagstaff, Arizona 86001  
Phone: (928) 774-7488  
[www.grandcanyontrust.org](http://www.grandcanyontrust.org)

Grand Canyon Trust focuses its conservation work in the canyon country of the Colorado Plateau. Here lies the nation's greatest concentration of national parks and monuments, evidence of the special status society has conferred on this spectacular region. Their mission is to protect and restore the Colorado Plateau – its spectacular landscapes, flowing rivers, clean air, diversity of plants and animals, and areas of beauty and solitude.

**McDowell Sonoran Land Trust**

PO Box 14365  
Scottsdale, AZ 85267-4365  
Phone: (480) 998-7971  
Founded: 1990  
[www.mslt.org](http://www.mslt.org)

Since 1990, the McDowell Sonoran Land Trust has worked through the citizens of Scottsdale to protect the McDowell Mountains and adjacent Sonoran Desert through lands donations and acquisition. Today, preservation of the original 16,460 acres of the McDowell Sonoran Preserve is almost complete and the Trust is starting to focus on the acquisition and preservation of an additional 19,940 acres of mountain and desert lands.

**The Nature Conservancy,  
Phoenix Conservation Center**

7500 North Dreamy Draw Drive, Suite 145  
Phoenix, Arizona 85020  
602-322-6990

The Nature Conservancy's mission is to preserve the plants, animals and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. For more than 35 years, The Nature Conservancy in Arizona has been working locally with communities, businesses and the people providing hope for the preservation of our land, our water, our way of life. A few of the ways by which we achieve our mission include, but are not limited to land acquisition, conservation easements, debt for nature swaps and conservation trust funds. The Nature Conservancy's work in Arizona is varied and stretches across five landscapes: the Apache Highlands, Arizona and New Mexico Mountains, Colorado Plateau, Mojave Desert, and Sonoran Desert.

### **Southeast Arizona Land Trust**

PO Box 116  
Sonoita, AZ 85637-0116  
Phone: (520) 455-5592  
Founded: 1994

The focus of Southeast Arizona Land Trust is on protecting and/or restoring 142,000 acres of land roughly south of Tucson and east of Tohono O'Odham Reservation.

### **Superstition Area Land Trust**

PO Box 582  
Apache Junction, AZ 85217-0582  
Phone: (480) 983-2345  
Founded: 1993  
[www.azsalt.org](http://www.azsalt.org)

The Superstition Area Land Trust's primary mission is to assure the long-term conservation, preservation and management of natural open spaces surrounding the Superstition Wilderness Area in Pinal and Gila counties through education, advocacy, land acquisition, federal and state lands protection and other conservation actions.

### **Trust for Public Land**

409 E. Palace Avenue  
Santa Fe, NM 87501  
Phone: (505) 988-5922  
[www.tpl.org](http://www.tpl.org)

The Trust for Public Land is a national non-profit land conservation organization headquartered in San Francisco. TPL's mission is to conserve land for people to enjoy as parks, gardens, and natural areas, ensuring livable communities for generations to come. Working with Arizona communities, leadership and landowners since 1980, TPL has helped preserve almost 200,000 acres of urban open space, sites of cultural and historic significance, working lands and wilderness.

### **Verde Valley Land Preservation Institute**

PO Box 2226  
Sedona, AZ 86339-2226  
Phone: (928) 821-3905  
[www.verdevalleylpi.org](http://www.verdevalleylpi.org)

Verde Valley Land Preservation Institute is an Arizona nonprofit corporation operating within the Verde Valley of Arizona for the purpose of acquiring, managing and enhancing the natural open space in the Verde Valley region. Their mission is to develop and implement immediate and long-range strategies to preserve and enhance the natural open space of the Verde Valley. The Institute will ensure a public collaborative process involving scientific research, education, planning, and land acquisition, management, development, and preservation techniques.

**Western Arizona Land Trust**

49614 Highway 60  
Wickenburg, AZ 85390  
Phone: (928) 684-2772

**The Wilderness Land Trust**

PO Box 1420  
Carbondale, CO 81623  
Phone: (970) 963-1725  
[wildernesslandtrust.org](http://wildernesslandtrust.org)

The Wilderness Land Trust has actively assisted the Bureau of Land Management with projects in four Arizona desert wilderness areas: Mount Tipton, Muggins Mountains, Swansea, and Wabayuma Peak. The BLM manages approximately 1.3 million acres of primarily desert wilderness areas in Arizona. All told, the WLT has been involved in protecting almost 1,000 acres of land in eleven separate transactions.

**The Southwest Forest Alliance**

P.O. Box 1948  
Flagstaff, AZ 86002  
Phone: (928) 774-6514  
[www.swfa.org](http://www.swfa.org)

A Flagstaff based forest advocacy group that since 1994 has focused on grassroots organizing within the environmental community in Arizona and New Mexico. The Southwest Forest Alliance was formed to develop a scientifically based vision for restoring degraded forest ecosystems and to seek public support for this vision. These efforts have focused on the protection of old growth forests and damaged watersheds. An integral part of the SWFA's campaign includes public education and grassroots organization within local forest dependent communities. The SWFA mission is to chart a new course for public lands management and protection in Arizona and New Mexico focusing on restoration of degraded ecosystems through scientific research, helping forest dependent communities become self-sustaining, and increasing public awareness and involvement in land management issues.

### **Ecological Restoration Institute**

P.O. Box 15017  
Flagstaff, AZ 86011  
Phone: (928) 523-7182  
[www.eri.nau.edu](http://www.eri.nau.edu)

The Ecological Restoration Institute is an independent research branch of Northern Arizona University. Since 1970, the ERI has been a pioneer in conducting research and disseminating information about restoration treatment outcomes, strategies, and techniques in the Southwest. ERI's work has greatly benefited from partnerships with the Bureau of Land Management, Forest Service, Native American tribes, and other land managers, as well as with an array of communities and academic researchers. As a result, they have gained a great deal of practical knowledge about the planning, implementation, and monitoring of restoration projects in Southwestern ponderosa pine forests.

### **American Farmland Trust-Rocky Mountain Region**

PO Box 1417  
Fort Collins, CO 80524  
Phone: (800) 370-4879  
[www.farmland.org](http://www.farmland.org)

American Farmland Trust is a private, nonprofit farmland conservation organization founded in 1980 to stop the loss of productive farm and ranch land and to promote farming practices that led to a healthy environment. Its action-oriented programs include public education, technical assistance in policy development and demonstration farmland protection projects. Farms and ranches in the Rockies produce everything from tender beef to prize-winning peaches, in addition to providing scenic open spaces and habitat for wildlife that residents cherish. Sadly, much of this land is under siege. Thousands of acres of high quality agricultural land and wildlife habitat in the Rockies are squandered and fragmented each year due to low-density, scattershot rural subdivisions and 35-acre ranchettes.

### **The Sonoran Institute**

7650 E. Broadway, Suite 203  
Tucson, AZ 85710  
Phone: (520) 290-0828  
[www.sonoran.org](http://www.sonoran.org)

Over the past decade, the Sonoran Institute has assisted dozens of communities throughout Western North America, helping them realize conservation and other community goals. The Institute's community stewardship work creates lasting benefits including healthy landscapes, vibrant economies, and livable communities that embrace conservation as an integral element of their economies and quality of life.

In carrying out its mission, the Sonoran Institute 1) helps communities understand their economy within the context of global, regional, and local economic and demographic trends, 2) helps communities make an inventory of natural and cultural assets that may be affected by growth and

development, 3) helps communities tailor land-use policies, conservation plans, and collaborative land management strategies to meet local needs and 4) helps communities implement economic development strategies that do not compromise natural amenities and community values.

- ◆ Preserving and Protecting Arizona Wilderness areas

### **Greater Flagstaff Forests Partnership**

1300 S. Milton Road, Suite 218

Flagstaff, AZ 86001

Phone: (928) 226-0644

[www.gffp.org](http://www.gffp.org)

The Greater Flagstaff Forests Partnership is a non-profit alliance of 26 environmental and governmental organizations dedicated to researching and demonstrating approaches to forest ecosystem restoration in the ponderosa pine forests surrounding Flagstaff, Arizona. The Partnership was formed through a cooperative agreement between the U.S. Forest Service and the Forest Foundation in 1998. The Partnership's three primary goals are to:

- ◆ Restore natural ecosystem structures, function, and composition of ponderosa pine forests.
- ◆ Manage forest fuels to reduce the probability of catastrophic fire.
- ◆ Research, test, develop, and demonstrate key ecological, economic, and social dimensions of restoration efforts.

## SECTION 2

### **I. Eligibility Criteria for Forest Legacy Areas**

According to the Forest Legacy Program Implementation guidelines, “Eligibility Criteria are a set of factors developed by the State lead agency, in consultation with the State Forest Stewardship Coordinating Committee (SFSCC), to evaluate geographic areas to determine if they qualify as a Forest Legacy Area.” The basic criteria adopted by the Arizona State Land Department and the State Forest Stewardship Coordinating Committee that must be satisfied to designate a Forest Legacy Area are:

- The area contains private lands that satisfy the definition for “forest”.
  - Lands stocked with at least 10% tree cover of any size (at maturity, the trees must be greater than 8 feet in height). Ten percent stocked, when viewed from a vertical direction, equates to an aerial canopy cover of leaves and branches of 25% or greater.
  - The minimum area for classification is 1 acre, owned by an individual or by an organized group of individuals.
- The private lands contain significant environmental values that satisfy the definition for an “important forest area”.
  - Riparian areas
  - Fish and wildlife habitat and corridors
  - Known threatened and endangered species
  - Timber, and other forest commodities
  - Scenic resources
  - Public recreation opportunities
  - Known cultural/historic resources
  - Watershed/Water supply values.
- The private forests are at risk of conversion to non-forest uses by roads and/or other human developments.
- Large unfragmented, undeveloped blocks of private forest are at risk of conversion to low density residential development.

### **II. Arizona’s Forest Legacy Areas**

Using the above definitions of forest, threatened forest, and important forest, along with map layers showing areas with high environmental values, public values and development threats we propose three Forest Legacy Areas for Arizona. The selection of these FLAs take into account that there are extensive areas of the state that are not suitable by virtue of their ownership or their ecological condition. For example, Indian reservations and trust lands are protected through the

trust relationship between the U.S. Department of Interior and the tribe. The extensive heart of the Sonoran Desert in southwestern Arizona is largely in public ownership or is within an Indian reservation or does not meet other criteria and thus is not included.

The three Forest Legacy Areas proposed are the Arizona Strip, Arizona Highlands and Sky Islands.

**Arizona Strip:** This FLA includes pinyon-juniper woodlands that are part of the larger, intact natural landscape of the Colorado Plateau. It is generally defined as the area north of the Grand Canyon National Park and the Kaibab National Forest, and west of the Navajo Indian Reservation. Subunits of the FLA are Mohave and Coconino counties.

**Arizona Highlands:** This FLA covers the most extensively forested region of the state. It includes the ponderosa pine forests of the Mogollon Plateau, the mixed conifer and high elevation riparian systems of the White Mountains, the forested mountains of west-central Arizona, and important riparian forests along central Arizona rivers such as the Verde, Salt, Little Colorado, Blue and Bill Williams. Forest types include conifer, pinyon juniper and riparian. The area is roughly bounded on the north by the Lake Mead National Recreation Area, the Hualapai Indian Reservation, Grand Canyon National Park and the Navajo Indian Reservation and on the south by La Paz County, Maricopa, Pinal and Gila Counties. Private lands within the Tonto National Forest, and the southern portion of Apache Sitgreaves National Forest are included. Subunits of this FLA are Mohave, Yavapai, Coconino, Maricopa, Gila, Navajo, Apache and Greenlee counties.

**Sky Islands:** Southeast Arizona is characterized by basin and range topography and it contains some of the state's most diverse forest habitats including mixed conifer, pinyon juniper, madroan oak woodlands and riparian. Its proximity to subtropical Mexican forests accounts for the area's high biological diversity, with many forest species reaching their northernmost limits. Important riparian forest systems include the San Pedro, Santa Cruz, and Gila Rivers and many of their tributaries and headwater areas. The FLA includes the eastern portions of Pinal and Pima counties, Gila County south of Tonto National Forest, Graham County south of the San Carlos Apache Indian Reservation, Greenlee County south of the Apache/Sitgreaves national Forest, and all of Santa Cruz County and Cochise County.

Within these three areas, all private forestlands that meet the four basic eligibility criteria are eligible for FLP participation. Individual proposals for protecting properties with FLP funding would be ranked according to the Forest Value and Threat Criteria Prioritization Process (Figure 7).

#### A. Project Eligibility Criteria

Project Proposals within an FLA must meet the six criteria listed below in order to be eligible for consideration and to be ranked and prioritized.

- **The parcel must be private land or be tribal non-trust allotment lands**
- **The parcel must be private forestland**

- **The parcel must be at least 5 acres in size**
- **The landowner must be a willing participant and agree to have a Landowner Forest Stewardship Plan (LFSP) written for the property**
- **The parcel must be an environmentally-important forest area**
- **The parcel must be threatened by conversion to non-forest uses.**

Once a project is judged to be eligible it will be scored and ranked in accordance with the criteria and weighting factors summarized in the evaluation form that follows.

Six overarching criteria were selected for use in the prioritization process for evaluating competing FLP projects. The criteria listed in priority order are:

- Ecological and Environmental values,
- Site viability and importance to other forestlands
- Threat immediacy
- Contribution to larger conservation strategy
- Public values
- Local support and presence of partners and/or matching funding

The criteria can be ranked by assessing a variety of factors that contribute to each of the criteria. These factors are found in the Forest Value and Threat Criteria Prioritization Process table below.

**Figure 7: Forest Value and Threat Criteria  
Prioritization Process**

Forest Value Criteria	Weight (3,2,1)	Score (1-5)	Weighted Score (Wt X Score)	Conversion Threat Criteria	Weight (3,2,1)	Score (1-5)	Weighted Score (Wt X Score)
<b>Riparian Forest Example</b>	<b>3</b>	<b>4</b>	<b>12</b>				
Riparian Forest	3			Immediacy	3		
Forest Condition	2			Road Impact	1		
Threatened, Endangered, Rare, Sensitive Species	3			Housing Density	2		
Critical Habitat	2			Subdivision Platted			
Contribution to other Conservation programs	2			Census Block Change	2		
Protected Area Inholding	2			Property for Sale	3		
Watershed/Aquifer Recharge	3			<b>Total Threat of Conversion</b>	<b>11</b>		
Movement Corridor	2						
<b>Total Environmental and Ecological Values</b>	<b>19</b>						
Large Block (>100 ac.)	3						
Proximity to Protected Land (>1,000 ac.)	2						
Readiness	3						
Time Limitations	2						
Affordability (Per Acre Cost)	2						
<b>Total Site Viability Value</b>	<b>12</b>						
Local Support	3						
Matching funds	3						
Other Conservation Planning or partners	3						
<b>Total Project Support</b>	<b>9</b>						
Scenic	2						
Recreation	2						
Cultural	2						
Economic	2						
<b>Total Public Values</b>	<b>8</b>						
<b>TOTAL WEIGHTED SCORE</b>							

Weighting factors are rated 1,2,3 with 3 being the highest priority. Weighting totals reflect the relative importance of each of the evaluation categories. For example, the environmental and ecological value total weight of 19 gives the highest of the six categories. The weighting factors given above are provisional and may be modified as they are tested.

Where spatial data layers are available, criteria will be mapped in FLAs and compounded in a composite map that shows areas with a color coding system. For example properties that lie in a designated conservation area which also incorporates public values are reflected in the color-coding of the FLA maps, as are those forests that lie in TNC conservation areas. Some map layers are not at present incorporated into the composite maps but these may be developed as the program matures and the rating criteria adjusted to reflect this improved knowledge.

Criteria lacking in spatial data layers will be evaluated according to guidelines developed by the Forest Stewardship Committee as part of the individual project evaluation process. Weightings will be reviewed and revised as necessary by the Forest Stewardship Committee. For example, critical habitat designations for threatened or endangered species are evolving as new species are listed or designations take place. Likewise the presence or absence of threatened, endangered or sensitive species on a property may also be fluid and open to new information being brought to the ranking process.

To assess a particular property’s over-all ranking for FLP funding, priority will be given to areas of high forest value first regardless of the degree of threat. Threat criteria will play a secondary role in assessing over-all project ranking as illustrated by the following figure:

<p><b>High Value High Threat</b></p> <p><b>Priority 1</b></p>	<p><b>High Threat Low Value</b></p> <p><b>Priority 3</b></p>
<p><b>High Value Low Threat</b></p> <p><b>Priority 2</b></p>	<p><b>Low Value Low Threat</b></p> <p><b>Priority 4</b></p>

*Environmental and Ecological Factors*

Environmental or ecological factors to be assessed about a proposal include: presence of riparian forest; forest condition; presence of threatened, endangered or sensitive species; critical habitat designated for listed species; designated conservation area; watershed or aquifer recharge area or wildlife movement corridor. Priority will be given to riparian forest and examples of other high quality forest types. Forest values also include the presence of priority wildlife such as threatened, endangered, sensitive, and species of concern as well as designated critical habitat for listed species. The presence of wildlife movement corridors where documented is also a significant value. Other special attributes that would influence ranking include forestlands overlying water supply aquifers or contribution to watershed conditions. Building upon previous conservation planning efforts will be advantageous thus, giving higher priority to those projects that are within a pre-existing local, regional, or global conservation plan. Examples include: at a

local scale, areas that fall within the Pima County Sonoran Desert Conservation Plan; at a regional scale, areas within The Nature Conservancy's ecoregionally based portfolio of conservation areas; and at a global scale areas within the globally recognized biodiversity hotspot of the Madrean Archipelago.

*The viability and importance of the site to other forestlands (Site Viability)*

Large blocks of land have higher ecological integrity due to their ability to maintain ecosystem level processes such as hydrologic cycling and natural fire regimes. They can also offer greater social and economic benefits due to their size. For these reasons, priority will be given to those private parcels that add to existing protected lands, such as county parks, state parks, national forests, national parks, wilderness areas, and/or other public land managed for natural resources. For example, in the Arizona Strip the predominant or matrix ownership for pinyon-juniper forest is Bureau of Land Management, however the scattered private parcels within the BLM ownership should be protected because if they are developed the integrity and manageability of the entire forest will be lost. Likewise, priority should be given to properties which when grouped together become a large intact forest block compared to smaller isolated parcels of forestland.

*Local support, and presence of partners and/or matching funding (Project Support)*

With Arizona's increasing population and the recent boom in ex-urban development there are many areas of private forest at risk of development. Given the limited funds of the FLP, it is important to leverage funds and encourage support offered through local partnerships. To this end, higher priority will be ascribed to those projects that demonstrate local support and/or provide matching funds.

*Immediacy of threats to the site (Threat Immediacy)*

The immediacy of road and development threat to a site is a key factor in determining overall priority level. Areas that are under imminent threat of development and possess high ecological, public, or economic values will receive higher priority. However, ecological value can decrease while the threat (and cost) of private forestland increases with increasing proximity to existing developments. Thus, it is important to give priority to projects with high ecological, public, or economic value that can be protected within the timeline of the FLP process. Such projects should be carefully evaluated to determine the feasibility of success. This strategy provides protection to properties with the greatest ecological, public, and economic value at the lowest price.

*Public values*

Public values include scenic and recreational benefits provided by the site, as well as the presence of cultural resources such as archaeological or historic sites. The importance of the private forest to the local economy through local timber harvest, ranching, and traditional forest uses is also a public value.

B. Goals and Objectives of Arizona's FLP

The main goals for the Arizona FLP are (1) protect important private forest from conversion to non-forest uses through development and ex-urban growth; (2) maintain the ecological integrity

of Arizona's forests to protect watershed functions; (3) protect native plant and wildlife habitat; (4) protect cultural and public values within the forests; and (5) maintain traditional forest uses such as timber harvest, livestock ranching, and recreational opportunities.

To reach these goals several program objectives have been identified:

- ◆ Reduce forest fragmentation through protection of ecologically and publicly important private forestland by focusing on large forested blocks where feasible.
- ◆ Protect riparian forest habitat in large or small blocks. Resource values are independent of parcel size in riparian settings
- ◆ Maintain watershed functions and protect water supply by protecting forests in the upper watersheds, along ephemeral streams, around springs, and the entire length of perennial reaches
- ◆ Protect wide ranging, rare, threatened, and/or endangered plant and wildlife habitat
- ◆ Protect important historical and cultural sites
- ◆ Promote forest stewardship by working together with private, federal, and state land managers

### **III. Assessment of Need Information Gathering Processing**

#### **A. Spatial Information and Analysis**

To aide the prioritization process for identifying environmentally important forests at risk of non-forest conversion, three spatially explicit data sets were used to identify areas of high public and ecological value as well as areas of road and development threats within private forest lands. These data sets were a result of spatial analyses using a Geographic Information System (ArcView 3.3 and ArcMap 9). The forest types were delineated using GAP vegetation (1998) and riparian vegetation information from the Arizona Game and Fish Department (AZGFD 1994) (Figure 1 and 2). Land ownership information was acquired from the Arizona Land Resource Information System (Figure 8, ALRIS 2003).

The *public value* spatial layer was intended to evaluate private forestlands in context of values that the general public may place on public lands and cultural resources. The two key components of public value are described as (1) presence of or proximity to areas with cultural and historical sites and (2) proximity to public recreation opportunities. Cultural importance was based on information from the Arizona State Museum, which identified acres of cultural resources by township/section map units. Areas within 8 km of public land with recreation opportunities (i.e., parks, wilderness areas, National Forests, and BLM land) were also defined as having public value. The combination of culturally and recreationally important areas within private forestlands is referred to as *public values* and is shown.

The *environmental value* spatial information was based on over six years of planning effort by The Nature Conservancy to identify areas for conservation in Arizona. The network of conservation areas in each of the five ecoregions that converge in Arizona identify and represent the diversity of species, communities, and ecological systems within an ecoregion including but not limited to forest resources. The conservation portfolio was created to capture the context of threatened, endangered, and common species locations and habitat requirements (including wildlife corridors), as well as to evaluate their importance to ecological functioning of an area,

and overall biodiversity of the region. This spatial data was then used to select and display private forest holdings that occur within the portfolio of conservation sites. Thus the supporting mapping does not display the conservation portfolio per se but identifies private forests that occur within the portfolio.

The *development threat* spatial layer shows areas that have been heavily impacted by human development. This spatial layer was a combination of 1) road impacts, based on road size (i.e., interstate, dirt road) and their ecological impacts (Theobald 2003, Figure 8); 2) estimated current housing density, based on aerial photography (from 1994 to present) from which areas with structures were identified as rural, mixed, or urban. [Mike Fisher, with the Bureau of Land Management, created this digital information to assist land management agencies in natural resource planning.]; 3) Mohave County assessor data (Mohave County GIS Department); 4) Coconino County subdivision data (Coconino County GIS Department); and 5) Pima County assessor data (Pima County GIS Department).

Figure 8: Description of road buffer widths used in the development spatial layer.

ROAD DESCRIPTION	Total Buffer Width (m)
Primary: limited access or interstate highway	1000
Primary: other U.S. or State highway	500
Secondary: state and county	200
Local	200
Vehicular: four-wheel drive	30

Given that the information used to create the public, ecological, and threat spatial layers was obtained from various sources which were collected and recorded using different spatial scales, with unknown accuracy, it was important to field verify those aspects of the data that were feasible. To this end, a sample of private forestlands was visited to check the accuracy of GAP vegetation and Arizona Game and Fish Department riparian vegetation. In addition, housing density was assessed and its relationship to biotic integrity was qualitatively determined.

Other spatial data analyzed and incorporated in the Assessment of Need included generalized locations of threatened, endangered, and sensitive species as well as other species of special concern on private forestlands. This information was provided by the Arizona Game and Fish Department and under agreement will remain confidential. Exact species locations and maps of these species are not provided in the AON. The Arizona Forest Health program, a collaborative project of the USDA Forest Service and University of Arizona Cooperative Extension, provided spatial data of insect damage to Arizona’s forests.

### B. Field Validation

Field verification was conducted for two weeks in April 2004, and was targeted to areas where *public value*, *environmental value*, and *development threat* intersected. Over the course of our trips, approximately 2,400 miles, 25 conservation areas, 7 National Forests, and 18 riparian areas were visited along with several representatives from each of the four forest types and the different types of development threats. Regarding the vegetation spatial information, observations from the field assessment suggest the following: mixed conifer forests were

identified accurately most often, with pinyon-juniper woodlands fairly accurate as well. The accuracy of riparian forest identification was highly variable. Riparian forests were either not identified or they were misidentified as another vegetation type. To improve the accuracy of identification of riparian forest additional information such as presence of perennial water or native fish was used in conjunction with the vegetation layer. Finally, Madrean oak woodlands appeared to be the least well identified vegetation community. Madrean oak woodlands were often misidentified as mesquite or not identified at all.

Field observations of the development threats revealed this layer to be fairly accurate in terms of properly identifying housing density and road size. Assessment of the impact of the housing density on biotic integrity suggested that areas with mixed or urban housing density are too heavily impacted in their present state to be of significant conservation value. Either singularly or in combination, rural housing density or road impacted areas still had relatively intact forest communities. We also noted that rural areas near booming communities appeared to be at the highest risk for development.

Based on field validation and observations, maps contained within the AON should be used as a *general guide* for assisting in prioritizing private forest lands, public values, ecological values, and development threats, *not a definitive map* of their locations.

Recommendations for priorities are as follows:

- ❖ Riparian forest along perennial water represents a small proportion of the total forest in Arizona, yet a disproportionately high number of species depend on them. Riparian forests are some of the most biologically diverse and rich communities in Arizona. Given their dwindling extent and high value, these areas should be the top priority.
- ❖ Areas classified as having rural housing density or only road impact near Kingman, Prescott, Chino Valley, Flagstaff, Heber to Show Low along Highway 260, Sonoita, Elgin, and Green Valley should be prioritized for Forest Legacy Program funds due to their imminent conversion by development.

#### **IV. Arizona's Forest Legacy Area Descriptions**

Each FLA is summarized as follows: a general description of the area with key land managers and rivers identified; a brief description of the vegetation communities contained within the FLA; discussion of the ecological and public values. Each FLA description also contains an overview of the growth and development patterns within the FLA. The Arizona counties that the FLAs overly are listed and economic and demographic data along with a county write up if provided in Appendix I. All of the tables and figures presented in this appendix are courtesy of the Sonoran Institute's Economic Profile System (Sonoran Institute 2000). The descriptive information for each county was adapted from the Arizona Department of Commerce county profiles (2003). Finally, there is a description of the Forest Legacy Program priority goals and objectives for each FLA. The goals and objectives are not intended to be an exhaustive list but rather they represent items in need of conservation based upon spatial analyses and field assessments.

During the development of the Assessment of Need, the contractor worked in conjunction with the ASLD, the AFSC, the US Forest Service and others. The public review process and comments are provided in further detail and outlined in Section 3; see Public Review and Comments.

While the ecological and public values vary for each FLA, the strategies for protection and conservation are the same for the three FLAs. They are as follows:

- 1) Implementation of a conservation easement program that focuses on protecting priority forestland. Conservation easements that are acquired under the program may be held by the Arizona State Land Department or by Local Governments working in conjunction with Arizona State Land Department under appropriate agreements between the entities.
- 2) Use FLP funding to leverage other funding sources for forestland protection and conservation easements.
- 3) Hold forestland conservation easement conference in Arizona in an effort to identify conservation partners, become aware of priorities of other organizations and individuals, and to build upon on-going forestland protection efforts.
- 4) Establish conservation partnerships in order to facilitate easement acquisition.
- 5) Develop site specific forest stewardship plans.

Similarly, the public benefits derived from identifying these FLAs are also the same for each FLA and they are as follows:

- 1) Protection of watershed values and water quality and quantity for human use.
- 2) Protection of valuable plant and wildlife habitat.
- 3) Protection of traditional forest uses and cultures.
- 4) Protection of scenic landscapes and aesthetics.
- 5) Reduction of wildland-urban interface issues.

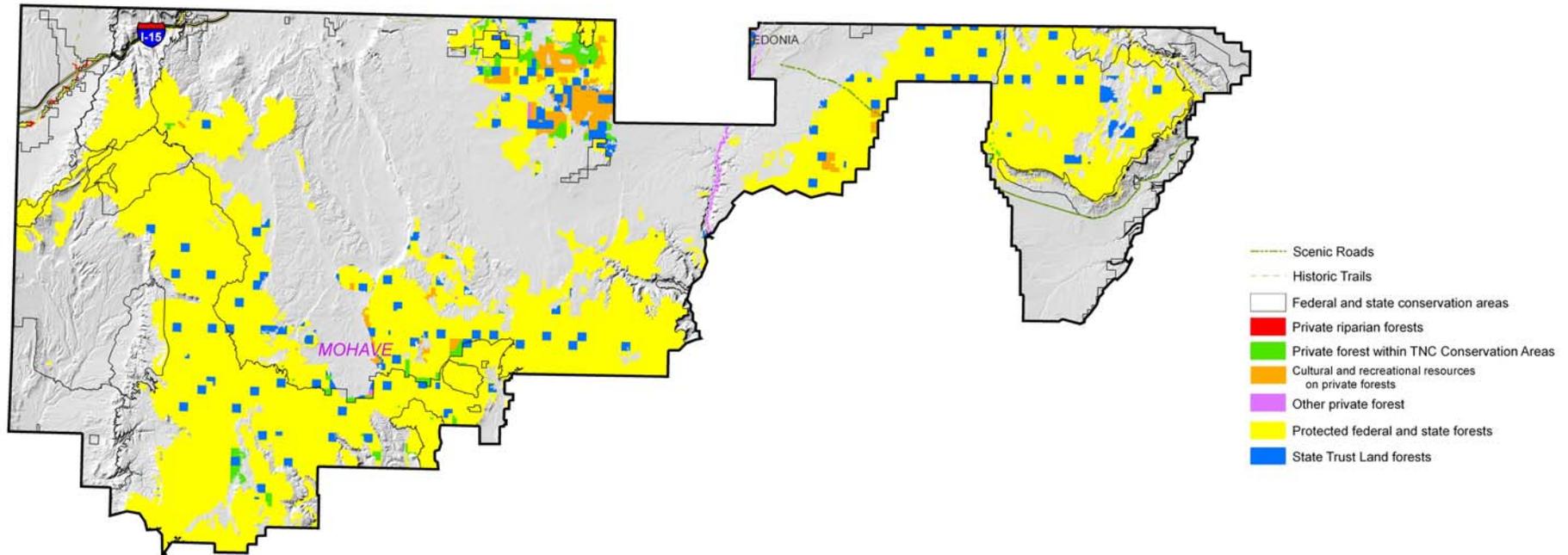
### **A. Arizona Strip Forest Legacy Area**

The Arizona Strip FLA consists of the portions of Mohave and Coconino counties located north of Grand Canyon National Park, Lake Mead National Recreation Area and Kaibab National Forest. The predominant forest and woodland ownership in the Arizona Strip is Bureau of Land Management land with 1,158,313 acres followed by Arizona state trust lands with 71,210 acres and then by privately owned land with 59,651 acres.

#### **Vegetation Patterns**

Vegetation within the Arizona Strip FLA is a mixture of Mohave Desertscrub on its western edge, Great Basin grasslands bordering the pinyon-juniper woodlands that occur over much of the areas. The pinyon-juniper woodlands cover about 1,276,912 acres in the FLA with 1,145,839 acres occurring on Bureau of Land Management. There are approximately 71,125 acres of pinyon-juniper on Arizona State trust lands and 58,706 acres on private land. About

# Map 5: Arizona Strip Environmental and Public Values

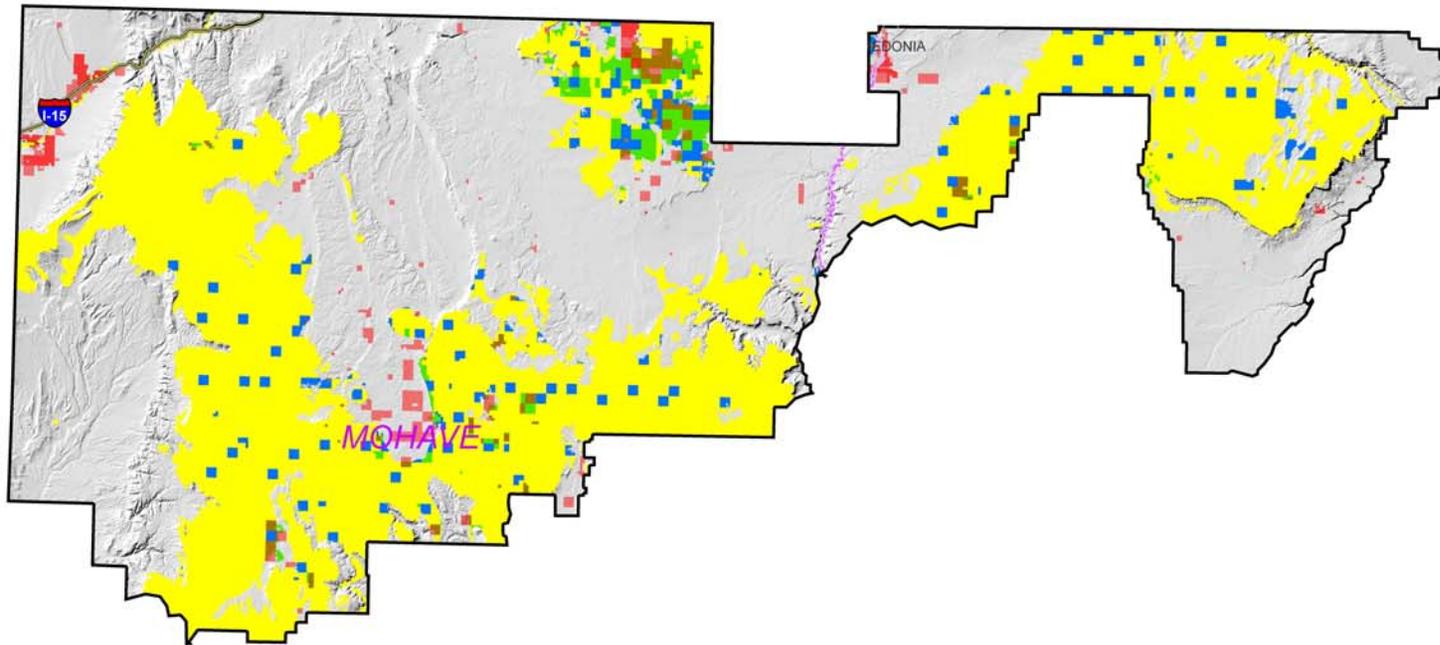


May 2005



# Map 6: Arizona Strip

## Developed Areas



- Developed Areas
- Forest heavily impacted by development
- Private Forests
- Federal and State protected forests
- State Trust Forests

0 5 10 20 30 40 Miles



7,572 acres of mixed conifer forest and 4,902 acres of riparian forest occur on Bureau of Land Management. On private lands there is about 935 acres of riparian forest.

Ecological and public values are associated with the extensive area of BLM Forestland and the private forest inholdings. These areas are used for recreation and also support other public values such as cultural resources. There is a concentration of ecological values associated with the Virgin River riparian area and also in the north central portion of the FLA. See Map 5.

Appendix E provides complete information on occurrences of federally listed species, sensitive species and species of concern by county.

### Growth and Development Patterns

The Arizona Strip is separated from the remainder of the state by the Grand Canyon and is remote. Population growth that is occurring in Mohave County and in Coconino County is occurring around the population centers of Kingman, Flagstaff and Sedona with little growth pressure occurring in most of the Arizona Strip FLA. A growth corridor and pressure for development does exist along the I-15 corridor and the Virgin River between St. George and Las Vegas. The locations of private forests also coincide with increased levels of road construction and these areas also have public values due to their proximity and integration with public lands. See Map 6.

For a more complete discussion of Coconino and Mohave county resource values and demographics please see Appendix I which contains information on forest resources, land tenure, threats assessment for all Arizona Counties.

### Goal and Objectives

- 1) Protect riparian forest values along the Virgin River and associated use by riparian obligate species such as the federally listed Southwestern Willow Flycatcher and native fish species.
- 2) Protect traditional forest uses, recreational and ranching uses by focusing attention on privately owned pinyon-juniper woodlands in the north central portion of the FLA.
- 3) Prevent fragmentation of public pinyon-juniper woodlands and creation of WUI issues by protecting private woodlands from unplanned development.

## **B. Arizona Highlands Forest Legacy Area**

### General Description

The Arizona Highlands FLA encompasses a swath that traverses the central highlands of Arizona from Nevada to New Mexico. It captures portions of the Arizona-New Mexico Mountains, Colorado Plateau, Apache Highlands and the Mohave Desert ecoregions. Elevations range from 482 feet at Lake Havasu City, Arizona on the Colorado River in western Mohave County to 12,643 feet at Humphrey's Peak north of Flagstaff in Coconino County.

The FLA consists of the Mohave County south of Grand Canyon National Park; all of Yavapai County; Coconino County south of Grand Canyon National Park; the northeastern portions of Maricopa and Pinal Counties; Gila County, except for its extreme southern corner; Navajo County located south of the Navajo Indian Reservation and North of the White Mountains Apache Indian Reservation; Apache County south of the Navajo Indian Reservation; and that portion of Greenlee County that contains the Apache/Sitgreaves National Forest.

The predominant ownership in the Arizona Highlands FLA is Federal with Bureau of Land Management ownership totaling 3,426,572 acres most of which is located in Mohave County. USDA Forest Service ownership totaling 8,846,457 acres in Yavapai County, southern Coconino County, western Gila County, eastern Maricopa County, the southern parts of Apache and Navajo Counties and all of Greenlee County in the FLA. The remaining portion of the FLA is a mix of state trust lands with 3,776,256 acres and private lands with 6,382,323 acres. The state trust lands and private lands often occur in a checkerboard pattern and thus their fates are closely related.

#### Vegetation Patterns

The extreme variations of altitude, precipitation, soil types and terrain contribute to exceptional diversity and interspersion of habitat types. In general, the pattern follows elevation zones with Mohave desertscrub in the low western portion of the FLA ranging up through Great Basin grasslands as elevation increases moving to the east. As elevations continue to increase the pinyon-juniper woodlands become predominant. Moving further to the east in Yavapai County and western Coconino County the vegetation types shift to chaparral in the southern lower elevations with a transition to Great Basin grasslands and then to pinyon-juniper woodlands and finally mixed conifer forests as elevation increases. This same pattern continues across southern Coconino, Navajo and Apache Counties. The mixed conifer forest being the predominant forest type with fringes of pinyon-juniper woodlands to the north grading out into Great Basin grasslands along the I 40 corridor and north into the Navajo Reservation.

There are a total of 10,382,804 forested acres in the Arizona Highlands FLA. Federal, state and local agencies own and manage 7,886,239 acres and 2,480,878 acres are in private ownership. There are a total of 3,030,794 acres of mixed conifer forest, 123,543 acres of madrean oak woodland, 7,005,536 acres of pinyon-juniper woodland and 222,931 acres of riparian forest. Private lands contain 134,434 acres or 4.4% of the mixed conifer, 16,937 acres or 13.7% of the madrean oak woodland, 2,254,401 acres or 32% of the pinyon-juniper woodlands and 75,106 acres or 33.7% of the riparian forest.

Interspersed with the upland deserts, grasslands and forests are the major rivers of the Arizona Highlands and their tributary streams. These include the Bill Williams and Santa Maria rivers in Southern Mohave County, Verde River, Salt River, Black, Blue, White, Little Colorado and Aqua Fria Rivers as well as their numerous tributaries. These rivers support extensive riparian forests and these are of exceptional value due to the great diversity of wildlife that depend on riparian forests in Arizona.

The forests of the Arizona Highlands FLA support raptors such as Mexican spotted owl, American peregrine falcon, ferruginous hawk, northern goshawk, osprey, American bald eagle, and black hawk. Southwestern willow flycatcher, Yuma clapper rail is federally listed endangered riparian obligate species and Western yellow-billed cuckoo is a candidate species for listing. Aquatic species include the federally listed razorback sucker, Gila topminnow, loach minnow and spikedace, as well as lowland and Chiricahua leopard frogs. Appendix E provides complete information on occurrences of federally listed species, sensitive species and species of concern by county.

Public and ecological values are concentrated in a large area in Coconino and Yavapai Counties and along the northern boundary of the Apache/Sitgreaves National forest in Eastern Coconino, Navajo and Apache Counties. See Map 7.

### Growth and Development Patterns

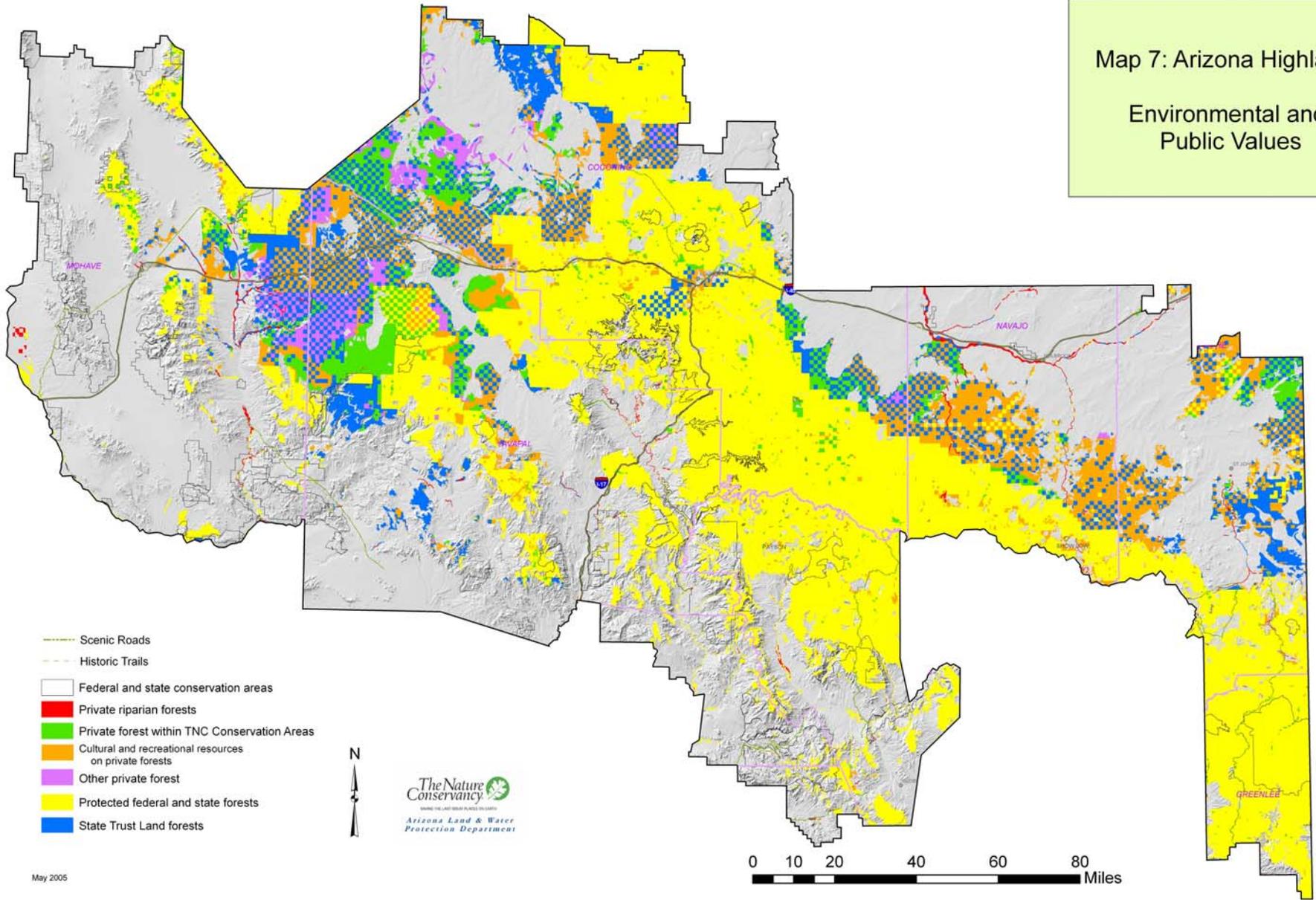
The Arizona Highlands contains some of the most rapidly growing areas in the state. Since 1970 Mohave and Yavapai counties have grown by 130 thousand or 494% and 131 thousand or 350% respectively. Although some of the growth in Mohave County occurred in the Arizona Strip FLA along the I-15 corridor, most occurred in the vicinity of Kingman and Bullhead City. These growth rates for Mohave and Yavapai counties exceeded that of the state average growth rate. During the same period Coconino County grew by 67 thousand or 137% and Navajo County grew by 50 thousand or 103%. Although this rate of growth was slower than the state average it exceeded the national average. Apache County grew by 36 thousand, a 111% increase and Gila County by 21 thousand, a 74% increase during the period. Although Maricopa and Pinal counties were very rapidly growing counties the portions of these counties that lie within the Arizona Highlands are predominantly within the Tonto National Forest. Greenlee County is the only county that lost population since 1970, losing approximately 1,900 people or 18% of its population.

Within the FLA, growth is occurring around Kingman and Bullhead City in the west, around Prescott, Prescott Valley, Chino Valley and Paulden and along the Highway 69 corridor between Cordes Junction and Prescott in Yavapai County. In Coconino county growth is focused around Flagstaff and adjacent to the boundaries of the Coconino National Forest. Sedona is also a growth center. In the eastern portion of the FLA the greatest growth is occurring in the White Mountain communities of Heber, Showlow, Pinetop-Lakeside, Greer, and Springerville. See Map 8. These areas are experiencing boom conditions for real estate sales and values and are popular spots for retirement and recreational second homes. It is paradoxical that while the White Mountains area is considered in this document to be a high priority for program attention, land exchange proponents are seeking the disposition of national forestland for development purposes through land exchanges adjacent to communities such as Showlow.

Throughout much of the Arizona Highlands the rapid pace of development and the pattern of development are contributing to a serious and growing set of wildland-urban interface issues. Flagstaff and the White Mountain Communities are essentially large growing inholdings within the National Forests and their vulnerability to fire is increasingly obvious every fire season. The proposed Forest Legacy Program can be used to offset this vulnerability to some extent by

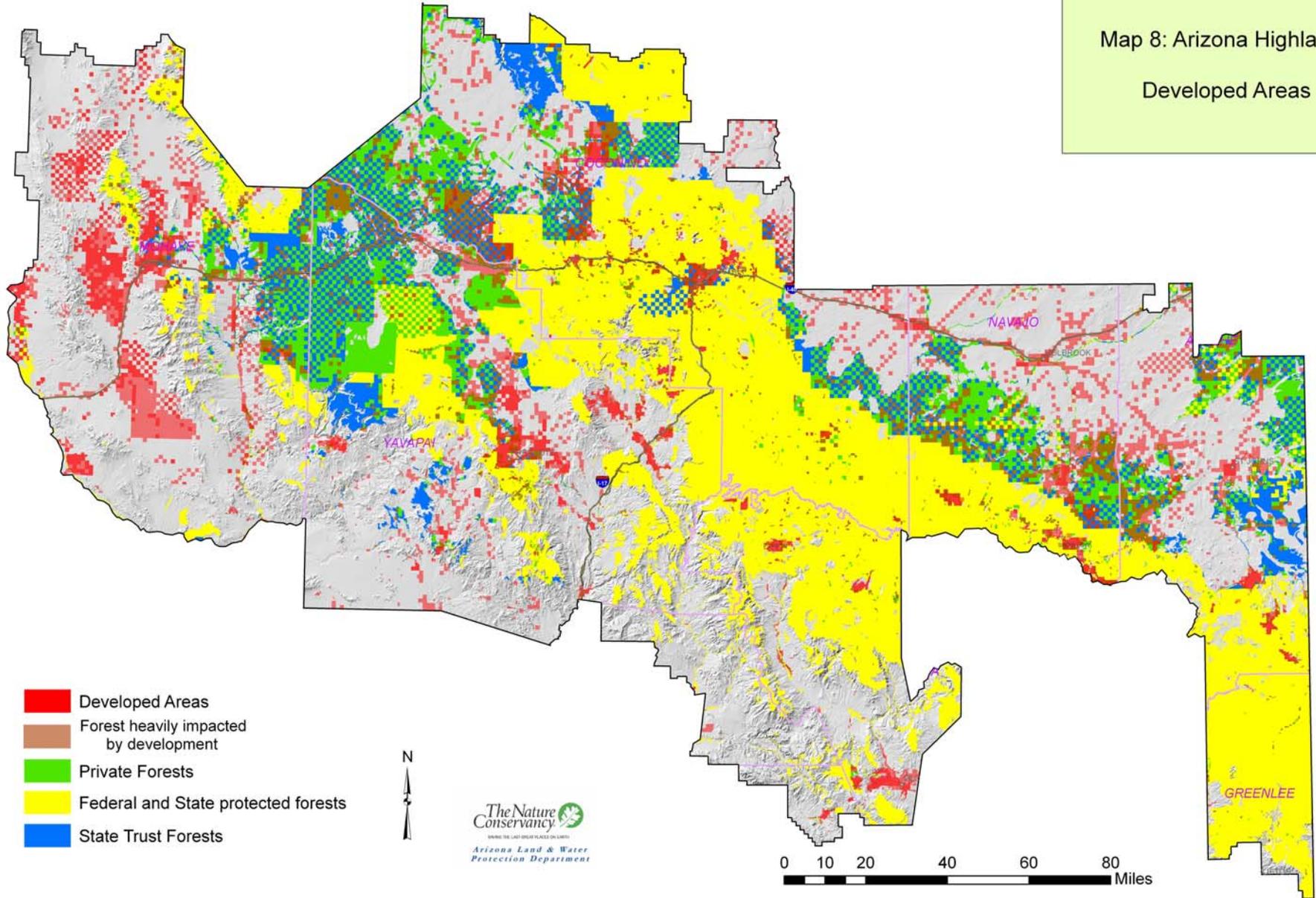
# Map 7: Arizona Highlands

## Environmental and Public Values



Map 8: Arizona Highlands

Developed Areas



providing protected private areas as a buffer between the public forest and developed cities, towns and residential areas.

Another disturbing pattern of development is becoming common in the Arizona Highlands Forest Legacy Area. That is the rapid conversion of large ranches to forty-acre subdivisions. This has become a favored development strategy by land investors and speculators because it requires a minimal investment in development infrastructure and long term involvement in the outcomes of the development. The value of the initial investment increases substantially due to the reduction of parcel size with a related increase in per acre value. This type of speculation also takes advantage of the checkerboard pattern of state trust land and private land that exists across most of the Arizona Highlands. Arizona law allows each of the forty-acre parcels to be split five times without application of any subdivision requirements. The land use pattern being created on the private lands thus will contribute to a growing crisis in wildland-urban interface management conflicts. This development pattern carried to its logical end will restrict management through the use of natural processes, such as fire on much of the 1,421,977 acres of state trust forests and woodlands in the FLA.

For a more detailed discussion of growth and development patterns by county refer to Appendix I.

### Goals and Objectives

1. Protect private riparian forests and associated public values such as recreation, watershed and aquifer functions, and ecological values such as breeding bird and native fish habitat and other wildlife use along perennial and near perennial streams. Of particular significance are the Bill Williams and its tributaries, the Verde River and its tributaries, Salt River and tributaries and the Little Colorado and its tributaries.
2. Reduce fragmentation of publicly owned pinyon-juniper forests and retain management options by protecting private forests that are interspersed throughout the FLA.
3. Sustain traditional pinyon-juniper forest uses such as gathering of firewood, fence posts, and pinyon nuts, as well as hunting, birdwatching and other recreational uses by protecting the vast pinyon-juniper woodlands that occur throughout much of the FLA.
4. Reduce fragmentation of the National Forests by protecting private inholdings and private forests located in areas adjacent to National Forest boundaries through the use of conservation easements.
5. Manage wildland-urban interface issues by protecting key private forestlands from development adjacent to National Forest boundaries.
6. Maintain the highest quality natural areas by protecting private forest and woodlands within Nature Conservancy designated conservation areas.

7. Maintain wildlife movement corridors between the mixed conifer forest of the high elevations, across the mid elevation pinyon-juniper to large functional grassland units by focusing attention on undeveloped private lands along known wildlife corridors.

### **C. Sky Islands Forest Legacy Area**

#### General Description

The Sky Islands FLA consists of the southeastern portion of Pinal County; the eastern half of Pima county; all of Santa Cruz county and Cochise County; as well as the extreme southern corner of Gila County; Graham County south of the San Carlos Apache Reservation; and Greenlee County south of the Apache/Sitgreaves National Forest. The FLA contains the Coronado National Forest, which occurs as eleven distinct districts, which total 1,647,324 acres. Bureau of Land Management holdings are concentrated in a band across the northern edge of the FLA although scattered holdings occur elsewhere such as along the San Pedro River and east of the San Pedro River. BLM holdings total 1,831,745 acres within the Sky Islands FLA. The Arizona State Land Department is the largest landowner and manager in the FLA with 4,055,529 acres and private lands comprise the second largest ownership at 3,656,575 acres.

#### Vegetation Patterns

The Sky Islands FLA contains portions of two ecoregions. The Sonoran Desert Ecoregion covers the western half of the FLA and the Apache Highlands covers the eastern half of the area. The Sonoran Desert transitions into the semi-desert grasslands and madrean oak woodlands of the Apache highlands as elevations increase to the south and east.

At the higher elevations of the Sky Islands, mixed conifer forests grade up into spruce-fir forest on mountain peaks. The mixed conifer forest transitions to madrean oak woodland as elevation drops. The forested mountains and foothills are connected across the basins by semi-desert grasslands or Sonoran desert scrub at lower elevations. The basin bottoms are traversed by streams such as the San Pedro and Santa Cruz Rivers that flow from southeast to the northwest where they join with the Gila River that runs from east to west along the northern edge of the Sky Islands FLA. Associated with these rivers are the cottonwood willow riparian gallery forests and the mesquite bosques (forests) that cover the riparian terraces along many of the stream systems.

Forested areas within the FLA total 1,377,458 acres or about 37.7% of the total area of the FLA. Mixed conifer comprises 137,515 acres of which 2,727 acres are in private ownership. Madrean oak woodland is the most extensive forest type with 1,114,908 acres of which 99,637 acres or about 8.9 % in private ownership. Pinyon-juniper is the least extensive with 29,814 acres in total of which 7,727 acres or about 25.9% in private ownership. Riparian forest comprises 95,221 acres of which 46,038 or about 48% in private ownership. Much of the Sky Islands FLA is part of a greater geographical region referred to as the Madrean Archipelago which was recently added to Conservation International's list of the world's hotspots for biological diversity. (Andrew Smith personal communication).

The mixed conifer forests are vital habitat for animals such as the Mount Graham red squirrel and Pinaleno Mountain snail. This FLA's forestlands are home to a large array of species ranging from the endangered to the Mexican spotted owl to the Southwestern willow flycatcher. Several species of bats and hummingbirds migrate through this area while some animals, like the tropical kingbird (*Tyrannus melancholicus*) and jaguar reach their northern limits in these forests. Federally listed endangered plant species such as Kearney's blue star (*Amsonia kearneyana*) and Huachuca water umber (*Lilaeopsis schaffneriana*, var. *recurvata*) are also found here.

The riparian gallery forests along perennial water or near perennial stream reaches are vital to a large number of aquatic species such as the Sonoran and desert suckers, Apache trout (*Oncorhynchus apache*), roundtail chub, spikedace (*Meda fulgida*), speckled dace, longfin dace (*Agosia chrysogaster*), and loach minnow, as well as the Chiricahua and lowland leopard frogs. These forests are vital as habitat for many riparian obligate bird species such as the federally listed endangered southwestern willow flycatcher as well as a host of other riparian obligate birds such as the Western yellow-billed cuckoo, yellow warbler, summer tanager, black hawk, gray hawk, and zone-tailed hawk.

In Pinal County there are 61 species that are threatened, endangered, sensitive or of special concern. In Cochise county there are 153 species that are threatened, endangered, sensitive or of special concern. Santa Cruz County has 121 species that are threatened, endangered, sensitive or of special concern. In Pima County there are 99 species that are threatened, endangered, sensitive or of special concern. Likewise in Greenlee County there are 44 species at risk or of concern, Graham County has 69 such species and Pinal County there are 61 species at risk or of concern.

Ecological and public values are concentrated around the riparian areas and at the North end of the Chiricahua Mountains and in eastern Greenlee County associated with the Gila River and the San Francisco River. There is also a cluster of ecological and public values private forest that occurs on the West side of the Mule Mountains in the Upper San Pedro basin. Map 9.

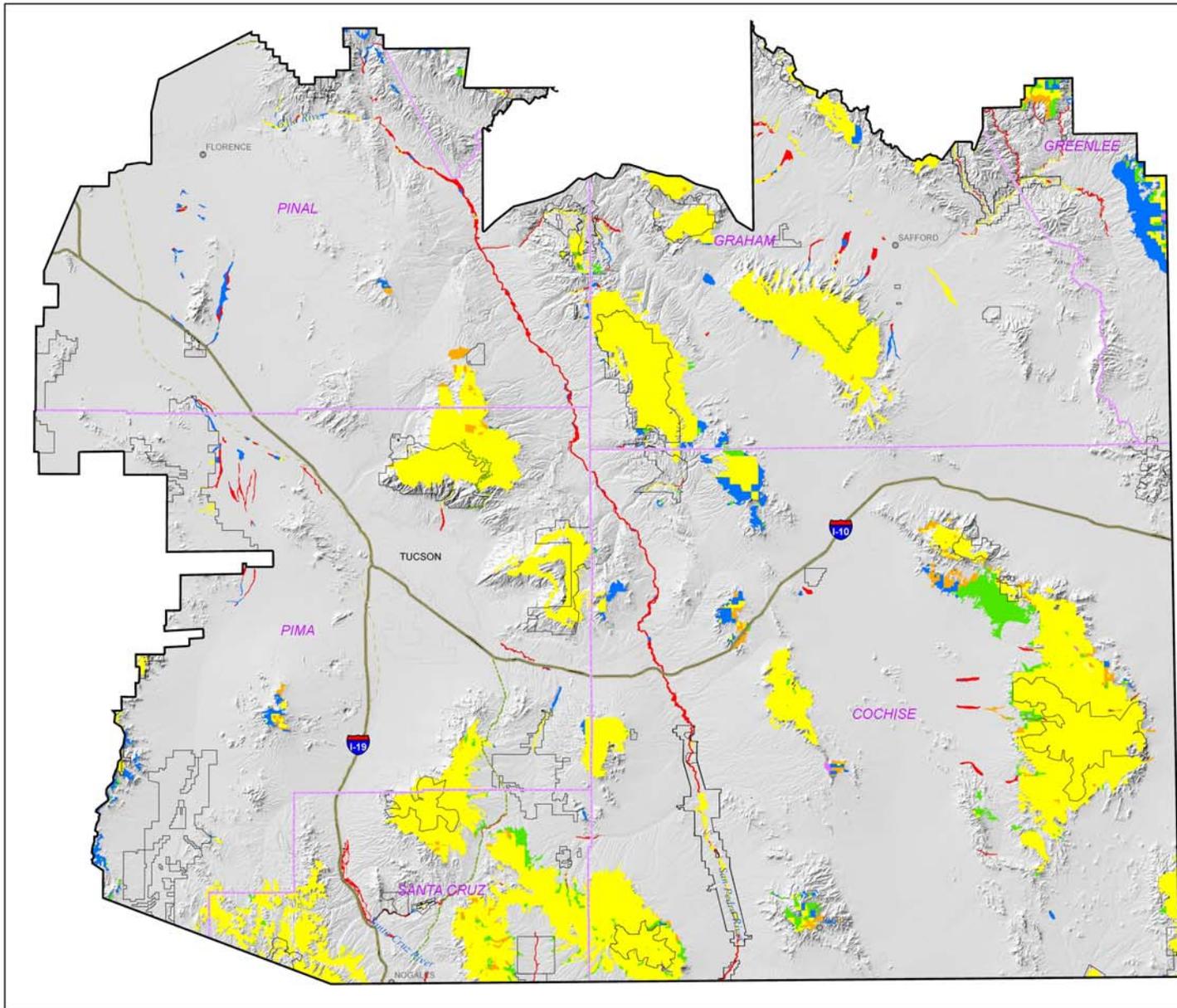
### Growth and Development Patterns

Growth in the Sky Islands FLA is of special concern due to the increasing effects of population expansion on scarce water resources and their related effects on stream and riparian systems. Growth has been increasing around population centers such as Tucson, Benson, Sierra Vista and Casa Grande. Large master planned developments arise on the landscape seemingly overnight and create satellite communities that become growth centers on their own and displace native forest and woodlands. See Map 10.

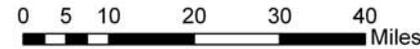
Although an enormous amount of growth has occurred and still continues in the desert lands around Tucson there is an increasing amount of suburban development in the higher elevations of Southeast Arizona. This growth is being fueled by the economic factors such as Fort Huachuca in the San Pedro Basin (the largest single employer in Southern Arizona) and by the favorable climate that is drawing retirees in increasing numbers. The highest value lands and

# Map 9: Sky Islands

## Environmental and Public Values



- Scenic Roads
- Historic Trails
- Federal and state conservation areas
- Private riparian forests
- Private forest within TNC Conservation Areas
- Cultural and recreational resources on private forests
- Other private forest
- Protected federal and state forests
- State Trust Land forests

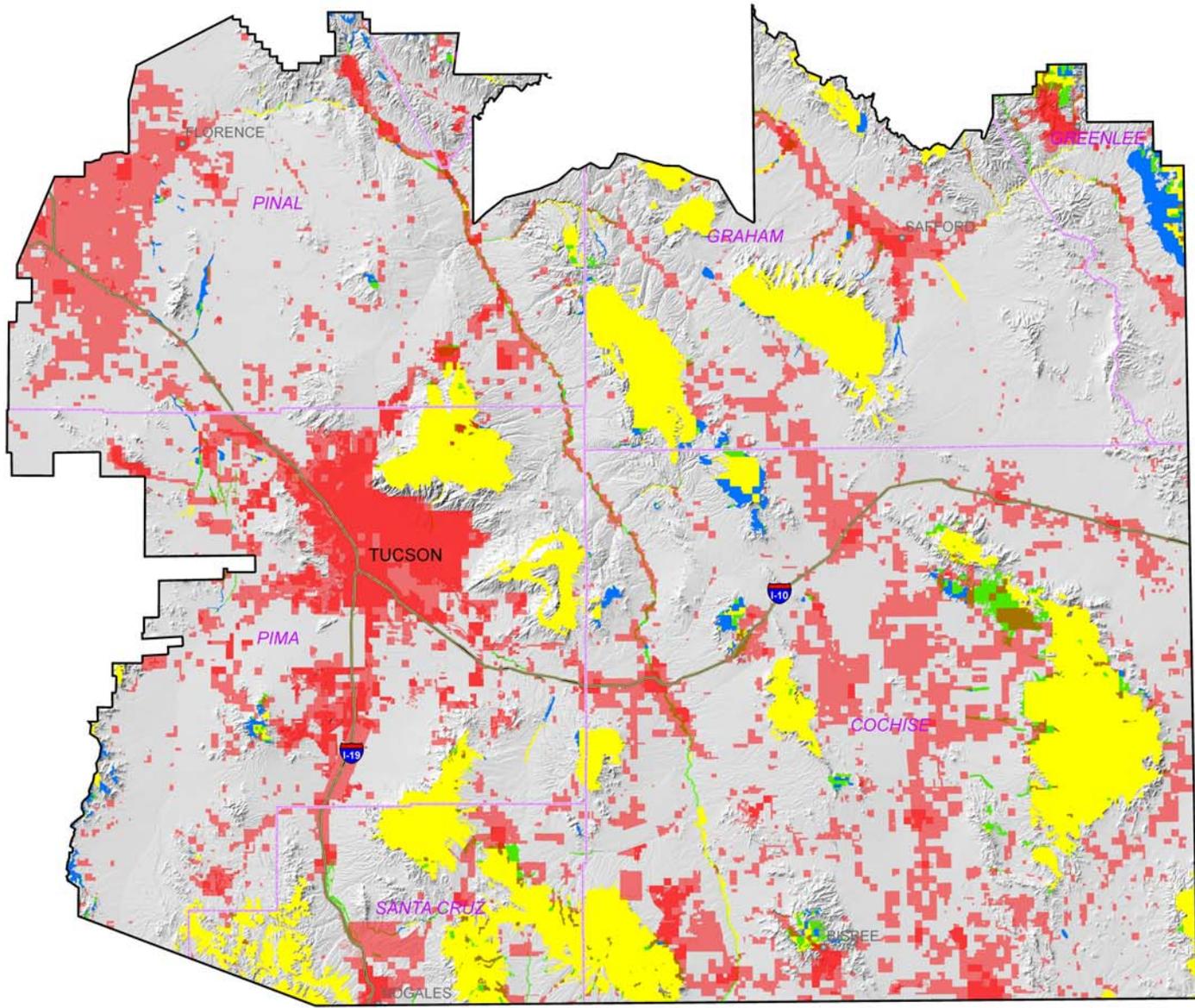


May 2005

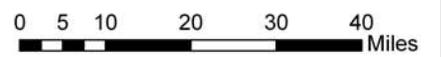


# Map 10: Sky Islands

## Developed Areas



- Developed Areas
- Forest heavily impacted by development
- Private Forests
- Federal and State protected forests
- State Trust Forests



the most desirable lands for development are the madrean oak woodlands that surround the protected Sky Islands.

In the Sky Islands FLA the Santa Cruz, San Pedro, and Gila rivers and their tributaries are greatly threatened or impacted to some degree by urbanization. Most of the Santa Cruz River downstream of Santa Cruz County was lost as a fully functioning system from the 1940's. It is now essentially a dry riverbed with the remaining riparian values throughout the reach in Pima and Pinal counties dependent on the discharges of effluent from Pima County's wastewater treatment plant. In Santa Cruz County the Santa Cruz River retains its riparian forest in the headwaters in the San Rafael Valley because the valley has been spared development thusfar. In the reach downstream of Nogales to Tubac effluent discharges from the International Wastewater Treatment plant just north of the Mexico Border contribute significant flows to the river. The upper San Pedro River in Cochise County is under threat from rapid urbanization in the Sierra Vista subwatershed. The lower San Pedro in northern Cochise County, Pima and Pinal counties has been substantially impacted by excessive water use related to agricultural irrigation and mining withdrawals. In the San Pedro River basin, programs are underway to protect groundwater and surface flows and considerable progress has been made in protecting riparian forestlands through acquisition of fee title ownership and conservation easements by Bureau of Land Management, Bureau of Reclamation, The Nature Conservancy, Pima County and others. However, much work remains to be done.

#### Goals and Objectives

- 1) Prevent fragmentation of riparian corridors and protect to the greatest extent possible riparian and aquatic wildlife habitat.
- 2) Protect wildlife movement corridors between the mixed conifer forests in Forest Service hands through the privately owned madrean oak woodlands to protect the forest connections with the grasslands and riparian forests.
- 3) Protect aquifer recharge areas and important watersheds through the use of conservation easements to limit development on private forestlands.

SECTION 3

**Project Development Process**

The Arizona Forest Legacy program is proposed to be implemented following the eight step process described in the Project Development Process that follows.

*Arizona Forest Legacy Program  
Project Development Process  
May, 2005*

- Step 1: Distribute Request For Proposals (RFP).....January 15<sup>th</sup>**  
A request will be put out to land trusts, county & municipal governments, and other interested parties announcing the program, providing general information including eligibility criteria, and publicizing the application deadline of May 1<sup>st</sup>.
- Step 2: Application Period.....January 15<sup>th</sup> to April 15<sup>th</sup>**  
Applications will be accepted throughout this period. Preliminary assessment of eligibility may be done during this time as a prerequisite to the project evaluation period.
- Step 3: Project Application Review & Evaluation.....April 15<sup>th</sup> to May 15<sup>th</sup>**  
The Forest Legacy Subcommittee of the Arizona Forest Stewardship Committee (AFSC) will review, rate, and rank applications during this time. Their findings and recommendations will then be presented to the AFSC for consideration and approval action.
- Step 4: AFSC Application Review & Prioritization.....May 15<sup>th</sup> to June 1<sup>st</sup>**  
The AFSC will consider the findings and recommendations of the Forest Legacy Subcommittee, and take action to approve, disapprove, or table applications. A final ranking of projects will be made at this meeting.
- Step 5: Notification of Applicants.....June 1<sup>st</sup> to June 15<sup>th</sup>**  
Applicants will be notified of the status of their project applications. Top-ranked applicants will be encouraged to “partner up” with a conservation organization to assist in the gathering of baseline information for their parcel, and to begin due diligence work.
- Step 6: Obtain Landowner Options.....August 1<sup>st</sup> to September 1<sup>st</sup>**

The state FLP Coordinator will work to obtain an option(s) from the highest-ranked one-to-three applicants. Granting of an option by the landowner will be a determining factor in final selection for submission to the Forest Legacy Information System (FLIS).

**Step 7: State Project Prioritization & Submission.....September 1<sup>st</sup> to September 15<sup>th</sup>**

Following the collection of additional information on parcel characteristics, eligibility, and the resolution of landowner options, the AFSC will do a final prioritization of up to three (3) parcels for entry into the (FLIS).

**Step 8: Submission of Application(s) to USFS Region.....October 1<sup>st</sup> to October 15<sup>th</sup>**

One-to-three priority applications are forwarded to the Southwestern Regional Office of the USDA Forest Service for funding consideration. Landowner(s) whose applications have been forwarded to the Forest Service will be notified and subsequently kept informed.

## SECTION 4

### **I. Public Review and Comments**

The public review process consisted of a detailed review by the Arizona State Forest Stewardship Committee (AFSC), as well as outreach to, and review and feedback by the Governor's Forest Health Oversight Council, the Governor's Forest Health Advisory Council, the League of Arizona Cities & Towns, the County Supervisors' Association, Coconino County, City of Scottsdale, City of Flagstaff, City of Sedona, Trust for Public Land, Forestry Division field personnel of the Arizona State Land Department, the NRCS State Technical Committee (see rosters, Appendix J), and several other formal and informal outreach and communication venues.

The public participation strategy took advantage of the diverse representation of several different councils, associations, committees, and interest groups. Several of these groups are heavily involved in the legislative process and in the formulation of policy on natural resource management and protection throughout Arizona. Accordingly, these groups are accountable...both to the organizations they represent and to the voters of their jurisdictions. Thus, outreach to these groups provided a conduit to their larger constituencies and to the values which they possess. Membership rosters of these organizations identifying their affiliations, along with several letters of support, can be found in Appendices J and K.

The Arizona Forest Stewardship Committee had the most extensive and detailed involvement in the development of the Assessment of Need. The AFSC is composed of 25 members representing the following entities: Arizona Association of Conservation Districts, Arizona Cooperative Extension Service, Arizona Department of Agriculture, Arizona Department of Environmental Quality, Arizona Department of Transportation, Arizona Game and Fish Department, Arizona State Land Department, USDI Bureau of Land Management, USDI Bureau of Indian Affairs, Four Corners Sustainable Forests Partnership, The Nature Conservancy, USDA Natural Resource Conservation Service, Northern Arizona University, San Carlos Apache Tribe, Sierra Club, University of Arizona, USDA Farm Services Agency, U.S. Fish and Wildlife Service, USDA Forest Service, and private forestland owners.

AFSC's role is to function in a supporting and advisory capacity, providing assistance and recommendations to the State Forester regarding the development, implementation, and oversight of Cooperative Forestry Assistance programs. The AFSC was intimately involved in the development and updating of the Forest Land Enhancement Program (FLEP) State Priority Plan and the State Forest Stewardship Program Plan. Similarly, the AFSC acted in an advisory capacity during the development of the AON, providing recommendations as well as review and comment on drafts and revisions.

In March of 2004, the AFSC was presented with information about the Forest Legacy Program and the Assessment of Need to be developed for Arizona. Some of the presentation and discussion topics included: the eligibility criteria, FLA boundaries, project evaluation criteria, and the spatial data sets to be used in generating information for the AON. Committee members provided valuable feedback that was considered during the AON development process and

incorporated into the AON. One such comment resulted in a more liberal definition of forestlands. Other suggestions included comments on the project evaluation criteria such as maintenance of wildlife corridors, identifying critical habitat for threatened and endangered species, and weighting traditional uses more highly in the project selection criteria process.

Earlier drafts of the AON were made available to all members of the AFSC and comments were received from four members. In general, the comments were editorial in nature with requests for clarification on some timber statistics and historical information. There were no incongruities with the approach, direction, or tone of the document. The AFSC feedback was carefully considered and as appropriate, incorporated into the final AON document.

Other outreach activities included contacting the Region 3 Forest Service Public Affairs Media Officer to create awareness that Arizona would be participating in the FLP in the near future. To this end each of the six National Forest supervisors and seven of the Forest Service land resource personnel in Arizona were contacted to provide input on environmentally important private forests that were contained within or adjacent to the Forest boundaries (Appendix G). Responses were received from the Tonto and Apache-Sitgreaves National Forests. This information was incorporated into the FLA within which they occurred. Other regional Forest Service personnel also provided comments and suggestions.

Informal public outreach also occurred with many different agencies and organizations during the course of compiling information and preparing the AON. Through informal conversations, agencies and organizations were informed about the FLP in Arizona. The following are some of the entities contacted: the Arizona Department of Commerce, Arizona Game and Fish Department, various divisions in the State Land Department such as Land Information, Title and Transfer and Natural Resources, Trust for Public Land, Arizona State Museum, University of Arizona Cooperative Extension's Arizona Forest Health Program, National Park Service Rivers, Trails & Conservation Assistance, Sonoran Institute, and Bureau of Land Management. The Nature Conservancy's Arizona chapter featured an article about the upcoming Forest Legacy Program in their donor newsletter (distributed to 3,300 members) and in their spring newsletter (distributed to 25,000 members). See Appendix H as an example of one such article.

In January, 2005 the AFSC met with Rick Cooksey, National Forest Legacy Program Manager and Kathryn Conant of the USDA Forest Service's Washington Office Staff. The purpose of the meeting was to critically assess a revision strategy for Arizona's AON. Mr. Cooksey and Ms. Conant provided valuable insight within the framework of a general overview of the Forest Legacy Program. After questions, answers and considerable discussion, the meeting culminated in adoption of the proposed strategy. Properly executed, this strategy will result in approval of Arizona's AON by the Secretary of Agriculture and successful entry into the Forest Legacy Program by the State of Arizona.

Even as the Forest Legacy Program will evolve and improve over time, so continual efforts will be engaged to disseminate and receive information to and from the public. The intent is that a positive dialogue will continue with all agencies, organizations, and individuals who have an interest in the future of Arizona's private forestland.

## LITERATURE CITATIONS

- Abert, J.W. 1848a. Report of his examination of New Mexico in the years 1846–1847. 30th Congress, 1st Session, Senate Executive Document 23. Washington, DC: Government Printing Office.
- Abert, J.W. 1848b. Examination of New Mexico in the years 1846–47. 30th Congress, 1st session, House Executive Document 41. Washington, DC: Government Printing Office: 456–460.
- Abolt, R.A.P. 1997. Fire histories of upper elevation forests in the Gila Wilderness, New Mexico via scar and stand age structure analysis. M.S. thesis, University of Arizona, Tucson. 120 p.
- American Farmland Trust (AFT). 2004. Strategic ranchland in the Rocky Mountain west mapping threats to prime ranchland in seven western states. Palisade CO: American Farmland Trust. Accessed June 2004, available at [http://www.farmland.org/rocky\\_mountain/arizona.htm](http://www.farmland.org/rocky_mountain/arizona.htm).
- Anderson, R.S. 1993. A 35,000 year vegetation and climate history from Potato Lake, Mogollon Rim, Arizona. *Quaternary Research*. 40:351–359.
- Anderson, R.S., J.L. Betancourt, J.I. Mead, R.H. Hevly, and D.P. Adam. 2000. Middle- and late-Wisconsin paleobotanic and paleoclimatic records from the southern Colorado Plateau, USA. *Palaeogeography, Palaeoclimatology, Palaeoecology*. 155:31-57.
- Arizona County Population Projections - 1980-2050. U.S. Census for 1980 and 1990. U.S. Census Bureau, Washington, DC and Arizona Department of Economic Security, Research Administration, Population Statistics Unit. Phoenix, AZ.
- Arizona Department of Commerce. 2003. County Profiles. Phoenix, AZ: Arizona Department of Commerce. Accessed May 2004, available at [http://www.commerce.state.az.us/communities/county\\_profiles.asp](http://www.commerce.state.az.us/communities/county_profiles.asp).
- Arizona Game and Fish Department (AZGFD). 1994. Riparian spatial data. Phoenix, AZ: Arizona Game and Fish Department. Accessed February 2004, available at <http://www.land.state.az.us/alris/index.html>.
- Arizona Game and Fish Department (AZGFD). 2004. Arizona Partners in Flight. Phoenix, AZ: Arizona Game and Fish Department. Accessed April 2004, available at [http://www.mirror-pole.com/apif\\_web/](http://www.mirror-pole.com/apif_web/).
- Arizona Geological Survey (AZGS). 2004. Mineral and energy resources. Phoenix, AZ: Arizona Geological Survey. Accessed May 2004, available at <http://www.azgs.state.az.us>.
- Arizona Land Resource Information System(ALRIS). 1998. Phoenix, AZ: Arizona State Land Department. Spatial data. Accessed February 2004, available at <http://www.land.state.az.us/alris/index.html>.

Arizona State Land Department (ASLD). 2003. Arizona State Land Department Annual Report 2002-2003. Phoenix, AZ: Arizona State Land Department.

Arizona State Museum (ASM). 2004. Cultural resources on private land in Arizona. Tucson, AZ: Arizona State Museum. Spatial data.

Bahre, C.J. 1991. The legacy of change: historic human impact on vegetation in the Arizona borderlands. Tucson, AZ: University of Arizona Press.

Baker, R.D., R.S. Maxwell, V.H. Treat, and H.C. Dethloff. 1988. Timeless heritage: a history of the Forest Service in the Southwest. FS-409. Washington, DC: U.S. Department of Agriculture, Forest Service. 208 p.

Baker, W.L. and T.T. Veblen. 1990. Spruce beetles and fires in the 19th century subalpine forests of western Colorado, USA. *Arctic and Alpine Research*. 22(1):65-80.

Bailey, R.G., P.E. Avers, T. King, and W.H. McNab. eds. 1994. Ecoregions and subregions of the United States. Washington, DC: U.S. Department of Agriculture, Forest Service.

Brown, D.E., editor. 1994. Biotic Communities Southwestern United States and Northwestern Mexico. Salt Lake City, UT: University of Utah Press.

Brown, D.E. and C.H. Lowe. 1977. Biotic communities of the Southwest. General Technical Report RM-41. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Range and Experiment Station.

Brown, D.E. and C.H. Lowe. 1980. Biotic communities of the Southwest. General Technical Report RM-78. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Range and Experiment Station.

Betancourt, J.L., J.S. Dean, and H.M. Hull. 1986. Prehistoric long-distance transport of construction beams, Chaco Canyon, New Mexico. *American Antiquity*. 51:370-375.

Betancourt, J.L., E.A. Pierson, K.A. Rylander, J.A. Fairchild-Parks, and J.S. Dean. 1993. The influence of history and climate on New Mexico pinyon-juniper woodlands. Managing pinyon-juniper ecosystems for sustainability and social needs. General Technical Report RM-236. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Range and Experiment Station.

Carleton, J.O., W.A. Robbie, G.T. Robertson, C.L. Spann, H.G. Brown III, J. Gass, D.W. Shaw, T. Robison, W.H. Moir, D. Potter, R.A. Fletcher, R. Galeano-Popp, and G.J. Miller. 1991. General ecosystem survey. Albuquerque, NM: U.S. Department of Agriculture, Forest Service, Southwestern Region. 188 p. plus maps.

Chronic, H. 1983. *Roadside Geology of Arizona*. Missoula, MT: Mountain Press Publishing Company. 321 p.

City data.com. 2004. City data, Arizona. Accessed June 2004, available at <http://www.city-data.com>.

Conner, R.C., J.D. Born, A.W. Green, and R.A. O'Brien. 1990. *Forest Resources of Arizona*. Resource Bulletin INT-69. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 100 p.

Covington, W.W. and M.M. Moore. 1994. Southwestern ponderosa forest structure: changes since Euro-American settlement. *Journal of Forestry*. 92(1):39–47.

Covington, W. W., R.L. Everett, R. Steele, L.L. Irwin, T.A. Daer, Auclair, and N.D. Allan, 1994. Historical and Anticipated Changes in Forest Ecosystems of the Inland West of the United States. In: pp. 13-63. Sampson R.N. and D. Adams eds. *Assessing Forest Ecosystem Health in the Inland West*. Binghamton, NY: The Haworth Press, Inc.

Dahms, C.W. and B.W. Geils, tech. eds. 1997. *An assessment of forest ecosystem health in the Southwest*. General Technical Report RM-GTR-295. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 97 p.

Dean, J.S., W.H. Doelle, and J.D. Orcutt. 1994. Adaptive stress, environment, and demography. Gumerman, G.J., ed. *Themes in Southwest prehistory*. Santa Fe, NM: School of American Research Press: 53–86.

DeByle, N.V. 1985. *Management for esthetics and recreation, forage, water, and wildlife*. DeByle, N.V. and R.P. Winokur, eds. *Aspen: ecology and management in the western United States*. General Technical Report RM-119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Range and Experiment Station: 223–232.

Elmore, W. and B. Kauffman. 1994. Riparian and watershed systems: Degradation and restoration. *Ecological Implications of livestock herbivory in the West*. 212-231. Denver, CO: Society for Range Management.

Finch, D. M., J.L. Ganey, W. Yong, R. Kimbal, and R. Sallabanks. 1997. Effects and interactions of fire, logging and grazing. In: *Ecology and Management of Songbirds in Southwestern Ponderosa Pine Forests*. General Technical Report. USDA Forest Service, Rocky Mountain Forest and Range Experimental Station.

Goerold, W.T. 1989. *The energy and mineral sector in Arizona*. Washington, DC: The Wilderness Society.

Gottfried, G.J. 1992. *Ecology and management of the Southwestern pinyon-juniper woodlands*. Ffolliott, P.F., G.J. Gottfried, D.A. Bennett, C. Hernandez, A. Ortega-Rubio, R.H. Hamre, tech. coords. *Ecology and management of oak and associated woodlands: perspectives in the*

southwestern United States and northern Mexico; 1992 April 27–30; Sierra Vista, AZ. General Technical Report RM–218. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station.

Grissino-Mayer, H.D., C.H. Baisan, and T.W. Swetnam. 1995. Fire history in the Pinaleno Mountains of southeastern Arizona: effects of human-related disturbances. DeBano, L.F., P.F. Ffolliott, A. Ortega-Rubio, G.J. Gottfried, R.H. Hamre, and C.B. Edminster, tech. coords., Biodiversity and management of the Madrean Archipelago: the Sky Islands of southwestern United States and northwestern Mexico; 1994 September 19–23; Tucson, Arizona. General Technical Report RM-264. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 399–407.

Johnson, M. 1994. Changes in Southwestern forests: stewardship implications. *Journal of Forestry*. 94:16-19.

Johnson, M., H. Salwasser, and B. Bollenbacher. 2001. The role of wood removals in sustainable forest management in the United States: the contribution of federal lands. *Forests and society : the role of research : congress report XXI IUFRO World Congress 2000, 7-12 August 2000* Kuala Lumpur: Institut Penyelidikan Perhutanan Malaysia.

Jones, J.R. and N.V. DeByle. 1985. Fire. DeByle, N.V. and R.P. Winokur., eds. *Aspen: ecology and management in the western United States*. General Technical Report RM–119. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station: 77–81.

Kauffman, J.B., W.C. Krueger, and M. Vavra. 1983. Effects of Late Season Cattle Grazing on Riparian Plant- Communities. *Journal of Range Management*. 36:685-691.

Land Trust Alliance. 1998. 1998 National Directory Conservation Land Trusts. Washington, DC: Land Trust Alliance.

Linnane, J.P. 1986. Integrated forest protection guide, Western spruce budworm in the Southwest. Forest Pest Management Report R3–86–7. Albuquerque, NM: U.S. Department of Agriculture, Forest Service, Southwestern Region. 22 p.

Myers, L.A. and E.C. Martin. 1963. Fifty years progress in converting virgin southwestern ponderosa pine to managed stands. *Journal of Forestry*. 61(8):583–586.

National Association of State Foresters (NASF). 2002. 2002 State Forestry Statistics. Washington, DC: National Association of State Foresters. Accessed February 2004, available at [www.stateforesters.org](http://www.stateforesters.org).

Nations, D.J. and E. Stump. 1997. *Roadside Geology of Arizona*. Dubuque, IA: Kendall/Hunt Publishing Company. 272 p.

- Natural Resources Conservation Service. 1997. Summary Report, 1997 National Resources Inventory. Washington, DC: U.S. Department of Agriculture, Natural Resources Conservation Service. Accessed March 2004, available at <http://www.nrcs.usda.gov/technical/NRI/>.
- O'Brien, R.A. 2002. Arizona's Forest Resources, 1999. Resource Bulletin RMRS-RB-2. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 116 p.
- Ohmart, R. D. 1996. Historical and present impacts of livestock grazing on fish and wildlife resources in western riparian habitats. *Rangeland wildlife*: 245-279. Denver, CO: Society for Range Management.
- Phillips, K.A., N.J. Niemuth, and D. Bain. 2000. Arizona mining update-for 1999. Circular No. 87. Phoenix, AZ: Arizona Department of Mines and Mineral Resources.
- Sartwell, C. and R.E. Stevens. 1975. Mountain pine beetle in ponderosa pine, prospects for silvicultural control in second growth stands. *Journal of Forestry*. 73(3): 136-140.
- Schmid, J.M. and R.H. Frye. 1977. Spruce beetle in the Rockies. General Technical Report RM-49. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 38 p.
- Schroeder, M.F. and C.C. Buck. 1970. Fire weather handbook 360. Washington, DC: U.S. Department of Agriculture. 229 p.
- Schubert, G.H. 1974. Silviculture of southwestern ponderosa pine: the status of our knowledge. Research Paper RM-123. Fort Collins, CO: U.S. Department of Agriculture, Forest Service. 71 p.
- Scott, J.M., F. Davis, B. Csuti, R. Noss, B. Butterfield, C. Groves, H. Anderson, S. Caicco, F. D'Erchia, T.C. Edwards, Jr., J. Ulliman, and R.G. Wright. 1993. Gap analysis: a geographic approach to protection of biological diversity. *Wildlife Monographs* 123:1-41.
- Smiley, T.J., J.D. Nations, T.L. Pew, and J.P. Schafer, eds. 1984. *Landscapes of Arizona: The Geological Story*. Lanham, MD: University Press of America, The Rowman & Littlefield Publishing Group.
- Smith, W.B., J.S. Vissage, D.R. Darr, and R.M. Sheffield. 2001. Forest Resources of the United States, 1997. General Technical Report-NC-219. St. Paul MN: U.S. Department of Agriculture, Forest Service, Accessed March 2004 available at [http://nrcs2.fs.fed.us/4801/fiadb/rpa\\_tablet/97\\_GTR\\_219\\_english\\_RPA.pdf](http://nrcs2.fs.fed.us/4801/fiadb/rpa_tablet/97_GTR_219_english_RPA.pdf).
- Sonoran Institute. 2000. Sonoran Institute's Economic Profile System. Tucson, AZ: Sonoran Institute. Accessed May, 2004, available at [http://www.sonoran.org/programs/eps/si\\_se\\_epsindex.html](http://www.sonoran.org/programs/eps/si_se_epsindex.html).

- Spencer, J.S. 1966. Arizona's Forest. Resource Bulletin INT-6. Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 64 p.
- Stark, R.W. 1982. Generalized ecology and life cycle of bark beetles. Mitton, J.B. and K.B. Sturgeon, eds. Bark beetles in North American conifers, a system for the study of evolutionary biology. Austin, TX: University of Texas Press: 21–25.
- Swetnam, T.W. 1990. Fire history and climate in the southwestern United States. Krammes, J.S., tech. coord. Proceedings of the symposium, Effects of fire management of Southwestern natural resources; 1988 November 15–17; Tucson, AZ. General Technical Report RM–191. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Range and Experiment Station: 6–17.
- Swetnam, T.W. and C.H. Baisan. 1996. Historical fire regime patterns in the southwestern United States since A.D. 1700. Allen, C.D. tech. ed. Proceedings of the 2nd La Mesa Fire symposium; Fire effects in southwestern forests. General Technical Report RM–GTR–286. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Range and Experiment Station: 11–32.
- Theobald, D.M. 2003. Targeting conservation action through assessment of protection and exurban threats. *Conservation Biology*. 17:1624-1637.
- Veblen, T.T., K.S. Hadley, E.M. Nel, T. Kitzberger, M. Reid, and R. Villalba. 1994. Disturbance regime and disturbance interaction in a Rocky Mountain subalpine forest. *Journal of Ecology*. 82:125–135.
- White Mountains of Arizona, Demographic Profile 4 – Total Building Permits. 1998-2002. Show Low, AZ: White Mountain Regional Development Corporation. Accessed June 2004, available at <http://www.wmrdc.org/>.
- Woolsey, T.S., Jr. 1911. Western yellow pine in Arizona and New Mexico. Bulletin 101. Washington, DC: U.S. Department of Agriculture, Forest Service.
- Wozniak, F.E. 1987. Irrigation in the Rio Grande Valley, New Mexico: a study of the development of irrigation systems before 1945. Santa Fe, NM: New Mexico Historic Preservation Division.
- Witcher, J.C., C. Stone, and W.R. Hahman. 1982. Geothermal resources of Arizona State of Arizona Bureau of Geology and Mineral Technology. Tucson, AZ: University of Arizona.
- USDA. 1997. Timber Product Output. U.S. Department of Agriculture, Forest Service. Accessed April 2004, available at [http://www.fs.fed.us/rm/ogden/data\\_retrieval.html](http://www.fs.fed.us/rm/ogden/data_retrieval.html).
- USDA. 2003a. Forest Legacy Program implementation guidelines. Washington, DC: U.S. Department of Agriculture, Forest Service.

USDA. 2003b. Draft RPA 2002 Forest Resource Tables. St. Paul, MN: U.S. Department of Agriculture, Forest Service. Accessed April 2004, available at [http://ncrs2.fs.fed.us/4801/fiadb/rpa\\_table/2002\\_rpa\\_draft\\_tables.htm](http://ncrs2.fs.fed.us/4801/fiadb/rpa_table/2002_rpa_draft_tables.htm).

USDA. 2004a. Managing arid and semi-arid watersheds. Flagstaff, AZ: U.S. Department of Agriculture, Forest Service and University of Arizona. Accessed April 2004, available at <http://ag.arizona.edu/OALS/watershed/index.html>.

USDA. 2004b. Ecological Site Descriptions. U.S. Department of Agriculture, Natural Resource Conservation Service, Arizona. Accessed April 2004, available at <http://cals.arizona.edu/agnic/az/siteguides/> and <http://www.az.nrcs.usda.gov/>.

U.S. Geological Survey (USGS). 1998. Arizona Gap Analysis Program (GAP). U.S. Geological Survey, Cooperative Park Studies Unit, University of Arizona, Tucson, AZ.

Appendix A: Vegetation communities comprising forest types for Arizona’s Forest Legacy Program.

Arizona Forest Legacy Program-Forest Type	Gap vegetation categories (1998)	Biotic Communities (Brown 1994)
Madrean Oak Woodland	<ul style="list-style-type: none"> <li>Encinal Mixed Oak</li> <li>Encinal Mixed Oak-Mesquite</li> <li>Encinal Mixed Oak-Mexican Mixed Pine</li> <li>Encinal Mixed Oak-Mexican Pine-Juniper</li> <li>Encinal Mixed Oak-Pinyon-Juniper</li> <li>Encinal Mixed Oak/Mix Chaparral/Semidesert Grassland-Mix Scrub</li> </ul>	<ul style="list-style-type: none"> <li>Madrean Evergreen Woodland</li> <li>Interior Chaparral</li> </ul>
Pinyon-Juniper Woodland	<ul style="list-style-type: none"> <li>GB Big Sagebrush-Juniper-Pinyon</li> <li>GB Juniper</li> <li>PJ (Mixed)/Mixed Chaparral-Scrub</li> <li>PJ-Shrub/Ponderosa Pine-Gambel Oak-Juniper</li> <li>PJ/Sagebrush/Mixed Grass-Scrub</li> <li>Pinyon-Juniper (Mixed)</li> <li>Pinyon-Juniper-Mixed Grass-Scrub</li> <li>Pinyon-Juniper-Mixed Shrub</li> <li>Pinyon-Juniper-Shrub Live Oak-Mixed Shrub</li> </ul>	Great Basin Conifer Woodland
Mixed Conifer	<ul style="list-style-type: none"> <li>Arizona Cypress</li> <li>Douglas Fir-Mixed Conifer</li> <li>Englemann Spruce-Mixed Conifer</li> <li>Ponderosa Pine</li> <li>Ponderosa Pine-Gambel Oak-Juniper/Pinyon-Juniper Complex</li> <li>Ponderosa Pine-Mixed Conifer</li> <li>Ponderosa Pine-Mixed Oak-Juniper</li> <li>Ponderosa Pine/Pinyon-Juniper</li> <li>Ponderosa Pine-Mixed Conifer/Shrub Live Oak</li> </ul>	<ul style="list-style-type: none"> <li>Subalpine Conifer Forest</li> <li>Rocky Mountain and Madrean Montane Conifer Forest</li> </ul>
Riparian Forests	<ul style="list-style-type: none"> <li>GB Riparian Forest/Mixed Riparian Scrub</li> <li>GB Riparian/Cottonwood-Willow Forest</li> <li>Int. Riparian/Cottonwood-Willow Forest</li> <li>Int. Riparian/Mesquite Forest</li> <li>Int. Riparian/Mixed Broadleaf Forest</li> <li>Son. Riparian/Cottonwood-Mesquite Forest</li> <li>Son. Riparian/Cottonwood-Willow Forest</li> <li>Son. Riparian/Leguminous Short-Tree Forest/Scrub</li> <li>Son. Riparian/Mesquite Forest</li> <li>Son. Riparian/Mixed Broadleaf Forest</li> <li>Son. Riparian/Mixed Riparian Scrub</li> <li>Cottonwood-Willow*</li> <li>Mesquite*</li> <li>Conifer Oak*</li> <li>Mixed Broadleaf*</li> <li>Tamarisk and Russian Olive*</li> </ul>	<ul style="list-style-type: none"> <li>Montane Riparian Forest/Wetlands</li> <li>Plains and Great Basin Riparian Forest/Wetlands</li> <li>Riparian Deciduous Forests and Woodlands</li> <li>Sonoran Riparian Deciduous Forest and Woodlands</li> </ul>

\* From AZ Game and Fish Department riparian vegetation 1993-1994

Appendix B: Complete list of spatial layers used in the Assessment of Need preparation and analyses.

<b>Spatial Layer</b>	<b>Source of Information</b>
Arizona GAP Vegetation	Arizona Gap Analysis Program (GAP). U.S. Geological Survey
Conservation Areas	The Nature Conservancy, Arizona Chapter
County Boundaries	ALRIS, Arizona State Land Department
Cultural Information	Arizona State Museum
Ecological Value	The Nature Conservancy, Arizona Chapter
Housing Density	Bureau of Land Management, State Office
Insect Outbreak	USDA Forest Service
Land Ownership	ALRIS, Arizona State Land Department
Perennial Water	ALRIS, Arizona State Land Department
Public Value	The Nature Conservancy, Arizona Chapter
Recreation Opportunities	The Nature Conservancy, Arizona Chapter
Riparian Vegetation	ALRIS, Arizona State Land Department
Development Areas	The Nature Conservancy, Arizona Chapter
Developed Areas	Mohave County GIS Department
Developed Areas	Coconino County GIS Department
Developed Areas	Yavapai County GIS Department
Developed Areas	Pima County GIS Department
Road Impact	The Nature Conservancy, Arizona Chapter
Roads (all classes)	ALRIS, Arizona State Land Department
Scenic Roads	ALRIS, Arizona State Land Department
Special Status Species	Arizona Game and Fish Department

Appendix C: Tree species in Arizona's timberland (T) or woodland (W)

Alligator juniper (*Juniperus deppeana*) W  
Apache pine (*Pinus engelmannii*) T  
Arizona cypress (*Cypressus arizonica*) T  
Arizona pinyon pine (*Pinus edulis* var. *fallax*) W  
Arizona white oak (*Quercus Arizonica*) W  
Aspen (*Populus tremuloides*) T  
Bigtooth maple (*Acer grandidentatum*) W  
Blue spruce (*Picea pungens*) T  
Border pinyon (*Pinus discolor*) W  
Boxelder (*Acer negundo*) T  
California juniper (*Juniperus californica*) W  
Chihuahua pine (*Pinus leiophylla*) T  
Corkbark fir (*Abies lasiocarpa* var. *arizonica*) T  
Cottonwood (*Populus* sp.) T  
Desert ironwood (*Olneya tesota*) W  
Douglas-fir (*Pseudotsuga menziesii*) T  
Emory oak (*Quercus emoryi*) W  
Engelmann spruce (*Picea engelmannii*) T  
Gambel oak (*Quercus gambelii*) W  
Mexican blue oak (*Quercus oblongifolia*) W  
Mexican pinyon pine (*Pinus cembroides*) W  
New Mexico locust (*Robinia neomexicana* var. *neomexicana*) W  
Oneseed juniper (*Juniperus monosperma*) W  
Ponderosa pine (*Pinus ponderosa*) T  
Rocky Mountain juniper (*Juniperus scopulorum*) W  
Rocky Mountain maple (*Acer glabrum*) W  
Redberry juniper (*Juniperous erythrocarpa*) W  
Silverleaf oak (*Quercus hypoleucoides*) W  
Singleleaf pinyon (*Pinus monophylla*) W  
Southwestern white pine (*Pinus strobiformis*) T  
Subalpine fir (*Abies lasiocarpa*) T  
Tamarisk (*Tamarix* sp.) W  
Twoneedle pinyon (*Pinus edulis*) W  
Utah juniper (*Juniperus osteosperma*) W  
Velvet mesquite (*Prosopis velutina*) W  
Western honey mesquite (*Prosopis glandulosa* v. *torreyana*) W  
White fir (*Abies concolor*) T

Appendix D: Private forest acres by county for each forest type.

County	Forest Type	Acres
Apache	Conifer Forest	6,722
	Madrean Oak Woodlands	0
	Pinyon Juniper Woodlands	337,766
	Riparian Forest	3,469
	<b>Total</b>	<b>347,957</b>
Cochise	Conifer Forest	272
	Madrean Oak Woodlands	66,905
	Pinyon Juniper Woodlands	0
	Riparian Forest	9,530
	<b>Total</b>	<b>76,707</b>
Coconino	Conifer Forest	78,710
	Madrean Oak Woodlands	0
	Pinyon Juniper Woodlands	658,534
	Riparian Forest	960
	<b>Total</b>	<b>738,204</b>
Gila	Conifer Forest	5,273
	Madrean Oak Woodlands	2,311
	Pinyon Juniper Woodlands	11,807
	Riparian Forest	2,642
	<b>Total</b>	<b>22,034</b>
Graham	Conifer Forest	0
	Madrean Oak Woodlands	2,351
	Pinyon Juniper Woodlands	844
	Riparian Forest	6,085
	<b>Total</b>	<b>9,279</b>
Greenlee	Conifer Forest	2,821
	Madrean Oak Woodlands	3,517
	Pinyon Juniper Woodlands	8,998
	Riparian Forest	2,344
	<b>Total</b>	<b>17,680</b>
LaPaz	Conifer Forest	0
	Madrean Oak Woodlands	0
	Pinyon Juniper Woodlands	0
	Riparian Forest	1,805
	<b>Total</b>	<b>1,805</b>

---

Maricopa	Conifer Forest	0
	Madrean Oak Woodlands	0
	Pinyon Juniper Woodlands	190
	Riparian Forest	12,257
	<b>Total</b>	<b>12,447</b>
Mohave	Conifer Forest	985
	Madrean Oak Woodlands	2,234
	Pinyon Juniper Woodlands	297,122
	Riparian Forest	20,862
	<b>Total</b>	<b>321,204</b>
Navajo	Conifer Forest	18,720
	Madrean Oak Woodlands	0
	Pinyon Juniper Woodlands	399,116
	Riparian Forest	23,777
	<b>Total</b>	<b>441,613</b>
Pima	Conifer Forest	760
	Madrean Oak Woodlands	4,511
	Pinyon Juniper Woodlands	0
	Riparian Forest	6,844
	<b>Total</b>	<b>12,115</b>
Pinal	Conifer Forest	0
	Madrean Oak Woodlands	5,306
	Pinyon Juniper Woodlands	354
	Riparian Forest	9,822
	<b>Total</b>	<b>15,483</b>
Santa Cruz	Conifer Forest	0
	Madrean Oak Woodlands	16,855
	Pinyon Juniper Woodlands	0
	Riparian Forest	4,307
	<b>Total</b>	<b>21,162</b>
Yavapai	Conifer Forest	23,269
	Madrean Oak Woodlands	12,686
	Pinyon Juniper Woodlands	625,902
	Riparian Forest	4,062
	<b>Total</b>	<b>665,919</b>
Yuma	Conifer Forest	0
	Madrean Oak Woodlands	0
	Pinyon Juniper Woodlands	0
	Riparian Forest	2,419
	<b>Total</b>	<b>2,419</b>

---

Appendix E: List of all of the U.S. Department of Interior Fish and Wildlife Service’s listed endangered (E), threatened (T), candidate (C) or of special concern (SC) species, the Bureau of Land Management’s (BLM) sensitive species (S), the United States Forest Service’s (USFS) sensitive species (S), as well as Arizona Game and Fish Department’s Wildlife of Special Concern in Arizona (WSC) species that exist within private forest land by county.

County	Scientific Name	Common Name	Category	ESA Listing	BLM Sensitive Species	USFS Sensitive Species	AGFD Wildlife of Special Concern in Arizona
<b>Apache</b>							
	<i>Anodonta californiensis</i>	California Floater	Invertebrate Animal	SC		S	
	<i>Daihinibaenetes arizonensis</i>	Arizona Giant Sand Treader Cricket	Invertebrate Animal	SC	S	S	
	<i>Psephenus montanus</i>	White Mountains Water Penny Beetle	Invertebrate Animal	SC		S	
	<i>Pyrgulopsis trivialis</i>	Three Forks Springsnail	Invertebrate Animal	C	S	S	
	<i>Allium gooddingii</i>	Goodding Onion	Vascular Plant	SC		S	
	<i>Astragalus nutriosensis</i>	Nutrioso Milk-vetch	Vascular Plant	SC			
	<i>Calypso bulbosa</i>	Western Fairy Slipper	Vascular Plant				
	<i>Castilleja mogollonica</i>	White Mountains Paintbrush	Vascular Plant	SC		S	
	<i>Goodyera repens</i>	Lesser Rattlesnake Plantain	Vascular Plant				
	<i>Ipomoea plummerae</i> var. <i>cuneifolia</i>	Huachuca Morning Glory	Vascular Plant			S	
	<i>Malaxis porphyrea</i>	Purple Adder's Mouth	Vascular Plant				
	<i>Platanthera hyperborea</i>	Boreal Bog Orchid	Vascular Plant				
	<i>Platanthera purpurascens</i>	Slender Bog Orchid	Vascular Plant				
	<i>Rumex orthoneurus</i>	Blumer's Dock	Vascular Plant	SC		S	
	<i>Salix arizonica</i>	Arizona Willow	Vascular Plant			S	
	<i>Senecio quaerens</i>	Gila Groundsel	Vascular Plant	SC		S	
	<i>Stellaria porsildii</i>	Porsild's Starwort	Vascular Plant			S	
	<i>Streptopus amplexifolius</i>	White Mandarin Twisted Stalk	Vascular Plant				
	<i>Trifolium neurophyllum</i>	White Mountains Clover	Vascular Plant	SC		S	
	<i>Zigadenus virescens</i>	Green Death Camas	Vascular Plant				

<i>Accipiter gentilis</i>	Northern Goshawk	Vertebrate Animal	SC		S	WSC
<i>Bufo microscaphus</i>	Arizona Toad	Vertebrate Animal	SC		S	
<i>Catharus fuscescens</i>	Veery	Vertebrate Animal				WSC
<i>Catostomus clarki</i>	Desert Sucker	Vertebrate Animal	SC	S		
<i>Catostomus insignis</i>	Sonora Sucker	Vertebrate Animal	SC	S		
<i>Catostomus sp. 3</i>	Little Colorado Sucker	Vertebrate Animal	SC	S	S	WSC
<i>Ceryle alcyon</i>	Belted Kingfisher	Vertebrate Animal				WSC
<i>Charadrius montanus</i>	Mountain Plover	Vertebrate Animal	PT		S	
<i>Coccyzus americanus occidentalis</i>	Western Yellow-billed Cuckoo	Vertebrate Animal	C		S	WSC
<i>Dolichonyx oryzivorus</i>	Bobolink	Vertebrate Animal				WSC
<i>Dumetella carolinensis</i>	Gray Catbird	Vertebrate Animal				WSC
<i>Empidonax traillii extimus</i>	Southwestern Willow Flycatcher	Vertebrate Animal	LE		S	WSC
<i>Euderma maculatum</i>	Spotted Bat	Vertebrate Animal	SC	S		WSC
<i>Euptilotis neoxenus</i>	Eared Quetzal	Vertebrate Animal			S	
<i>Falco peregrinus anatum</i>	American Peregrine Falcon	Vertebrate Animal	SC		S	WSC
<i>Haliaeetus leucocephalus</i>	Bald Eagle	Vertebrate Animal	LT		S	WSC
<i>Idionycteris phyllotis</i>	Allen's Big-eared Bat	Vertebrate Animal	SC	S		
<i>Lepidomeda vittata</i>	Little Colorado Spinedace	Vertebrate Animal	LT		S	WSC
<i>Myotis volans</i>	Long-legged Myotis	Vertebrate Animal	SC	S		
<i>Oncorhynchus apache</i>	Apache (Arizona) Trout	Vertebrate Animal	LT		S	WSC

<i>Pandion haliaetus</i>	Osprey	Vertebrate Animal				WSC
<i>Perognathus flavus goodpasteri</i>	Springerville Pocket Mouse	Vertebrate Animal	SC		S	
<i>Pinicola enucleator</i>	Pine Grosbeak	Vertebrate Animal				WSC
<i>Rana chiricahuensis</i>	Chiricahua Leopard Frog	Vertebrate Animal	LT		S	WSC
<i>Rana pipiens</i>	Northern Leopard Frog	Vertebrate Animal			S	WSC
<i>Rana yavapaiensis</i>	Lowland Leopard Frog	Vertebrate Animal	SC		S	WSC
<i>Rhinichthys osculus</i>	Speckled Dace	Vertebrate Animal	SC	S		
<i>Setophaga ruticilla</i>	American Redstart	Vertebrate Animal				WSC
<i>Sorex palustris</i>	Water Shrew	Vertebrate Animal				WSC
<i>Spermophilus tridecemlineatus monticola</i>	White Mountains Ground Squirrel	Vertebrate Animal			S	
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Vertebrate Animal	LT		S	WSC
<i>Thamnophis rufipunctatus</i>	Narrow-headed Gartersnake	Vertebrate Animal	SC		S	WSC
<i>Tiaroga cobitis</i>	Loach Minnow	Vertebrate Animal	LT		S	WSC
<i>Zapus hudsonius luteus</i>	New Mexican Jumping Mouse	Vertebrate Animal	SC		S	WSC
<b>Cochise</b>						
<i>Agathymus aryxna</i>	Arizona Giant Skipper	Invertebrate Animal			S	
<i>Agathymus evansi</i>	Huachuca Giant-skipper	Invertebrate Animal			S	
<i>Agathymus neumogeni</i>	Neumogen's Giant Skipper	Invertebrate Animal			S	
<i>Cicindela oregona maricopa</i>	Maricopa Tiger Beetle	Invertebrate Animal	SC	S	S	

<i>Erynnis scudderii</i>	Scudder's Dusky Wing	Invertebrate Animal			S
<i>Neophasia terlootii</i>	Chiricahua Pine White	Invertebrate Animal			S
<i>Psephenus arizonensis</i>	Arizona Water Penny Beetle	Invertebrate Animal	SC		S
<i>Pyrgulopsis thompsoni</i>	Huachuca Springsnail	Invertebrate Animal	C	S	S
<i>Stygobromus arizonensis</i>	Arizona Cave Amphipod	Invertebrate Animal	SC		S
<i>Sympetrum signiferum</i>	Mexican Meadowfly	Invertebrate Animal			S
<i>Allium plummerae</i>	Plummer Onion	Vascular Plant			
<i>Ammocodon chenopodioides</i>	Goosefoot Moonpod	Vascular Plant		S	
<i>Apacheria chiricahuensis</i>	Chiricahua Rock Flower	Vascular Plant			
<i>Arabis tricornuta</i>	Chiricahua Rock Cress	Vascular Plant			S
<i>Asclepias lemmonii</i>	Lemmon Milkweed	Vascular Plant			S
<i>Asplenium dalhousiae</i>	Dalhouse Spleenwort	Vascular Plant		S	
<i>Astragalus cobrensis</i> var. <i>maguirei</i>	Coppermine Milk-vetch	Vascular Plant	SC		S
<i>Astragalus hypoxylus</i>	Huachuca Milk-vetch	Vascular Plant	SC	S	S
<i>Carex chihuahuensis</i>	A Sedge	Vascular Plant			S
<i>Carex ultra</i>	Arizona Giant Sedge	Vascular Plant		S	S
<i>Castilleja nervata</i>	Trans-pecos Indian-paintbrush	Vascular Plant			S
<i>Cleome multicaulis</i>	Playa Spider Plant	Vascular Plant	SC		
<i>Coryphantha robbinsorum</i>	Cochise Pincushion Cactus	Vascular Plant	LT		
<i>Coryphantha robbinsorum</i>	Cochise Pincushion Cactus	Vascular Plant	LT		
<i>Coryphantha scheeri</i> var. <i>valida</i>	Slender Needle Corycactus	Vascular Plant			
<i>Coryphantha strobiliformis</i>	Cob Corycactus	Vascular Plant			
<i>Coursetia glabella</i>		Vascular Plant	SC		S
<i>Croton fruticosus</i>	Encinillas	Vascular Plant		S	
<i>Draba standleyi</i>	Standley Whitlow-grass	Vascular Plant	SC		

<i>Echinocereus ledingii</i>	Pinaleno Hedgehog Cactus	Vascular Plant			
<i>Echinocereus pectinatus</i> <i>var. pectinatus</i>	Texas Rainbow Cactus	Vascular Plant			
<i>Epithelantha micromeris</i>	Button Cactus	Vascular Plant			
<i>Epithelantha micromeris</i>	Button Cactus	Vascular Plant			
<i>Erigeron arisolius</i>		Vascular Plant			S
<i>Erigeron kuschei</i>	Chiricahua Fleabane	Vascular Plant	SC		S
<i>Erigeron lemmonii</i>	Lemmon Fleabane	Vascular Plant	C		
<i>Eriogonum capillare</i>	San Carlos Wild-buckwheat	Vascular Plant	SC		
<i>Euphorbia macropus</i>	Woodland Spurge	Vascular Plant	SC		
<i>Gentianella wislizeni</i>	Wislizeni Gentian	Vascular Plant	SC		S
<i>Graptopetalum bartramii</i>	Bartram Stonecrop	Vascular Plant	SC	S	S
<i>Hedeoma costatum</i>	Chiricahua Mock Pennyroyal	Vascular Plant			S
<i>Hedeoma dentatum</i>	Mock-pennyroyal	Vascular Plant			S
<i>Heterotheca rutteri</i>	Huachuca Golden Aster	Vascular Plant	SC	S	S
<i>Heuchera glomerulata</i>	Arizona Alum Root	Vascular Plant			S
<i>Hexalectris revoluta</i>	Chisos Coral-root	Vascular Plant		S	S
<i>Hexalectris spicata</i>	Crested Coral Root	Vascular Plant			
<i>Hexalectris warnockii</i>	Texas Purple Spike	Vascular Plant	SC	S	S
<i>Hieracium pringlei</i>	Pringle Hawkweed	Vascular Plant	SC		S
<i>Hieracium rusbyi</i>	Rusby Hawkweed	Vascular Plant			S
<i>Ibervillea tenuisecta</i>	Texas Globe Berry	Vascular Plant		S	
<i>Ipomoea plummerae</i> <i>var.</i> <i>cuneifolia</i>	Huachuca Morning Glory	Vascular Plant			S
<i>Ipomoea thurberi</i>	Thurber's Morning-glory	Vascular Plant			S
<i>Laennecia eriophylla</i>	Woolly Fleabane	Vascular Plant			S
<i>Lilaeopsis schaffneriana</i> <i>var. recurva</i>	Huachuca Water Umbel	Vascular Plant	LE		
<i>Lilium parryi</i>	Lemmon Lily	Vascular Plant	SC		S
<i>Lithospermum viride</i>	Green Puccoon	Vascular Plant		S	
<i>Lobelia fenestralis</i>	Leafy Lobelia	Vascular Plant			
<i>Lupinus huachucanus</i>	Huachuca Mountain Lupine	Vascular Plant			S
<i>Lupinus lemmonii</i>	Lemmon's Lupine	Vascular Plant			S

---

<i>Malaxis corymbosa</i>	Madrean Adders Mouth	Vascular Plant			
<i>Malaxis porphyrea</i>	Purple Adder's Mouth	Vascular Plant			
<i>Malaxis tenuis</i>	Slender Adders Mouth	Vascular Plant			
<i>Malaxis tenuis</i>	Slender Adders Mouth	Vascular Plant			
<i>Mammillaria viridiflora</i>	Varied Fishhook Cactus	Vascular Plant			
<i>Mammillaria wrightii</i> var. <i>wilcoxii</i>	Wilcox Fishhook Cactus	Vascular Plant			
<i>Metastelma mexicanum</i>	Wiggins Milkweed Vine	Vascular Plant	SC		S
<i>Muhlenbergia dubioides</i>	Box Canyon Muhly	Vascular Plant			S
<i>Pectis imberbis</i>	Beardless Chinch Weed	Vascular Plant	SC		S
<i>Peniocereus greggii</i> var. <i>greggii</i>	Night-blooming Cereus	Vascular Plant	SC		
<i>Penstemon discolor</i>	Catalina Beardtongue	Vascular Plant			S
<i>Penstemon ramosus</i>	Branching Penstemon	Vascular Plant			S
<i>Penstemon superbus</i>	Superb Beardtongue	Vascular Plant			S
<i>Perityle cochisensis</i>	Chiricahua Rock Daisy	Vascular Plant			S
<i>Physalis latiphysa</i>	Broad-leaf Ground-cherry	Vascular Plant			S
<i>Platanthera limosa</i>	Thurber's Bog Orchid	Vascular Plant			
<i>Polemonium pauciflorum</i> ssp. <i>hinckleyi</i>	Hinckley's Ladder	Vascular Plant	SC		S
<i>Psilactis gentryi</i>	Mexican Bare-ray-aster	Vascular Plant			S
<i>Rumex orthoneurus</i>	Blumer's Dock	Vascular Plant	SC		S
<i>Salvia amissa</i>	Aravaipa Sage	Vascular Plant	SC	S	S
<i>Samolus vagans</i>	Chiricahua Mountain Brookweed	Vascular Plant			S
<i>Schiedeella parasitica</i>	Fallen Ladies'-tresses	Vascular Plant			
<i>Senecio carlomasonii</i>	Seemann Groundsel	Vascular Plant			S
<i>Senecio huachucanus</i>	Huachuca Groundsel	Vascular Plant			S
<i>Senecio neomexicanus</i> var. <i>toumeyi</i>	Toumey Groundsel	Vascular Plant			S
<i>Sisyrinchium cernuum</i>	Nodding Blue-eyed Grass	Vascular Plant			S
<i>Stellaria porsildii</i>	Porsild's Starwort	Vascular Plant			S
<i>Stenorrhynchos</i> <i>michuacanum</i>	Michoacan Ladies'-tresses	Vascular Plant			

---

<i>Talinum marginatum</i>	Tepic Flame Flower	Vascular Plant	SC		S	
<i>Tephrosia thurberi</i>	Thurber Hoary Pea	Vascular Plant			S	
<i>Tragia laciniata</i>	Sonoran Noseburn	Vascular Plant			S	
<i>Vauquelinia californica</i> <i>ssp. pauciflora</i>	Limestone Arizona Rosewood	Vascular Plant	SC			
<i>Viola umbraticola</i>	Shade Violet	Vascular Plant			S	
<i>Zigadenus virescens</i>	Green Death Camas	Vascular Plant				
<i>Accipiter gentilis</i>	Northern Goshawk	Vertebrate Animal	SC		S	WSC
<i>Agosia chrysogaster</i>	Longfin Dace	Vertebrate Animal	SC	S		
<i>Amazilia beryllina</i>	Berylline Hummingbird	Vertebrate Animal			S	
<i>Amazilia violiceps</i>	Violet-crowned Hummingbird	Vertebrate Animal			S	WSC
<i>Ambystoma tigrinum</i> <i>stebbinsi</i>	Sonoran Tiger Salamander	Vertebrate Animal	LE			WSC
<i>Ammodramus bairdii</i>	Baird's Sparrow	Vertebrate Animal	SC			WSC
<i>Anthus spragueii</i>	Sprague's Pipit	Vertebrate Animal				WSC
<i>Aspidoscelis burti</i> <i>stictogrammus</i>	Giant Spotted Whiptail	Vertebrate Animal	SC	S	S	
<i>Asturina nitida maxima</i>	Northern Gray Hawk	Vertebrate Animal	SC	S	S	WSC
<i>Buteogallus anthracinus</i>	Common Black-hawk	Vertebrate Animal			S	WSC
<i>Campostoma ornatum</i>	Mexican Stoneroller	Vertebrate Animal	SC		S	WSC
<i>Catostomus clarki</i>	Desert Sucker	Vertebrate Animal	SC	S		
<i>Catostomus insignis</i>	Sonora Sucker	Vertebrate Animal	SC	S		
<i>Choeronycteris mexicana</i>	Mexican Long-tongued Bat	Vertebrate Animal	SC	S		WSC
<i>Coccyzus americanus</i> <i>occidentalis</i>	Western Yellow-billed Cuckoo	Vertebrate Animal	C		S	WSC
<i>Corynorhinus townsendii</i> <i>pallescens</i>	Pale Townsend's Big-eared Bat	Vertebrate Animal	SC			

<i>Crotalus willardi willardi</i>	Arizona Ridge-nosed Rattlesnake	Vertebrate Animal			S	WSC
<i>Cyprinella formosa</i>	Beautiful Shiner	Vertebrate Animal	LT			WSC
<i>Dendrocygna autumnalis</i>	Black-bellied Whistling-duck	Vertebrate Animal				WSC
<i>Eleutherodactylus augusti cactorum</i>	Western Barking Frog	Vertebrate Animal			S	WSC
<i>Empidonax fulvifrons pygmaeus</i>	Northern Buff-breasted Flycatcher	Vertebrate Animal	SC			WSC
<i>Empidonax traillii extimus</i>	Southwestern Willow Flycatcher	Vertebrate Animal	LE		S	WSC
<i>Eumops perotis californicus</i>	Greater Western Mastiff Bat	Vertebrate Animal	SC			
<i>Eumops perotis californicus</i>	Greater Western Mastiff Bat	Vertebrate Animal	SC			
<i>Euptilotis neoxenus</i>	Eared Quetzal	Vertebrate Animal			S	
<i>Falco peregrinus anatum</i>	American Peregrine Falcon	Vertebrate Animal	SC		S	WSC
<i>Gila intermedia</i>	Gila Chub	Vertebrate Animal	PE		S	WSC
<i>Gila purpurea</i>	Yaqui Chub	Vertebrate Animal	LE			WSC
<i>Gila robusta</i>	Roundtail Chub	Vertebrate Animal	SC		S	WSC
<i>Gopherus agassizii (Sonoran population)</i>	Sonoran Desert Tortoise	Vertebrate Animal	SC			WSC
<i>Ictalurus pricei</i>	Yaqui Catfish	Vertebrate Animal	LT			WSC
<i>Ictinia mississippiensis</i>	Mississippi Kite	Vertebrate Animal				WSC
<i>Idionycteris phyllotis</i>	Allen's Big-eared Bat	Vertebrate Animal	SC	S		
<i>Lasiurus blossevillii</i>	Western Red Bat	Vertebrate Animal				WSC
<i>Lasiurus xanthinus</i>	Western Yellow Bat	Vertebrate Animal				WSC
<i>Leptonycteris curasoae yerbabuena</i>	Lesser Long-nosed Bat	Vertebrate Animal	LE		S	WSC

<i>Myotis ciliolabrum</i>	Western Small-footed Myotis	Vertebrate Animal	SC	S		
<i>Myotis thysanodes</i>	Fringed Myotis	Vertebrate Animal	SC	S		
<i>Myotis velifer</i>	Cave Myotis	Vertebrate Animal	SC	S		
<i>Myotis volans</i>	Long-legged Myotis	Vertebrate Animal	SC	S		
<i>Nyctinomops femorosaccus</i>	Pocketed Free-tailed Bat	Vertebrate Animal		S		
<i>Nyctinomops macrotis</i>	Big Free-tailed Bat	Vertebrate Animal	SC	S		
<i>Panthera onca</i>	Jaguar	Vertebrate Animal	LE		S	WSC
<i>Phrynosoma cornutum</i>	Texas Horned Lizard	Vertebrate Animal	SC	S		
<i>Plegadis chihi</i>	White-faced Ibis	Vertebrate Animal	SC	S		
<i>Poeciliopsis occidentalis sonoriensis</i>	Yaqui Topminnow	Vertebrate Animal	LE			WSC
<i>Rana blairi</i>	Plains Leopard Frog	Vertebrate Animal				WSC
<i>Rana chiricahuensis</i>	Chiricahua Leopard Frog	Vertebrate Animal	LT		S	WSC
<i>Rana subaquavocalis</i>	Ramsey Canyon Leopard Frog	Vertebrate Animal	SC		S	
<i>Rana yavapaiensis</i>	Lowland Leopard Frog	Vertebrate Animal	SC		S	WSC
<i>Rhinichthys osculus</i>	Speckled Dace	Vertebrate Animal	SC	S		
<i>Sciurus nayaritensis chiricahuae</i>	Chiricahua Fox Squirrel	Vertebrate Animal	SC		S	
<i>Sigmodon ochrognathus</i>	Yellow-nosed Cotton Rat	Vertebrate Animal	SC			
<i>Sistrurus catenatus edwardsii</i>	Desert Massasauga	Vertebrate Animal			S	WSC
<i>Sorex arizonae</i>	Arizona Shrew	Vertebrate Animal	SC		S	WSC
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Vertebrate Animal	LT		S	WSC

<i>Thamnophis eques megalops</i>	Northern Mexican Gartersnake	Vertebrate Animal	SC		S	WSC
<i>Thomomys bottae mearnsi</i>	Mearns' Southern Pocket Gopher	Vertebrate Animal	SC			
<i>Trogon elegans</i>	Elegant Trogon	Vertebrate Animal				WSC
<i>Tyrannus melancholicus</i>	Tropical Kingbird	Vertebrate Animal				WSC
<b>Coconino</b>						
<i>Anodonta californiensis</i>	California Floater	Invertebrate Animal	SC		S	
<i>Archeolarca cavicola</i>	Grand Canyon Cave Pseudoscorpion	Invertebrate Animal	SC			
<i>Cicindela oregona maricopa</i>	Maricopa Tiger Beetle	Invertebrate Animal	SC	S	S	
<i>Discus shimekii cockerelli</i>	Cockerell's Striate Disc (Snail)	Invertebrate Animal	SC	S		
<i>Metrichia nigrutta</i>	Page Spring Micro Caddisfly	Invertebrate Animal	SC			
<i>Oxyloma haydeni haydeni</i>	Niobrara Ambersnail	Invertebrate Animal			S	S
<i>Allium bigelovii</i>	Bigelow Onion	Vascular Plant				
<i>Amsonia peeblesii</i>	Peebles Blue Star	Vascular Plant			S	
<i>Aquilegia desertorum</i>	Mogollon Columbine	Vascular Plant				
<i>Argemone arizonica</i>	Roaring Springs Prickly-poppy	Vascular Plant	SC			
<i>Artemisia pygmaea</i>	Pygmy Sagebrush	Vascular Plant			S	
<i>Astragalus cremnophylax</i> var. <i>cremnophylax</i>	Sentry Milk-vetch	Vascular Plant	LE			
<i>Astragalus cremnophylax</i> var. <i>myriorrhaphis</i>	Cliff Milk-vetch	Vascular Plant	SC	S		S
<i>Astragalus rusbyi</i>	Rusby's Milk-vetch	Vascular Plant				S
<i>Calypso bulbosa</i>	Western Fairy Slipper	Vascular Plant				
<i>Chrysothamnus molestus</i>	Tusayan Rabbitbrush	Vascular Plant	SC			S
<i>Cimicifuga arizonica</i>	Arizona Bugbane	Vascular Plant	SC			S
<i>Cirsium parryi</i> ssp. <i>mogollonicum</i>	Mogollon Thistle	Vascular Plant	SC			S

<i>Coryphantha missouriensis</i>	Missouri Corycactus	Vascular Plant				
<i>Erigeron saxatilis</i>	Rock Fleabane	Vascular Plant				S
<i>Eriogonum ericifolium</i> var. <i>ericifolium</i>	Heathleaf Wild-buckwheat	Vascular Plant				S
<i>Eriogonum ripleyi</i>	Ripley Wild-buckwheat	Vascular Plant	SC			S
<i>Errazurizia rotundata</i>	Roundleaf Errazurizia	Vascular Plant		S		
<i>Gentianopsis barbellata</i>	Bearded Gentian	Vascular Plant				S
<i>Hedeoma diffusum</i>	Flagstaff Pennyroyal	Vascular Plant				S
<i>Heuchera eastwoodiae</i>	Eastwood Alum Root	Vascular Plant				S
<i>Listera convallarioides</i>	Broadleaf Twayblade	Vascular Plant				
<i>Malaxis porphyrea</i>	Purple Adder's Mouth	Vascular Plant				
<i>Pediocactus bradyi</i>	Brady Pincushion Cactus	Vascular Plant	LE			
<i>Pediocactus paradinei</i>	Kaibab Pincushion Cactus	Vascular Plant	SC	S		S
<i>Pediocactus sileri</i>	Siler Pincushion Cactus	Vascular Plant	LT			
<i>Penstemon clutei</i>	Sunset Crater Beardtongue	Vascular Plant	SC			S
<i>Penstemon nudiflorus</i>	Flagstaff Beardtongue	Vascular Plant				S
<i>Phacelia serrata</i>	Cinder Phacelia	Vascular Plant	SC			
<i>Phacelia welshii</i>	Welsh Phacelia	Vascular Plant	SC			
<i>Pinus aristata</i>	Rocky Mountain Bristlecone Pine	Vascular Plant				
<i>Platanthera zothecina</i>	Alcove Bog-orchid	Vascular Plant	SC			
<i>Rosa stellata</i> ssp. <i>abyssa</i>	Grand Canyon Rose	Vascular Plant	SC	S		S
<i>Rumex orthoneurus</i>	Blumer's Dock	Vascular Plant	SC			S
<i>Sclerocactus sileri</i>	House Rock Fishhook Cactus	Vascular Plant				
<i>Senecio franciscanus</i>	San Francisco Peaks Groundsel	Vascular Plant	LT			
<i>Shepherdia argentea</i>	Silver Buffaloberry	Vascular Plant		S		
<i>Silene rectiramea</i>	Grand Canyon Catchfly	Vascular Plant	SC			
<i>Talinum validulum</i>	Tusayan Flame Flower	Vascular Plant	SC			
<i>Triteleia lemmoniae</i>	Mazatzal Triteleia	Vascular Plant				
<i>Zigadenus virescens</i>	Green Death Camas	Vascular Plant				
<i>Accipiter gentilis</i>	Northern Goshawk	Vertebrate Animal	SC		S	WSC
<i>Athene cucularia</i>	Western Burrowing Owl	Vertebrate	SC	S		

<i>hypugaea</i>		Animal				
<i>Bufo microscaphus</i>	Arizona Toad	Vertebrate Animal	SC		S	
<i>Buteo regalis</i>	Ferruginous Hawk	Vertebrate Animal	SC			WSC
<i>Buteogallus anthracinus</i>	Common Black-hawk	Vertebrate Animal			S	WSC
<i>Catostomus clarki</i>	Desert Sucker	Vertebrate Animal	SC	S		
<i>Catostomus insignis</i>	Sonora Sucker	Vertebrate Animal	SC	S		
<i>Catostomus sp. 3</i>	Little Colorado Sucker	Vertebrate Animal	SC	S	S	WSC
<i>Ceryle alcyon</i>	Belted Kingfisher	Vertebrate Animal				WSC
<i>Corynorhinus townsendii</i>	Pale Townsend's Big-eared Bat	Vertebrate Animal	SC			
<i>pallescens</i>						
<i>Crotalus viridis abyssus</i>	Grand Canyon Rattlesnake	Vertebrate Animal			S	
<i>Euderma maculatum</i>	Spotted Bat	Vertebrate Animal	SC	S		WSC
<i>Eumops perotis californicus</i>	Greater Western Mastiff Bat	Vertebrate Animal	SC			
<i>Euptilotis neoxenus</i>	Eared Quetzal	Vertebrate Animal			S	
<i>Falco peregrinus anatum</i>	American Peregrine Falcon	Vertebrate Animal	SC		S	WSC
<i>Gila intermedia</i>	Gila Chub	Vertebrate Animal	PE		S	WSC
<i>Gila robusta</i>	Roundtail Chub	Vertebrate Animal	SC		S	WSC
<i>Haliaeetus leucocephalus</i>	Bald Eagle	Vertebrate Animal	LT		S	WSC
<i>Idionycteris phyllotis</i>	Allen's Big-eared Bat	Vertebrate Animal	SC	S		
<i>Lasiurus blossevillii</i>	Western Red Bat	Vertebrate Animal				WSC
<i>Lepidomeda vittata</i>	Little Colorado Spinedace	Vertebrate Animal	LT		S	WSC

<i>Microtus mexicanus hualpaiensis</i>	Hualapai Mexican Vole	Vertebrate Animal	LE			WSC
<i>Microtus mexicanus navaho</i>	Navajo Mexican Vole	Vertebrate Animal	SC		S	WSC
<i>Myotis ciliolabrum</i>	Western Small-footed Myotis	Vertebrate Animal	SC		S	
<i>Myotis evotis</i>	Long-eared Myotis	Vertebrate Animal	SC		S	
<i>Myotis thysanodes</i>	Fringed Myotis	Vertebrate Animal	SC		S	
<i>Myotis volans</i>	Long-legged Myotis	Vertebrate Animal	SC		S	
<i>Nyctinomops macrotis</i>	Big Free-tailed Bat	Vertebrate Animal	SC		S	
<i>Oncorhynchus apache</i>	Apache (Arizona) Trout	Vertebrate Animal	LT		S	WSC
<i>Pandion haliaetus</i>	Osprey	Vertebrate Animal				WSC
<i>Perognathus amplus cineris</i>	Wupatki Arizona Pocket Mouse	Vertebrate Animal	SC		S	
<i>Pinicola enucleator</i>	Pine Grosbeak	Vertebrate Animal				WSC
<i>Plegadis chihi</i>	White-faced Ibis	Vertebrate Animal	SC		S	
<i>Rana blairi</i>	Plains Leopard Frog	Vertebrate Animal				WSC
<i>Rana chiricahuensis</i>	Chiricahua Leopard Frog	Vertebrate Animal	LT		S	WSC
<i>Rana pipiens</i>	Northern Leopard Frog	Vertebrate Animal			S	WSC
<i>Rana yavapaiensis</i>	Lowland Leopard Frog	Vertebrate Animal	SC		S	WSC
<i>Rhinichthys osculus</i>	Speckled Dace	Vertebrate Animal	SC		S	
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Vertebrate Animal	LT		S	WSC
<i>Thamnophis eques megalops</i>	Northern Mexican Gartersnake	Vertebrate Animal	SC		S	WSC
<i>Thamnophis rufipunctatus</i>	Narrow-headed Gartersnake	Vertebrate Animal	SC		S	WSC

---

**Gila**

<i>Agathon arizonicus</i>		Invertebrate Animal			S
<i>Cicindela oregona maricopa</i>	Maricopa Tiger Beetle	Invertebrate Animal	SC	S	S
<i>Pyrgulopsis simplex</i>	Fossil Springsnail	Invertebrate Animal	SC	S	S
<i>Pyrgulopsis sola</i>	Brown Springsnail	Invertebrate Animal	SC	S	S
<i>Abutilon parishii</i>	Pima Indian Mallow	Vascular Plant	SC		S
<i>Agave arizonica</i>	Arizona Agave	Vascular Plant	LE		S
<i>Agave delamateri</i>	Tonto Basin Agave	Vascular Plant	SC		S
<i>Agave murpheyi</i>	Hohokam Agave	Vascular Plant	SC	S	S
<i>Agave toumeyana</i> var. <i>bella</i>	Toumey Agave	Vascular Plant			
<i>Carex chihuahuensis</i>	A Sedge	Vascular Plant			S
<i>Cimicifuga arizonica</i>	Arizona Bugbane	Vascular Plant	SC		S
<i>Echinocereus triglochidiatus</i> var. <i>arizonicus</i>	Arizona Hedgehog Cactus	Vascular Plant	LE		S
<i>Erigeron anchana</i>	Mogollon Fleabane	Vascular Plant	SC		S
<i>Eriogonum capillare</i>	San Carlos Wild-buckwheat	Vascular Plant	SC		
<i>Fremontodendron californicum</i>	Flannel Bush	Vascular Plant		S	
<i>Heuchera eastwoodiae</i>	Eastwood Alum Root	Vascular Plant			S
<i>Listera convallarioides</i>	Broadleaf Twayblade	Vascular Plant			
<i>Mammillaria viridiflora</i>	Varied Fishhook Cactus	Vascular Plant			
<i>Osmorhiza brachypoda</i>	Sweet Cicely	Vascular Plant			S
<i>Penstemon nudiflorus</i>	Flagstaff Beardtongue	Vascular Plant			S
<i>Penstemon superbus</i>	Superb Beardtongue	Vascular Plant			S
<i>Perityle saxicola</i>	Fish Creek Rock Daisy	Vascular Plant	SC		S
<i>Phlox amabilis</i>	Arizona Phlox	Vascular Plant			S
<i>Rumex orthoneurus</i>	Blumer's Dock	Vascular Plant	SC		S
<i>Salvia amissa</i>	Aravaipa Sage	Vascular Plant	SC	S	S

---

<i>Salvia amissa</i>	Aravaipa Sage	Vascular Plant	SC	S	S	
<i>Triteleia lemmoniae</i>	Mazatzal Triteleia	Vascular Plant				
<i>Accipiter gentilis</i>	Northern Goshawk	Vertebrate Animal	SC		S	WSC
<i>Agosia chrysogaster</i>	Longfin Dace	Vertebrate Animal	SC	S		
<i>Asturina nitida maxima</i>	Northern Gray Hawk	Vertebrate Animal	SC	S	S	WSC
<i>Bufo microscaphus</i>	Arizona Toad	Vertebrate Animal	SC		S	
<i>Buteogallus anthracinus</i>	Common Black-hawk	Vertebrate Animal			S	WSC
<i>Catostomus clarki</i>	Desert Sucker	Vertebrate Animal	SC	S		
<i>Catostomus insignis</i>	Sonora Sucker	Vertebrate Animal	SC	S		
<i>Ceryle alcyon</i>	Belted Kingfisher	Vertebrate Animal				WSC
<i>Coccyzus americanus occidentalis</i>	Western Yellow-billed Cuckoo	Vertebrate Animal	C		S	WSC
<i>Corynorhinus townsendii pallascens</i>	Pale Townsend's Big-eared Bat	Vertebrate Animal	SC			
<i>Dolichonyx oryzivorus</i>	Bobolink	Vertebrate Animal				WSC
<i>Eleutherodactylus augusti cactorum</i>	Western Barking Frog	Vertebrate Animal			S	WSC
<i>Empidonax traillii extimus</i>	Southwestern Willow Flycatcher	Vertebrate Animal	LE		S	WSC
<i>Euptilotis neoxenus</i>	Eared Quetzal	Vertebrate Animal			S	
<i>Falco peregrinus anatum</i>	American Peregrine Falcon	Vertebrate Animal	SC		S	WSC
<i>Gila intermedia</i>	Gila Chub	Vertebrate Animal	PE		S	WSC
<i>Gila robusta</i>	Roundtail Chub	Vertebrate Animal	SC		S	WSC
<i>Gopherus agassizii (Sonoran population)</i>	Sonoran Desert Tortoise	Vertebrate Animal	SC			WSC
<i>Haliaeetus leucocephalus</i>	Bald Eagle	Vertebrate	LT		S	WSC

---

		Animal				
<i>Idionycteris phyllotis</i>	Allen's Big-eared Bat	Vertebrate Animal	SC	S		
<i>Lasiurus blossevillii</i>	Western Red Bat	Vertebrate Animal				WSC
<i>Macrotus californicus</i>	California Leaf-nosed Bat	Vertebrate Animal	SC	S		WSC
<i>Myotis thysanodes</i>	Fringed Myotis	Vertebrate Animal	SC	S		
<i>Myotis velifer</i>	Cave Myotis	Vertebrate Animal	SC	S		
<i>Myotis volans</i>	Long-legged Myotis	Vertebrate Animal	SC	S		
<i>Nyctinomops femorosaccus</i>	Pocketed Free-tailed Bat	Vertebrate Animal		S		
<i>Nyctinomops macrotis</i>	Big Free-tailed Bat	Vertebrate Animal	SC	S		
<i>Pandion haliaetus</i>	Osprey	Vertebrate Animal				WSC
<i>Poeciliopsis occidentalis occidentalis</i>	Gila Topminnow	Vertebrate Animal	LE			WSC
<i>Rallus longirostris yumanensis</i>	Yuma Clapper Rail	Vertebrate Animal	LE			WSC
<i>Rana chiricahuensis</i>	Chiricahua Leopard Frog	Vertebrate Animal	LT		S	WSC
<i>Rana pipiens</i>	Northern Leopard Frog	Vertebrate Animal			S	WSC
<i>Rana yavapaiensis</i>	Lowland Leopard Frog	Vertebrate Animal	SC		S	WSC
<i>Rhinichthys osculus</i>	Speckled Dace	Vertebrate Animal	SC	S		
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Vertebrate Animal	LT		S	WSC
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Vertebrate Animal	LT		S	WSC
<i>Thamnophis eques megalops</i>	Northern Mexican Gartersnake	Vertebrate Animal	SC		S	WSC
<i>Thamnophis rufipunctatus</i>	Narrow-headed Gartersnake	Vertebrate Animal	SC		S	WSC

---

<i>Xyrauchen texanus</i>	Razorback Sucker	Vertebrate Animal	LE		S	WSC
<b>Graham</b>						
<i>Cicindela oregona maricopa</i>	Maricopa Tiger Beetle	Invertebrate Animal	SC	S	S	
<i>Eumorsea pinaleno</i>	Pinaleno Monkey Grasshopper	Invertebrate Animal	SC		S	
<i>Limenitis archippus obsoleta</i>	Obsolete Viceroy Butterfly	Invertebrate Animal			S	
<i>Oreohelix grahamensis</i>	Pinaleno Mountainsnail	Invertebrate Animal			S	
<i>Pyrgulopsis arizonae</i>	Bylas Springsnail	Invertebrate Animal	SC	S	S	
<i>Sonorella christenseni</i>	Clark Peak Talussnail	Invertebrate Animal	SC		S	
<i>Sonorella grahamensis</i>	Pinaleno Talussnail	Invertebrate Animal	SC		S	
<i>Sonorella imitator</i>	Mimic Talussnail	Invertebrate Animal			S	
<i>Sonorella macrophallus</i>	Wet Canyon Talussnail	Invertebrate Animal	SC		S	
<i>Tryonia gilae</i>	Gila Tryonia	Invertebrate Animal	SC		S	
<i>Abutilon parishii</i>	Pima Indian Mallow	Vascular Plant	SC		S	
<i>Carex chihuahuensis</i>	A Sedge	Vascular Plant			S	
<i>Carex ultra</i>	Arizona Giant Sedge	Vascular Plant		S	S	
<i>Echinocereus ledingii</i>	Pinaleno Hedgehog Cactus	Vascular Plant				
<i>Erigeron heliographis</i>	Pinalenos Fleabane	Vascular Plant	SC			
<i>Erigeron piscaticus</i>	Fish Creek Fleabane	Vascular Plant	SC	S	S	
<i>Eriogonum capillare</i>	San Carlos Wild-buckwheat	Vascular Plant	SC			
<i>Eupatorium bigelovii</i>	Bigelow Thoroughwort	Vascular Plant			S	
<i>Hackelia ursina</i>	Chihuahuan Stickseed	Vascular Plant			S	
<i>Heuchera glomerulata</i>	Arizona Alum Root	Vascular Plant			S	
<i>Hieracium rusbyi</i>	Rusby Hawkweed	Vascular Plant			S	
<i>Mammillaria viridiflora</i>	Varied Fishhook Cactus	Vascular Plant				

<i>Mammillaria wrightii</i> <i>var. wilcoxii</i>	Wilcox Fishhook Cactus	Vascular Plant				
<i>Penstemon discolor</i>	Catalina Beardtongue	Vascular Plant			S	
<i>Penstemon ramosus</i>	Branching Penstemon	Vascular Plant			S	
<i>Penstemon superbus</i>	Superb Beardtongue	Vascular Plant			S	
<i>Physalis latiphysa</i>	Broad-leaf Ground-cherry	Vascular Plant			S	
<i>Platanthera purpurascens</i>	Slender Bog Orchid	Vascular Plant				
<i>Polemonium flavum</i>	Pinaleno Jacobs Ladder	Vascular Plant			S	
<i>Potentilla albiflora</i>	White-flowered Cinquefoil	Vascular Plant			S	
<i>Rumex orthoneurus</i>	Blumer's Dock	Vascular Plant	SC		S	
<i>Salvia amissa</i>	Aravaipa Sage	Vascular Plant	SC	S	S	
<i>Schiedeella parasitica</i>	Fallen Ladies'-tresses	Vascular Plant				
<i>Accipiter gentilis</i>	Northern Goshawk	Vertebrate Animal	SC		S	WSC
<i>Agosia chrysogaster</i>	Longfin Dace	Vertebrate Animal	SC	S		
<i>Aspidoscelis burti</i> <i>stictogrammus</i>	Giant Spotted Whiptail	Vertebrate Animal	SC	S	S	
<i>Bufo microscaphus</i>	Arizona Toad	Vertebrate Animal	SC		S	
<i>Buteogallus anthracinus</i>	Common Black-hawk	Vertebrate Animal			S	WSC
<i>Catostomus clarki</i>	Desert Sucker	Vertebrate Animal	SC	S		
<i>Catostomus insignis</i>	Sonora Sucker	Vertebrate Animal	SC	S		
<i>Choeronycteris mexicana</i>	Mexican Long-tongued Bat	Vertebrate Animal	SC	S		WSC
<i>Coccyzus americanus</i> <i>occidentalis</i>	Western Yellow-billed Cuckoo	Vertebrate Animal	C		S	WSC
<i>Cyprinodon macularius</i>	Desert Pupfish	Vertebrate Animal	LE			WSC
<i>Empidonax traillii</i> <i>extimus</i>	Southwestern Willow Flycatcher	Vertebrate Animal	LE		S	WSC
<i>Eumops perotis</i> <i>californicus</i>	Greater Western Mastiff Bat	Vertebrate Animal	SC			
<i>Falco peregrinus anatum</i>	American Peregrine Falcon	Vertebrate Animal	SC		S	WSC

<i>Gila intermedia</i>	Gila Chub	Vertebrate Animal	PE		S	WSC
<i>Gila robusta</i>	Roundtail Chub	Vertebrate Animal	SC		S	WSC
<i>Gila robusta</i>	Roundtail Chub	Vertebrate Animal	SC		S	WSC
<i>Idionycteris phyllotis</i>	Allen's Big-eared Bat	Vertebrate Animal	SC	S		
<i>Lasiurus blossevillii</i>	Western Red Bat	Vertebrate Animal				WSC
<i>Leptonycteris curasoae yerbabuena</i>	Lesser Long-nosed Bat	Vertebrate Animal	LE		S	WSC
<i>Macrotus californicus</i>	California Leaf-nosed Bat	Vertebrate Animal	SC	S		WSC
<i>Meda fulgida</i>	Spikedace	Vertebrate Animal	LT		S	WSC
<i>Microtus longicaudus leucophaeus</i>	White-bellied Long-tailed Vole	Vertebrate Animal			S	
<i>Myotis velifer</i>	Cave Myotis	Vertebrate Animal	SC	S		
<i>Myotis yumanensis</i>	Yuma Myotis	Vertebrate Animal	SC			
<i>Oncorhynchus apache</i>	Apache (Arizona) Trout	Vertebrate Animal	LT		S	WSC
<i>Poeciliopsis occidentalis occidentalis</i>	Gila Topminnow	Vertebrate Animal	LE			WSC
<i>Rana blairi</i>	Plains Leopard Frog	Vertebrate Animal				WSC
<i>Rana chiricahuensis</i>	Chiricahua Leopard Frog	Vertebrate Animal	LT		S	WSC
<i>Rana yavapaiensis</i>	Lowland Leopard Frog	Vertebrate Animal	SC		S	WSC
<i>Rhinichthys osculus</i>	Speckled Dace	Vertebrate Animal	SC	S		
<i>Sigmodon ochrognathus</i>	Yellow-nosed Cotton Rat	Vertebrate Animal	SC			
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Vertebrate Animal	LT		S	WSC
<i>Tamiasciurus hudsonicus grahamensis</i>	Mt Graham Red Squirrel	Vertebrate Animal	LE			WSC

<i>Thamnophis rufipunctatus</i>	Narrow-headed Gartersnake	Vertebrate Animal	SC		S	WSC
<i>Thomomys bottae mearnsi</i>	Mearns' Southern Pocket Gopher	Vertebrate Animal	SC			
<i>Tiaroga cobitis</i>	Loach Minnow	Vertebrate Animal	LT		S	WSC
<b>Greenlee</b>						
<i>Cicindela oregona maricopa</i>	Maricopa Tiger Beetle	Invertebrate Animal	SC	S	S	
<i>Psephenus montanus</i>	White Mountains Water Penny Beetle	Invertebrate Animal	SC		S	
<i>Speyeria nokomis nitocris</i>	Mountain Silverspot Butterfly	Invertebrate Animal			S	
<i>Allium gooddingii</i>	Goodding Onion	Vascular Plant	SC		S	
<i>Conioselinum mexicanum</i>	Mexican Hemlock Parsley	Vascular Plant	SC		S	
<i>Echinocereus fasciculatus</i>	Magenta-flower Hedgehog-cactus	Vascular Plant				
<i>Echinocereus fasciculatus</i>	Magenta-flower Hedgehog-cactus	Vascular Plant				
<i>Eriogonum capillare</i>	San Carlos Wild-buckwheat	Vascular Plant	SC			
<i>Hackelia ursina</i>	Chihuahuan Stickseed	Vascular Plant			S	
<i>Heuchera glomerulata</i>	Arizona Alum Root	Vascular Plant			S	
<i>Penstemon linarioides ssp. maguirei</i>	Maguire's Penstemon	Vascular Plant				
<i>Penstemon ramosus</i>	Branching Penstemon	Vascular Plant			S	
<i>Penstemon superbus</i>	Superb Beardtongue	Vascular Plant			S	
<i>Perityle ambrosiifolia</i>	Lace-leaf Rockdaisy	Vascular Plant		S		
<i>Rumex orthoneurus</i>	Blumer's Dock	Vascular Plant	SC		S	
<i>Senecio quaerens</i>	Gila Groundsel	Vascular Plant	SC		S	
<i>Trifolium neurophyllum</i>	White Mountains Clover	Vascular Plant	SC		S	
<i>Zigadenus virescens</i>	Green Death Camas	Vascular Plant				
<i>Accipiter gentilis</i>	Northern Goshawk	Vertebrate Animal	SC		S	WSC
<i>Agosia chrysogaster</i>	Longfin Dace	Vertebrate Animal	SC	S		

<i>Bufo microscaphus</i>	Arizona Toad	Vertebrate Animal	SC		S	
<i>Buteogallus anthracinus</i>	Common Black-hawk	Vertebrate Animal			S	WSC
<i>Catostomus clarki</i>	Desert Sucker	Vertebrate Animal	SC	S		
<i>Catostomus insignis</i>	Sonora Sucker	Vertebrate Animal	SC	S		
<i>Coccyzus americanus occidentalis</i>	Western Yellow-billed Cuckoo	Vertebrate Animal	C		S	WSC
<i>Empidonax traillii extimus</i>	Southwestern Willow Flycatcher	Vertebrate Animal	LE		S	WSC
<i>Eumops perotis californicus</i>	Greater Western Mastiff Bat	Vertebrate Animal	SC			
<i>Falco peregrinus anatum</i>	American Peregrine Falcon	Vertebrate Animal	SC		S	WSC
<i>Gila intermedia</i>	Gila Chub	Vertebrate Animal	PE		S	WSC
<i>Gila robusta</i>	Roundtail Chub	Vertebrate Animal	SC		S	WSC
<i>Meda fulgida</i>	Spikedace	Vertebrate Animal	LT		S	WSC
<i>Myotis volans</i>	Long-legged Myotis	Vertebrate Animal	SC	S		
<i>Oncorhynchus apache</i>	Apache (Arizona) Trout	Vertebrate Animal	LT		S	WSC
<i>Oncorhynchus gilae</i>	Gila Trout	Vertebrate Animal	LE		S	WSC
<i>Pandion haliaetus</i>	Osprey	Vertebrate Animal				WSC
<i>Rana chiricahuensis</i>	Chiricahua Leopard Frog	Vertebrate Animal	LT		S	WSC
<i>Rana pipiens</i>	Northern Leopard Frog	Vertebrate Animal			S	WSC
<i>Rana yavapaiensis</i>	Lowland Leopard Frog	Vertebrate Animal	SC		S	WSC
<i>Rhinichthys osculus</i>	Speckled Dace	Vertebrate Animal	SC	S		
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Vertebrate Animal	LT		S	WSC

<i>Thamnophis rufipunctatus</i>	Narrow-headed Gartersnake	Vertebrate Animal	SC	S	WSC
<i>Tiaroga cobitis</i>	Loach Minnow	Vertebrate Animal	LT	S	WSC
<i>Xyrauchen texanus</i>	Razorback Sucker	Vertebrate Animal	LE	S	WSC
<i>Zapus hudsonius luteus</i>	New Mexican Jumping Mouse	Vertebrate Animal	SC	S	WSC
<b>La Paz</b>					
<i>Cirsium mohavense</i>	Mohave Thistle	Vascular Plant		S	
<i>Aechmophorus clarkii</i>	Clark's Grebe	Vertebrate Animal			WSC
<i>Bufo microscaphus</i>	Arizona Toad	Vertebrate Animal	SC	S	
<i>Coccyzus americanus occidentalis</i>	Western Yellow-billed Cuckoo	Vertebrate Animal	C	S	WSC
<i>Corynorhinus townsendii pallescens</i>	Pale Townsend's Big-eared Bat	Vertebrate Animal	SC		
<i>Cyprinodon macularius</i>	Desert Pupfish	Vertebrate Animal	LE		WSC
<i>Empidonax traillii extimus</i>	Southwestern Willow Flycatcher	Vertebrate Animal	LE	S	WSC
<i>Eumops perotis californicus</i>	Greater Western Mastiff Bat	Vertebrate Animal	SC		
<i>Gila elegans</i>	Bonytail	Vertebrate Animal	LE		WSC
<i>Gopherus agassizii</i> (Sonoran population)	Sonoran Desert Tortoise	Vertebrate Animal	SC		WSC
<i>Heloderma suspectum cinctum</i>	Banded Gila Monster	Vertebrate Animal	SC	P	
<i>Ixobrychus exilis</i>	Least Bittern	Vertebrate Animal			WSC
<i>Laterallus jamaicensis coturniculus</i>	California Black Rail	Vertebrate Animal	SC	S	WSC
<i>Macrotus californicus</i>	California Leaf-nosed Bat	Vertebrate Animal	SC	S	WSC
<i>Myotis velifer</i>	Cave Myotis	Vertebrate Animal	SC	S	

<i>Myotis yumanensis</i>	Yuma Myotis	Vertebrate Animal	SC			
<i>Nyctinomops femorosaccus</i>	Pocketed Free-tailed Bat	Vertebrate Animal		S		
<i>Plegadis chihi</i>	White-faced Ibis	Vertebrate Animal	SC	S		
<i>Poeciliopsis occidentalis occidentalis</i>	Gila Topminnow	Vertebrate Animal	LE			WSC
<i>Rallus longirostris yumanensis</i>	Yuma Clapper Rail	Vertebrate Animal	LE			WSC
<i>Rana yavapaiensis</i>	Lowland Leopard Frog	Vertebrate Animal	SC		S	WSC
<i>Xyrauchen texanus</i>	Razorback Sucker	Vertebrate Animal	LE		S	WSC
<b>Maricopa</b>						
<i>Cicindela oregona maricopa</i>	Maricopa Tiger Beetle	Invertebrate Animal	SC	S	S	
<i>Limnitis archippus obsoleta</i>	Obsolete Viceroy Butterfly	Invertebrate Animal				S
<i>Agave arizonica</i>	Arizona Agave	Vascular Plant	LE			S
<i>Agave delamateri</i>	Tonto Basin Agave	Vascular Plant	SC			S
<i>Agave murpheyi</i>	Hohokam Agave	Vascular Plant	SC	S		S
<i>Agave toumeyana</i> var. <i>bella</i>	Toumey Agave	Vascular Plant				
<i>Allium bigelovii</i>	Bigelow Onion	Vascular Plant				
<i>Eriogonum ripleyi</i>	Ripley Wild-buckwheat	Vascular Plant	SC			S
<i>Fremontodendron californicum</i>	Flannel Bush	Vascular Plant			S	
<i>Mammillaria viridiflora</i>	Varied Fishhook Cactus	Vascular Plant				
<i>Opuntia echinocarpa</i>	Straw-top Cholla	Vascular Plant				
<i>Opuntia echinocarpa</i>	Straw-top Cholla	Vascular Plant				
<i>Purshia subintegra</i>	Arizona Cliff Rose	Vascular Plant	LE			
<i>Agosia chrysogaster</i>	Longfin Dace	Vertebrate Animal	SC	S		
<i>Agosia chrysogaster</i>	Longfin Dace	Vertebrate Animal	SC	S		

<i>Ardea alba</i>	Great Egret	Vertebrate Animal				WSC
<i>Athene cunicularia hypugaea</i>	Western Burrowing Owl	Vertebrate Animal	SC	S		
<i>Bufo microscaphus</i>	Arizona Toad	Vertebrate Animal	SC		S	
<i>Buteogallus anthracinus</i>	Common Black-hawk	Vertebrate Animal			S	WSC
<i>Catostomus clarki</i>	Desert Sucker	Vertebrate Animal	SC	S		
<i>Catostomus insignis</i>	Sonora Sucker	Vertebrate Animal	SC	S		
<i>Ceryle alcyon</i>	Belted Kingfisher	Vertebrate Animal				WSC
<i>Coccyzus americanus occidentalis</i>	Western Yellow-billed Cuckoo	Vertebrate Animal	C		S	WSC
<i>Corynorhinus townsendii pallascens</i>	Pale Townsend's Big-eared Bat	Vertebrate Animal	SC			
<i>Cyprinodon macularius</i>	Desert Pupfish	Vertebrate Animal	LE			WSC
<i>Dendrocygna autumnalis</i>	Black-bellied Whistling-duck	Vertebrate Animal				WSC
<i>Egretta thula</i>	Snowy Egret	Vertebrate Animal				WSC
<i>Empidonax traillii extimus</i>	Southwestern Willow Flycatcher	Vertebrate Animal	LE		S	WSC
<i>Eumeces gilberti arizonensis</i>	Arizona Skink	Vertebrate Animal	SC	S	S	WSC
<i>Gila elegans</i>	Bonytail	Vertebrate Animal	LE			WSC
<i>Gila robusta</i>	Roundtail Chub	Vertebrate Animal	SC		S	WSC
<i>Gopherus agassizii (Sonoran population)</i>	Sonoran Desert Tortoise	Vertebrate Animal	SC			WSC
<i>Haliaeetus leucocephalus</i>	Bald Eagle	Vertebrate Animal	LT		S	WSC
<i>Ixobrychus exilis</i>	Least Bittern	Vertebrate Animal				WSC
<i>Lasiurus blossevillii</i>	Western Red Bat	Vertebrate Animal				WSC

<i>Lasiurus xanthinus</i>	Western Yellow Bat	Vertebrate Animal				WSC
<i>Macrotus californicus</i>	California Leaf-nosed Bat	Vertebrate Animal	SC	S		WSC
<i>Myotis velifer</i>	Cave Myotis	Vertebrate Animal	SC	S		
<i>Myotis yumanensis</i>	Yuma Myotis	Vertebrate Animal	SC			
<i>Nyctinomops femorosaccus</i>	Pocketed Free-tailed Bat	Vertebrate Animal		S		
<i>Poeciliopsis occidentalis occidentalis</i>	Gila Topminnow	Vertebrate Animal	LE			WSC
<i>Ptychocheilus lucius</i>	Colorado Pikeminnow	Vertebrate Animal	LEXN			WSC
<i>Rallus longirostris yumanensis</i>	Yuma Clapper Rail	Vertebrate Animal	LE			WSC
<i>Rana yavapaiensis</i>	Lowland Leopard Frog	Vertebrate Animal	SC		S	WSC
<i>Rhinichthys osculus</i>	Speckled Dace	Vertebrate Animal	SC	S		
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Vertebrate Animal	LT		S	WSC
<i>Thamnophis eques megalops</i>	Northern Mexican Gartersnake	Vertebrate Animal	SC		S	WSC
<i>Xyrauchen texanus</i>	Razorback Sucker	Vertebrate Animal	LE		S	WSC
<b>Mohave</b>						
<i>Cicindela oregona maricopa</i>	Maricopa Tiger Beetle	Invertebrate Animal	SC	S	S	
<i>Pyrgulopsis deserta</i>	Desert Springsnail	Invertebrate Animal		S	S	
<i>Arctomecon californica</i>	Las Vegas Bearpoppy	Vascular Plant	SC			
<i>Astragalus lentiginosus var. ambiguus</i>	Freckled Milk-vetch	Vascular Plant	SC			
<i>Astragalus newberryi</i> var. <i>aquarii</i>		Vascular Plant			S	
<i>Astragalus toanus</i> var. <i>scidulus</i>	A Toana Milkvetch	Vascular Plant			S	

<i>Balsamorhiza hookeri</i> <i>var. hispidula</i>	A Balsamroot	Vascular Plant		S		
<i>Cirsium virginense</i>	Virgin Thistle	Vascular Plant	SC			
<i>Cycladenia humilis</i> var. <i>jonesii</i>	Jones' Cycladenia	Vascular Plant	LT			
<i>Enceliopsis argophylla</i>	Silverleaf Sunray	Vascular Plant		S		
<i>Eriogonum thompsonae</i> <i>var. atwoodii</i>	Atwood Wild-buckwheat	Vascular Plant	SC			S
<i>Fremontodendron</i> <i>californicum</i>	Flannel Bush	Vascular Plant		S		
<i>Lupinus latifolius</i> ssp. <i>leucanthus</i>	Broadleaf Lupine	Vascular Plant				S
<i>Mammillaria viridiflora</i>	Varied Fishhook Cactus	Vascular Plant				
<i>Opuntia basilaris</i> var. <i>aurea</i>	Yellow Beavertail	Vascular Plant				
<i>Pediocactus peeblesianus</i> <i>var. fickeiseniae</i>	Fickeisen Plains Cactus	Vascular Plant	C	S		S
<i>Pediocactus sileri</i>	Siler Pincushion Cactus	Vascular Plant	LT			
<i>Pediomelum castoreum</i>	Beaver Dam Scurf Pea	Vascular Plant	SC	S		
<i>Penstemon distans</i>	Mt. Trumbull Beardtongue	Vascular Plant	SC	S		S
<i>Penstemon petiolatus</i>	Sheep Range Beardtongue	Vascular Plant		S		
<i>Phacelia parishii</i>	Parish's Phacelia	Vascular Plant		S		
<i>Polygala rusbyi</i>	Hualapai Milkwort	Vascular Plant				S
<i>Purshia subintegra</i>	Arizona Cliff Rose	Vascular Plant	LE			
<i>Sclerocactus parviflorus</i>	Glen Canyon Cactus	Vascular Plant				
<i>Tetradymia argyraea</i>	Silver Felt Thorn	Vascular Plant		S		
<i>Townsendia smithii</i>	Blackrock Ground Daisy	Vascular Plant		S		
<i>Tricardia watsonii</i>	Three Hearts	Vascular Plant		S		
<i>Yucca whipplei</i>	Our Lords Candle	Vascular Plant				
<i>Accipiter gentilis</i>	Northern Goshawk	Vertebrate Animal	SC			S WSC
<i>Agosia chrysogaster</i>	Longfin Dace	Vertebrate Animal	SC	S		
<i>Athene cunicularia</i> <i>hypugaea</i>	Western Burrowing Owl	Vertebrate Animal	SC	S		
<i>Bufo microscaphus</i>	Arizona Toad	Vertebrate	SC			S

		Animal				
<i>Buteo regalis</i>	Ferruginous Hawk	Vertebrate	SC			WSC
		Animal				
<i>Buteogallus anthracinus</i>	Common Black-hawk	Vertebrate			S	WSC
		Animal				
<i>Catostomus clarki</i>	Desert Sucker	Vertebrate	SC	S		
		Animal				
<i>Catostomus insignis</i>	Sonora Sucker	Vertebrate	SC	S		
		Animal				
<i>Charina trivirgata gracia</i>	Desert Rosy Boa	Vertebrate	SC	S	S	
		Animal				
<i>Coccyzus americanus</i>	Western Yellow-billed Cuckoo	Vertebrate	C		S	WSC
<i>occidentalis</i>		Animal				
<i>Corynorhinus townsendii</i>	Pale Townsend's Big-eared Bat	Vertebrate	SC			
<i>pallescens</i>		Animal				
<i>Cyprinodon macularius</i>	Desert Pupfish	Vertebrate	LE			WSC
		Animal				
<i>Empidonax traillii</i>	Southwestern Willow	Vertebrate	LE		S	WSC
<i>extimus</i>	Flycatcher	Animal				
<i>Euderma maculatum</i>	Spotted Bat	Vertebrate	SC	S		WSC
		Animal				
<i>Eumops perotis</i>	Greater Western Mastiff Bat	Vertebrate	SC			
<i>californicus</i>		Animal				
<i>Falco peregrinus anatum</i>	American Peregrine Falcon	Vertebrate	SC		S	WSC
		Animal				
<i>Gila cypha</i>	Humpback Chub	Vertebrate	LE			WSC
		Animal				
<i>Gila elegans</i>	Bonytail	Vertebrate	LE			WSC
		Animal				
<i>Gila robusta</i>	Roundtail Chub	Vertebrate	SC		S	WSC
		Animal				
<i>Gila seminuda</i>	Virgin River Chub	Vertebrate	LE		S	WSC
		Animal				
<i>Gopherus agassizii</i>	Sonoran Desert Tortoise	Vertebrate	SC			WSC
<i>(Sonoran population)</i>		Animal				
<i>Haliaeetus leucocephalus</i>	Bald Eagle	Vertebrate	LT		S	WSC
		Animal				
<i>Heloderma suspectum</i>	Banded Gila Monster	Vertebrate	SC	P		
<i>cinctum</i>		Animal				

<i>Idionycteris phyllotis</i>	Allen's Big-eared Bat	Vertebrate Animal	SC	S		
<i>Lampropeltis pyromelana infralabialis</i>	Utah Mountain Kingsnake	Vertebrate Animal			S	
<i>Lasiurus blossevillii</i>	Western Red Bat	Vertebrate Animal				WSC
<i>Lepidomeda mollispinis mollispinis</i>	Virgin Spinedace	Vertebrate Animal	SC			WSC
<i>Macrotus californicus</i>	California Leaf-nosed Bat	Vertebrate Animal	SC	S		WSC
<i>Microtus mexicanus hualpaiensis</i>	Hualapai Mexican Vole	Vertebrate Animal	LE			WSC
<i>Myotis ciliolabrum</i>	Western Small-footed Myotis	Vertebrate Animal	SC	S		
<i>Myotis thysanodes</i>	Fringed Myotis	Vertebrate Animal	SC	S		
<i>Myotis velifer</i>	Cave Myotis	Vertebrate Animal	SC	S		
<i>Myotis volans</i>	Long-legged Myotis	Vertebrate Animal	SC	S		
<i>Myotis yumanensis</i>	Yuma Myotis	Vertebrate Animal	SC			
<i>Nyctinomops femorosaccus</i>	Pocketed Free-tailed Bat	Vertebrate Animal		S		
<i>Nyctinomops macrotis</i>	Big Free-tailed Bat	Vertebrate Animal	SC	S		
<i>Plagopterus argentissimus</i>	Woundfin	Vertebrate Animal	LE			WSC
<i>Rallus longirostris yumanensis</i>	Yuma Clapper Rail	Vertebrate Animal	LE			WSC
<i>Rana onca</i>	Relict Leopard Frog	Vertebrate Animal	C		S	WSC
<i>Rana pipiens</i>	Northern Leopard Frog	Vertebrate Animal			S	WSC
<i>Rana yavapaiensis</i>	Lowland Leopard Frog	Vertebrate Animal	SC		S	WSC
<i>Rhinichthys osculus</i>	Speckled Dace	Vertebrate Animal	SC	S		
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Vertebrate Animal	LT		S	WSC

	<i>Xantusia arizonae</i>	Arizona Night Lizard	Vertebrate Animal			S	
	<i>Xyrauchen texanus</i>	Razorback Sucker	Vertebrate Animal	LE		S	WSC
<b>Navajo</b>							
	<i>Anodonta californiensis</i>	California Floater	Invertebrate Animal	SC		S	
	<i>Amsonia peeblesii</i>	Peebles Blue Star	Vascular Plant			S	
	<i>Astragalus xiphoides</i>	Gladiator Milk Vetch	Vascular Plant	SC			
	<i>Errazurizia rotundata</i>	Roundleaf Errazurizia	Vascular Plant			S	
	<i>Pediocactus papyracanthus</i>	Paper-spined Cactus	Vascular Plant	SC			
	<i>Pediocactus peeblesianus</i> <i>var. peeblesianus</i>	Peebles Navajo Cactus	Vascular Plant	LE			
	<i>Accipiter gentilis</i>	Northern Goshawk	Vertebrate Animal	SC		S	WSC
	<i>Agosia chrysoaster</i>	Longfin Dace	Vertebrate Animal	SC		S	
	<i>Buteo regalis</i>	Ferruginous Hawk	Vertebrate Animal	SC			WSC
	<i>Catostomus clarki</i>	Desert Sucker	Vertebrate Animal	SC		S	
	<i>Catostomus sp. 3</i>	Little Colorado Sucker	Vertebrate Animal	SC		S	S
	<i>Gila robusta</i>	Roundtail Chub	Vertebrate Animal	SC		S	WSC
	<i>Idionycteris phyllotis</i>	Allen's Big-eared Bat	Vertebrate Animal	SC		S	
	<i>Lepidomeda vittata</i>	Little Colorado Spinedace	Vertebrate Animal	LT		S	WSC
	<i>Myotis evotis</i>	Long-eared Myotis	Vertebrate Animal	SC		S	
	<i>Myotis thysanodes</i>	Fringed Myotis	Vertebrate Animal	SC		S	
	<i>Myotis volans</i>	Long-legged Myotis	Vertebrate Animal	SC		S	
	<i>Pandion haliaetus</i>	Osprey	Vertebrate Animal				WSC

<i>Perognathus flavus goodpasteri</i>	Springerville Pocket Mouse	Vertebrate Animal	SC		S	
<i>Rana chiricahuensis</i>	Chiricahua Leopard Frog	Vertebrate Animal	LT		S	WSC
<i>Rana pipiens</i>	Northern Leopard Frog	Vertebrate Animal			S	WSC
<i>Rhinichthys osculus</i>	Speckled Dace	Vertebrate Animal	SC	S		
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Vertebrate Animal	LT		S	WSC
<i>Thamnophis eques megalops</i>	Northern Mexican Gartersnake	Vertebrate Animal	SC		S	WSC
<b>Pima</b>						
<i>Abutilon parishii</i>	Pima Indian Mallow	Vascular Plant	SC		S	
<i>Acacia smallii</i>	Sweet Acacia	Vascular Plant			S	
<i>Accipiter gentilis</i>	Northern Goshawk	Vertebrate Animal	SC		S	WSC
<i>Agathymus aryxna</i>	Arizona Giant Skipper	Invertebrate Animal			S	
<i>Agave parviflora ssp. parviflora</i>	Santa Cruz Striped Agave	Vascular Plant	SC	S	S	
<i>Agave schottii var. treleasei</i>	Trelease Agave	Vascular Plant	SC		S	
<i>Agosia chrysogaster</i>	Longfin Dace	Vertebrate Animal	SC	S		
<i>Allium gooddingii</i>	Goodding Onion	Vascular Plant	SC		S	
<i>Ammodramus bairdii</i>	Baird's Sparrow	Vertebrate Animal	SC			WSC
<i>Amoreuxia gonzalezii</i>	Saiya	Vascular Plant	SC		S	
<i>Amsonia grandiflora</i>	Large-flowered Blue Star	Vascular Plant	SC		S	
<i>Amsonia kearneyana</i>	Kearney's Blue Star	Vascular Plant	LE			
<i>Argia sabino</i>	Sabino Canyon Damselfly	Invertebrate Animal	SC		S	
<i>Asclepias lemmonii</i>	Lemmon Milkweed	Vascular Plant			S	
<i>Aspidoscelis burti stictogrammus</i>	Giant Spotted Whiptail	Vertebrate Animal	SC	S	S	
<i>Asturina nitida maxima</i>	Northern Gray Hawk	Vertebrate	SC	S	S	WSC

		Animal				
<i>Athene cunicularia hypugaea</i>	Western Burrowing Owl	Vertebrate Animal	SC	S		
<i>Boerhavia megaptera</i>	Tucson Mountain Spiderling	Vascular Plant				S
<i>Buteogallus anthracinus</i>	Common Black-hawk	Vertebrate Animal				S WSC
<i>Calephelis rawsoni arizonensis</i>	Arizona Metalmark	Invertebrate Animal				S
<i>Carex chihuahuensis</i>	A Sedge	Vascular Plant				S
<i>Carex ultra</i>	Arizona Giant Sedge	Vascular Plant			S	S
<i>Choeronycteris mexicana</i>	Mexican Long-tongued Bat	Vertebrate Animal	SC	S		WSC
<i>Coccyzus americanus occidentalis</i>	Western Yellow-billed Cuckoo	Vertebrate Animal	C			S WSC
<i>Colinus virginianus ridgwayi</i>	Masked Bobwhite	Vertebrate Animal	LE			WSC
<i>Corynorhinus townsendii pallescens</i>	Pale Townsend's Big-eared Bat	Vertebrate Animal	SC			
<i>Coryphantha scheeri</i> var. <i>robustispina</i>	Pima Pineapple Cactus	Vascular Plant	LE			
<i>Dendrocygna autumnalis</i>	Black-bellied Whistling-duck	Vertebrate Animal				WSC
<i>Dendrocygna bicolor</i>	Fulvous Whistling-duck	Vertebrate Animal	SC	S		
<i>Echinocactus horizonthalonius</i> var. <i>nicholii</i>	Nichol Turk's Head Cactus	Vascular Plant	LE			
<i>Echinomastus erectocentrus</i> var. <i>acunensis</i>	Acuna Cactus	Vascular Plant	C			
<i>Echinomastus erectocentrus</i> var. <i>erectocentrus</i>	Needle-spined Pineapple Cactus	Vascular Plant	SC			S
<i>Empidonax fulvifrons pygmaeus</i>	Northern Buff-breasted Flycatcher	Vertebrate Animal	SC			WSC
<i>Empidonax traillii extimus</i>	Southwestern Willow Flycatcher	Vertebrate Animal	LE			S WSC
<i>Erigeron arisolius</i>		Vascular Plant				S

<i>Eriogonum capillare</i>	San Carlos Wild-buckwheat	Vascular Plant	SC			
<i>Eriogonum ericifolium</i> <i>var. ericifolium</i>	Heathleaf Wild-buckwheat	Vascular Plant				S
<i>Eumops perotis</i> <i>californicus</i>	Greater Western Mastiff Bat	Vertebrate Animal	SC			
<i>Eumops underwoodi</i>	Underwood's Bonneted Bat	Vertebrate Animal	SC		S	
<i>Euphorbia gracillima</i>	Mexican Broomspurge	Vascular Plant				S
<i>Falco peregrinus anatum</i>	American Peregrine Falcon	Vertebrate Animal	SC			S WSC
<i>Gastrophryne olivacea</i>	Great Plains Narrow-mouthed Toad	Vertebrate Animal				WSC
<i>Gila intermedia</i>	Gila Chub	Vertebrate Animal	PE			S WSC
<i>Glaucidium brasilianum</i> <i>cactorum</i>	Cactus Ferruginous Pygmy-owl	Vertebrate Animal	LE			WSC
<i>Gopherus agassizii</i> <i>(Sonoran population)</i>	Sonoran Desert Tortoise	Vertebrate Animal	SC			WSC
<i>Graptopetalum bartramii</i>	Bartram Stonecrop	Vascular Plant	SC		S	S
<i>Hackelia ursina</i>	Chihuahuan Stickseed	Vascular Plant				S
<i>Hedeoma dentatum</i>	Mock-pennyroyal	Vascular Plant				S
<i>Hermannia pauciflora</i>	Sparseleaf Hermannia	Vascular Plant				S
<i>Heterelmis stephani</i>	Stephan's Heterelmis Riffle Beetle	Invertebrate Animal	C			S
<i>Heterotheca rutteri</i>	Huachuca Golden Aster	Vascular Plant	SC		S	S
<i>Hexalectris revoluta</i>	Chisos Coral-root	Vascular Plant			S	S
<i>Hexalectris spicata</i>	Crested Coral Root	Vascular Plant				
<i>Lasiurus blossevillii</i>	Western Red Bat	Vertebrate Animal				WSC
<i>Leptonycteris curasoae</i> <i>yerbabuena</i>	Lesser Long-nosed Bat	Vertebrate Animal	LE			S WSC
<i>Lilaeopsis schaffneriana</i> <i>var. recurva</i>	Huachuca Water Umbel	Vascular Plant	LE			
<i>Limnitis archippus</i> <i>obsoleta</i>	Obsolete Viceroy Butterfly	Invertebrate Animal				S
<i>Listera convallarioides</i>	Broadleaf Twayblade	Vascular Plant				
<i>Macrotus californicus</i>	California Leaf-nosed Bat	Vertebrate Animal	SC		S	WSC

<i>Malaxis tenuis</i>	Slender Adders Mouth	Vascular Plant			
<i>Mammillaria mainiae</i>	Counter Clockwise Fishhook Cactus	Vascular Plant			S
<i>Mammillaria thornberi</i>	Thornber Fishhook Cactus	Vascular Plant			
<i>Mammillaria viridiflora</i>	Varied Fishhook Cactus	Vascular Plant			
<i>Manihot davisiae</i>	Arizona Manihot	Vascular Plant			S
<i>Metastelma mexicanum</i>	Wiggins Milkweed Vine	Vascular Plant	SC		S
<i>Muhlenbergia dubioides</i>	Box Canyon Muhly	Vascular Plant			S
<i>Muhlenbergia xerophila</i>	Weeping Muhly	Vascular Plant			S
<i>Myotis velifer</i>	Cave Myotis	Vertebrate Animal	SC	S	
<i>Notholaena lemmonii</i>	Lemmon Cloak Fern	Vascular Plant	SC		
<i>Nyctinomops femorosaccus</i>	Pocketed Free-tailed Bat	Vertebrate Animal		S	
<i>Nyctinomops macrotis</i>	Big Free-tailed Bat	Vertebrate Animal	SC	S	
<i>Opuntia kelvinensis</i>	Kelvin Cholla	Vascular Plant			
<i>Pachyramphus aglaiae</i>	Rose-throated Becard	Vertebrate Animal			WSC
<i>Pandion haliaetus</i>	Osprey	Vertebrate Animal			WSC
<i>Panthera onca</i>	Jaguar	Vertebrate Animal	LE	S	WSC
<i>Passiflora foetida</i>	Foetid Passionflower	Vascular Plant			S
<i>Pectis imberbis</i>	Beardless Chinch Weed	Vascular Plant	SC		S
<i>Peniocereus greggii</i> var. <i>transmontanus</i>	Desert Night-blooming Cereus	Vascular Plant			
<i>Penstemon discolor</i>	Catalina Beardtongue	Vascular Plant			S
<i>Penstemon superbus</i>	Superb Beardtongue	Vascular Plant			S
<i>Platanthera limosa</i>	Thurber's Bog Orchid	Vascular Plant			
<i>Poeciliopsis occidentalis occidentalis</i>	Gila Topminnow	Vertebrate Animal	LE		WSC
<i>Rana chiricahuensis</i>	Chiricahua Leopard Frog	Vertebrate Animal	LT	S	WSC
<i>Rana yavapaiensis</i>	Lowland Leopard Frog	Vertebrate Animal	SC	S	WSC

<i>Samolus vagans</i>	Chiricahua Mountain Brookweed	Vascular Plant			S	
<i>Schiedeella parasitica</i>	Fallen Ladies'-tresses	Vascular Plant				
<i>Sigmodon ochrognathus</i>	Yellow-nosed Cotton Rat	Vertebrate Animal	SC			
<i>Sisyrinchium cernuum</i>	Nodding Blue-eyed Grass	Vascular Plant			S	
<i>Solanum lumholtzianum</i>	Lumholtz Nightshade	Vascular Plant			S	
<i>Stevia lemmonii</i>	Lemmon's Stevia	Vascular Plant			S	
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Vertebrate Animal	LT		S	WSC
<i>Tephrosia thurberi</i>	Thurber Hoary Pea	Vascular Plant			S	
<i>Thamnophis eques megalops</i>	Northern Mexican Gartersnake	Vertebrate Animal	SC		S	WSC
<i>Thelypteris puberula</i> var. <i>sonorensis</i>	Aravaipa Wood Fern	Vascular Plant		S		
<i>Tragia laciniata</i>	Sonoran Noseburn	Vascular Plant			S	
<i>Tumamoca macdougalii</i>	Tumamoc Globeberry	Vascular Plant		S	S	
<i>Tyrannus crassirostris</i>	Thick-billed Kingbird	Vertebrate Animal				WSC
<i>Tyrannus melancholicus</i>	Tropical Kingbird	Vertebrate Animal				WSC
<i>Viola umbraticola</i>	Shade Violet	Vascular Plant			S	
<b>Pinal</b>						
<i>Cicindela oregona maricopa</i>	Maricopa Tiger Beetle	Invertebrate Animal	SC	S	S	
<i>Abutilon parishii</i>	Pima Indian Mallow	Vascular Plant	SC			S
<i>Agave murpheyi</i>	Hohokam Agave	Vascular Plant	SC	S	S	
<i>Agave toumeyana</i> var. <i>bella</i>	Toumey Agave	Vascular Plant				
<i>Carex ultra</i>	Arizona Giant Sedge	Vascular Plant		S	S	
<i>Echinocereus triglochidiatus</i> var. <i>arizonicus</i>	Arizona Hedgehog Cactus	Vascular Plant	LE		S	
<i>Echinomastus erectocentrus</i> var. <i>erectocentrus</i>	Needle-spined Pineapple Cactus	Vascular Plant	SC		S	

<i>Erigeron anchana</i>	Mogollon Fleabane	Vascular Plant	SC		S	
<i>Erigeron piscaticus</i>	Fish Creek Fleabane	Vascular Plant	SC	S	S	
<i>Eriogonum capillare</i>	San Carlos Wild-buckwheat	Vascular Plant	SC			
<i>Euphorbia gracillima</i>	Mexican Broomsurge	Vascular Plant				S
<i>Ferocactus cylindraceus</i> var. <i>eastwoodiae</i>	Golden Barrel Cactus	Vascular Plant				
<i>Fremontodendron californicum</i>	Flannel Bush	Vascular Plant		S		
<i>Hedeoma dentatum</i>	Mock-pennyroyal	Vascular Plant				S
<i>Lilaeopsis schaffneriana</i> var. <i>recurva</i>	Huachuca Water Umbel	Vascular Plant	LE			
<i>Mammillaria viridiflora</i>	Varied Fishhook Cactus	Vascular Plant				
<i>Penstemon discolor</i>	Catalina Beardtongue	Vascular Plant				S
<i>Perityle gilensis</i> var. <i>gilensis</i>	Gila Rock Daisy	Vascular Plant				S
<i>Salvia amissa</i>	Aravaipa Sage	Vascular Plant	SC	S	S	
<i>Thelypteris puberula</i> var. <i>sonorensis</i>	Aravaipa Wood Fern	Vascular Plant		S		
<i>Agosia chrysogaster</i>	Longfin Dace	Vertebrate Animal	SC	S		
<i>Agosia chrysogaster</i>	Longfin Dace	Vertebrate Animal	SC	S		
<i>Ardea alba</i>	Great Egret	Vertebrate Animal				WSC
<i>Aspidoscelis burti</i> <i>stictogrammus</i>	Giant Spotted Whiptail	Vertebrate Animal	SC	S	S	
<i>Asturina nitida maxima</i>	Northern Gray Hawk	Vertebrate Animal	SC	S	S	WSC
<i>Bufo microscaphus</i>	Arizona Toad	Vertebrate Animal	SC		S	
<i>Buteogallus anthracinus</i>	Common Black-hawk	Vertebrate Animal			S	WSC
<i>Catostomus clarki</i>	Desert Sucker	Vertebrate Animal	SC	S		
<i>Catostomus insignis</i>	Sonora Sucker	Vertebrate Animal	SC	S		
<i>Choeronycteris mexicana</i>	Mexican Long-tongued Bat	Vertebrate Animal	SC	S		WSC

<i>Coccyzus americanus occidentalis</i>	Western Yellow-billed Cuckoo	Vertebrate Animal	C		S	WSC
<i>Corynorhinus townsendii pallescens</i>	Pale Townsend's Big-eared Bat	Vertebrate Animal	SC			
<i>Cyprinodon macularius</i>	Desert Pupfish	Vertebrate Animal	LE			WSC
<i>Dendrocygna autumnalis</i>	Black-bellied Whistling-duck	Vertebrate Animal				WSC
<i>Empidonax traillii extimus</i>	Southwestern Willow Flycatcher	Vertebrate Animal	LE		S	WSC
<i>Eumops perotis californicus</i>	Greater Western Mastiff Bat	Vertebrate Animal	SC			
<i>Falco peregrinus anatum</i>	American Peregrine Falcon	Vertebrate Animal	SC		S	WSC
<i>Gila robusta</i>	Roundtail Chub	Vertebrate Animal	SC		S	WSC
<i>Glaucidium brasilianum cactorum</i>	Cactus Ferruginous Pygmy-owl	Vertebrate Animal	LE			WSC
<i>Gopherus agassizii</i> (Sonoran population)	Sonoran Desert Tortoise	Vertebrate Animal	SC			WSC
<i>Haliaeetus leucocephalus</i>	Bald Eagle	Vertebrate Animal	LT		S	WSC
<i>Ictinia mississippiensis</i>	Mississippi Kite	Vertebrate Animal				WSC
<i>Ixobrychus exilis</i>	Least Bittern	Vertebrate Animal				WSC
<i>Leptonycteris curasoae yerbabuena</i>	Lesser Long-nosed Bat	Vertebrate Animal	LE		S	WSC
<i>Macrotus californicus</i>	California Leaf-nosed Bat	Vertebrate Animal	SC	S		WSC
<i>Meda fulgida</i>	Spikedace	Vertebrate Animal	LT		S	WSC
<i>Myotis ciliolabrum</i>	Western Small-footed Myotis	Vertebrate Animal	SC	S		
<i>Myotis thysanodes</i>	Fringed Myotis	Vertebrate Animal	SC	S		
<i>Myotis velifer</i>	Cave Myotis	Vertebrate Animal	SC	S		
<i>Myotis yumanensis</i>	Yuma Myotis	Vertebrate Animal	SC			

<i>Nyctinomops femorosaccus</i>	Pocketed Free-tailed Bat	Vertebrate Animal		S		
<i>Phyllorhynchus brownii lucidus</i>	Maricopa Leaf-nosed Snake	Vertebrate Animal			S	
<i>Poeciliopsis occidentalis occidentalis</i>	Gila Topminnow	Vertebrate Animal	LE			WSC
<i>Rallus longirostris yumanensis</i>	Yuma Clapper Rail	Vertebrate Animal	LE			WSC
<i>Rana yavapaiensis</i>	Lowland Leopard Frog	Vertebrate Animal	SC		S	WSC
<i>Rhinichthys osculus</i>	Speckled Dace	Vertebrate Animal	SC	S		
<i>Thamnophis eques megalops</i>	Northern Mexican Gartersnake	Vertebrate Animal	SC		S	WSC
<i>Tiaroga cobitis</i>	Loach Minnow	Vertebrate Animal	LT		S	WSC
<i>Tyrannus crassirostris</i>	Thick-billed Kingbird	Vertebrate Animal				WSC
<i>Tyrannus melancholicus</i>	Tropical Kingbird	Vertebrate Animal				WSC
<i>Xantusia arizonae</i>	Arizona Night Lizard	Vertebrate Animal			S	
<b>Santa Cruz</b>						
<i>Abutilon parishii</i>	Pima Indian Mallow	Vascular Plant	SC		S	
<i>Acacia smallii</i>	Sweet Acacia	Vascular Plant			S	
<i>Accipiter gentilis</i>	Northern Goshawk	Vertebrate Animal	SC		S	WSC
<i>Agathymus aryxna</i>	Arizona Giant Skipper	Invertebrate Animal			S	
<i>Agave parviflora ssp. parviflora</i>	Santa Cruz Striped Agave	Vascular Plant	SC	S	S	
<i>Agosia chrysogaster</i>	Longfin Dace	Vertebrate Animal	SC	S		
<i>Aimophila quinquestriata</i>	Five-striped Sparrow	Vertebrate Animal			S	
<i>Allium rhizomatum</i>	Redflower Onion	Vascular Plant		S	S	
<i>Amazilia violiceps</i>	Violet-crowned Hummingbird	Vertebrate Animal			S	WSC

<i>Ambystoma tigrinum stebbinsi</i>	Sonoran Tiger Salamander	Vertebrate Animal	LE				WSC
<i>Ammodramus bairdii</i>	Baird's Sparrow	Vertebrate Animal	SC				WSC
<i>Amoreuxia gonzalezii</i>	Saiya	Vascular Plant	SC		S		
<i>Amsonia grandiflora</i>	Large-flowered Blue Star	Vascular Plant	SC		S		
<i>Anthus spragueii</i>	Sprague's Pipit	Vertebrate Animal					WSC
<i>Arabis tricornuta</i>	Chiricahua Rock Cress	Vascular Plant				S	
<i>Argia sabino</i>	Sabino Canyon Damselfly	Invertebrate Animal	SC			S	
<i>Asclepias lemmonii</i>	Lemmon Milkweed	Vascular Plant				S	
<i>Asclepias uncialis</i>	Greene Milkweed	Vascular Plant	SC			S	
<i>Aspidoscelis burti stictogrammus</i>	Giant Spotted Whiptail	Vertebrate Animal	SC	S		S	
<i>Astragalus hypoxylus</i>	Huachuca Milk-vetch	Vascular Plant	SC	S		S	
<i>Asturina nitida maxima</i>	Northern Gray Hawk	Vertebrate Animal	SC	S		S	WSC
<i>Athene cunicularia hypugaea</i>	Western Burrowing Owl	Vertebrate Animal	SC	S			
<i>Browallia eludens</i>	Elusive New Browallia Species	Vascular Plant	SC			S	
<i>Buteogallus anthracinus</i>	Common Black-hawk	Vertebrate Animal				S	WSC
<i>Calephelis rawsoni arizonensis</i>	Arizona Metalmark	Invertebrate Animal				S	
<i>Capsicum annuum var. glabriusculum</i>	Chiltepin	Vascular Plant				S	
<i>Carex chihuahuensis</i>	A Sedge	Vascular Plant				S	
<i>Carex ultra</i>	Arizona Giant Sedge	Vascular Plant			S	S	
<i>Catostomus clarki</i>	Desert Sucker	Vertebrate Animal	SC	S			
<i>Catostomus insignis</i>	Sonora Sucker	Vertebrate Animal	SC	S			
<i>Choeronycteris mexicana</i>	Mexican Long-tongued Bat	Vertebrate Animal	SC	S			WSC
<i>Choisya mollis</i>	Santa Cruz Star Leaf	Vascular Plant	SC			S	
<i>Coccyzus americanus occidentalis</i>	Western Yellow-billed Cuckoo	Vertebrate Animal	C			S	WSC

<i>Conioselinum mexicanum</i>	Mexican Hemlock Parsley	Vascular Plant	SC		S	
<i>Corynorhinus townsendii pallescens</i>	Pale Townsend's Big-eared Bat	Vertebrate Animal	SC			
<i>Coryphantha recurvata</i>	Santa Cruz Beehive Cactus	Vascular Plant		S	S	
<i>Coryphantha scheeri</i> var. <i>robustispina</i>	Pima Pineapple Cactus	Vascular Plant	LE			
<i>Coursetia glabella</i>		Vascular Plant	SC		S	
<i>Crotalus willardi willardi</i>	Arizona Ridge-nosed Rattlesnake	Vertebrate Animal			S	WSC
<i>Cyprinodon macularius</i>	Desert Pupfish	Vertebrate Animal	LE			WSC
<i>Dalea tentaculoides</i>	Gentry Indigo Bush	Vascular Plant	SC	S	S	
<i>Dendrocygna autumnalis</i>	Black-bellied Whistling-duck	Vertebrate Animal				WSC
<i>Eleutherodactylus augusti cactorum</i>	Western Barking Frog	Vertebrate Animal			S	WSC
<i>Empidonax traillii extimus</i>	Southwestern Willow Flycatcher	Vertebrate Animal	LE		S	WSC
<i>Erigeron arisolius</i>		Vascular Plant			S	
<i>Euphorbia macropus</i>	Woodland Spurge	Vascular Plant	SC			
<i>Falco peregrinus anatum</i>	American Peregrine Falcon	Vertebrate Animal	SC		S	WSC
<i>Gastrophryne olivacea</i>	Great Plains Narrow-mouthed Toad	Vertebrate Animal				WSC
<i>Gila ditaenia</i>	Sonora Chub	Vertebrate Animal	LT			WSC
<i>Gila intermedia</i>	Gila Chub	Vertebrate Animal	PE		S	WSC
<i>Glaucidium brasilianum cactorum</i>	Cactus Ferruginous Pygmy-owl	Vertebrate Animal	LE			WSC
<i>Gopherus agassizii</i> (Sonoran population)	Sonoran Desert Tortoise	Vertebrate Animal	SC			WSC
<i>Graptopetalum bartramii</i>	Bartram Stonecrop	Vascular Plant	SC	S	S	
<i>Hedeoma dentatum</i>	Mock-pennyroyal	Vascular Plant			S	
<i>Heterelmis stephani</i>	Stephan's Heterelmis Riffle Beetle	Invertebrate Animal	C		S	
<i>Heterotheca rutteri</i>	Huachuca Golden Aster	Vascular Plant	SC	S	S	
<i>Hexalectris revoluta</i>	Chisos Coral-root	Vascular Plant		S	S	

<i>Hexalectris spicata</i>	Crested Coral Root	Vascular Plant				
<i>Hieracium pringlei</i>	Pringle Hawkweed	Vascular Plant	SC		S	
<i>Ipomoea plummerae</i> var. <i>cuneifolia</i>	Huachuca Morning Glory	Vascular Plant			S	
<i>Ipomoea thurberi</i>	Thurber's Morning-glory	Vascular Plant			S	
<i>Laennecia eriophylla</i>	Woolly Fleabane	Vascular Plant			S	
<i>Lampropeltis getula</i> <i>nigrita</i>	Western Black Kingsnake	Vertebrate Animal			S	
<i>Lasiurus blossevillii</i>	Western Red Bat	Vertebrate Animal				WSC
<i>Leptonycteris curasoae</i> <i>yerbabuena</i>	Lesser Long-nosed Bat	Vertebrate Animal	LE		S	WSC
<i>Lilaeopsis schaffneriana</i> var. <i>recurva</i>	Huachuca Water Umbel	Vascular Plant	LE			
<i>Lilium parryi</i>	Lemmon Lily	Vascular Plant	SC		S	
<i>Limnitis archippus</i> <i>obsoleta</i>	Obsolete Viceroy Butterfly	Invertebrate Animal			S	
<i>Lobelia fenestralis</i>	Leafy Lobelia	Vascular Plant				
<i>Lotus alamosanus</i>	Alamos Deer Vetch	Vascular Plant			S	
<i>Lupinus huachucanus</i>	Huachuca Mountain Lupine	Vascular Plant			S	
<i>Macroptilium supinum</i>	Supine Bean	Vascular Plant	SC		S	
<i>Macrotus californicus</i>	California Leaf-nosed Bat	Vertebrate Animal	SC	S		WSC
<i>Malaxis corymbosa</i>	Madrean Adders Mouth	Vascular Plant				
<i>Mammillaria wrightii</i> var. <i>wilcoxii</i>	Wilcox Fishhook Cactus	Vascular Plant				
<i>Manihot davisiae</i>	Arizona Manihot	Vascular Plant			S	
<i>Marina diffusa</i>	Escoba	Vascular Plant			S	
<i>Metastelma mexicanum</i>	Wiggins Milkweed Vine	Vascular Plant	SC		S	
<i>Muhlenbergia xerophila</i>	Weeping Muhly	Vascular Plant			S	
<i>Myotis velifer</i>	Cave Myotis	Vertebrate Animal	SC	S		
<i>Neophasia terlootii</i>	Chiricahua Pine White	Invertebrate Animal			S	
<i>Notholaena lemmonii</i>	Lemmon Cloak Fern	Vascular Plant	SC			
<i>Oxybelis aeneus</i>	Brown Vinesnake	Vertebrate				WSC

		Animal				
<i>Pachyramphus aglaiae</i>	Rose-throated Becard	Vertebrate				WSC
		Animal				
<i>Pandion haliaetus</i>	Osprey	Vertebrate				WSC
		Animal				
<i>Panthera onca</i>	Jaguar	Vertebrate	LE		S	WSC
		Animal				
<i>Paspalum virletii</i>	Virlet Paspalum	Vascular Plant			S	
<i>Passiflora foetida</i>	Foetid Passionflower	Vascular Plant			S	
<i>Pectis imberbis</i>	Beardless Chinch Weed	Vascular Plant	SC		S	
<i>Penstemon discolor</i>	Catalina Beardtongue	Vascular Plant			S	
<i>Penstemon superbus</i>	Superb Beardtongue	Vascular Plant			S	
<i>Physalis latiphysa</i>	Broad-leaf Ground-cherry	Vascular Plant			S	
<i>Poeciliopsis occidentalis</i>	Gila Topminnow	Vertebrate	LE			WSC
<i>occidentalis</i>		Animal				
<i>Polioptila nigriceps</i>	Black-capped Gnatcatcher	Vertebrate				WSC
		Animal				
<i>Psilotum nudum</i>	Whisk Fern	Vascular Plant				
<i>Pyrgulopsis thompsoni</i>	Huachuca Springsnail	Invertebrate	C	S	S	
		Animal				
<i>Rana chiricahuensis</i>	Chiricahua Leopard Frog	Vertebrate	LT		S	WSC
		Animal				
<i>Rana yavapaiensis</i>	Lowland Leopard Frog	Vertebrate	SC		S	WSC
		Animal				
<i>Rhinichthys osculus</i>	Speckled Dace	Vertebrate	SC	S		
		Animal				
<i>Samolus vagans</i>	Chiricahua Mountain Brookweed	Vascular Plant			S	
<i>Senecio carlomasonii</i>	Seemann Groundsel	Vascular Plant			S	
<i>Senecio huachucanus</i>	Huachuca Groundsel	Vascular Plant			S	
<i>Sigmodon ochrognathus</i>	Yellow-nosed Cotton Rat	Vertebrate	SC			
		Animal				
<i>Sisyrinchium cernuum</i>	Nodding Blue-eyed Grass	Vascular Plant			S	
<i>Solanum lumholtzianum</i>	Lumholtz Nightshade	Vascular Plant			S	
<i>Sorex arizonae</i>	Arizona Shrew	Vertebrate	SC		S	WSC
		Animal				
<i>Spiranthes delitescens</i>	Madrean Ladies'-tresses	Vascular Plant	LE			

<i>Stenorrhynchos michuacanum</i>	Michoacan Ladies'-tresses	Vascular Plant				
<i>Stevia lemmonii</i>	Lemmon's Stevia	Vascular Plant			S	
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Vertebrate Animal	LT		S	WSC
<i>Sympetrum signiferum</i>	Mexican Meadowfly	Invertebrate Animal			S	
<i>Talinum humile</i>	Pinos Altos Flame Flower	Vascular Plant	SC		S	
<i>Talinum marginatum</i>	Tepic Flame Flower	Vascular Plant	SC		S	
<i>Tephrosia thurberi</i>	Thurber Hoary Pea	Vascular Plant			S	
<i>Thamnophis eques megalops</i>	Northern Mexican Gartersnake	Vertebrate Animal	SC		S	WSC
<i>Thomomys umbrinus intermedius</i>	Southern Pocket Gopher	Vertebrate Animal			S	
<i>Tragia laciniata</i>	Sonoran Noseburn	Vascular Plant			S	
<i>Trogon elegans</i>	Elegant Trogon	Vertebrate Animal				WSC
<i>Tyrannus crassirostris</i>	Thick-billed Kingbird	Vertebrate Animal				WSC
<i>Tyrannus melancholicus</i>	Tropical Kingbird	Vertebrate Animal				WSC
<i>Viola umbraticola</i>	Shade Violet	Vascular Plant			S	
<b>Yavapai</b>						
<i>Cicindela oregona maricopa</i>	Maricopa Tiger Beetle	Invertebrate Animal	SC	S	S	
<i>Cylloepus parkeri</i>	Parker's Cylloepus Riffle Beetle	Invertebrate Animal	SC		S	
<i>Metrichia nigrutta</i>	Page Spring Micro Caddisfly	Invertebrate Animal	SC			
<i>Protophila balmorhea</i>	Balmorhea Saddle-case Caddisfly	Invertebrate Animal	SC			
<i>Pyrgulopsis glandulosa</i>	Verde Rim Springsnail	Invertebrate Animal	SC	S	S	
<i>Pyrgulopsis montezumensis</i>	Montezuma Well Springsnail	Invertebrate Animal	SC	S	S	
<i>Pyrgulopsis morrisoni</i>	Page Springsnail	Invertebrate Animal	C	S	S	

<i>Pyrgulopsis sola</i>	Brown Springsnail	Invertebrate Animal	SC	S	S	
<i>Agave arizonica</i>	Arizona Agave	Vascular Plant	LE		S	
<i>Agave delamateri</i>	Tonto Basin Agave	Vascular Plant	SC		S	
<i>Agave mckelveyana</i>	Mckelvey's Agave	Vascular Plant				
<i>Agave murpheyi</i>	Hohokam Agave	Vascular Plant	SC	S	S	
<i>Agave toumeyana</i> var. <i>bella</i>	Toumey Agave	Vascular Plant				
<i>Allium bigelovii</i>	Bigelow Onion	Vascular Plant				
<i>Astragalus newberryi</i> var. <i>aquarii</i>		Vascular Plant		S		
<i>Carex ultra</i>	Arizona Giant Sedge	Vascular Plant		S	S	
<i>Eriogonum apachense</i>	Apache Wild-buckwheat	Vascular Plant	SC			
<i>Eriogonum ericifolium</i> var. <i>ericifolium</i>	Heathleaf Wild-buckwheat	Vascular Plant			S	
<i>Eriogonum ripleyi</i>	Ripley Wild-buckwheat	Vascular Plant	SC		S	
<i>Fremontodendron</i> <i>californicum</i>	Flannel Bush	Vascular Plant		S		
<i>Hedeoma diffusum</i>	Flagstaff Pennyroyal	Vascular Plant			S	
<i>Heuchera eastwoodiae</i>	Eastwood Alum Root	Vascular Plant			S	
<i>Lupinus latifolius</i> ssp. <i>leucanthus</i>	Broadleaf Lupine	Vascular Plant			S	
<i>Mammillaria viridiflora</i>	Varied Fishhook Cactus	Vascular Plant				
<i>Penstemon nudiflorus</i>	Flagstaff Beardtongue	Vascular Plant			S	
<i>Phacelia parishii</i>	Parish's Phacelia	Vascular Plant		S		
<i>Phlox amabilis</i>	Arizona Phlox	Vascular Plant			S	
<i>Polygala rusbyi</i>	Hualapai Milkwort	Vascular Plant			S	
<i>Purshia subintegra</i>	Arizona Cliff Rose	Vascular Plant	LE			
<i>Salvia dorrii</i> ssp. <i>mearnsii</i>	Verde Valley Sage	Vascular Plant	SC		S	
<i>Talinum validulum</i>	Tusayan Flame Flower	Vascular Plant	SC			
<i>Thelypteris puberula</i> var. <i>sonorensis</i>	Aravaipa Wood Fern	Vascular Plant		S		
<i>Accipiter gentilis</i>	Northern Goshawk	Vertebrate Animal	SC		S	WSC
<i>Agosia chrysogaster</i>	Longfin Dace	Vertebrate	SC	S		

		Animal				
<i>Athene cunicularia</i>	Western Burrowing Owl	Vertebrate	SC	S		
<i>hypugaea</i>		Animal				
<i>Buteo regalis</i>	Ferruginous Hawk	Vertebrate	SC			WSC
		Animal				
<i>Buteogallus anthracinus</i>	Common Black-hawk	Vertebrate			S	WSC
		Animal				
<i>Catostomus clarki</i>	Desert Sucker	Vertebrate	SC	S		
		Animal				
<i>Catostomus insignis</i>	Sonora Sucker	Vertebrate	SC	S		
		Animal				
<i>Ceryle alcyon</i>	Belted Kingfisher	Vertebrate				WSC
		Animal				
<i>Charina trivirgata gracia</i>	Desert Rosy Boa	Vertebrate	SC	S	S	
		Animal				
<i>Coccyzus americanus</i>	Western Yellow-billed Cuckoo	Vertebrate	C		S	WSC
<i>occidentalis</i>		Animal				
<i>Corynorhinus townsendii</i>	Pale Townsend's Big-eared Bat	Vertebrate	SC			
<i>pallascens</i>		Animal				
<i>Cyprinodon macularius</i>	Desert Pupfish	Vertebrate	LE			WSC
		Animal				
<i>Empidonax traillii</i>	Southwestern Willow	Vertebrate	LE		S	WSC
<i>extimus</i>	Flycatcher	Animal				
<i>Euderma maculatum</i>	Spotted Bat	Vertebrate	SC	S		WSC
		Animal				
<i>Falco peregrinus anatum</i>	American Peregrine Falcon	Vertebrate	SC		S	WSC
		Animal				
<i>Gila intermedia</i>	Gila Chub	Vertebrate	PE		S	WSC
		Animal				
<i>Gila robusta</i>	Roundtail Chub	Vertebrate	SC		S	WSC
		Animal				
<i>Gopherus agassizii</i>	Sonoran Desert Tortoise	Vertebrate	SC			WSC
<i>(Sonoran population)</i>		Animal				
<i>Haliaeetus leucocephalus</i>	Bald Eagle	Vertebrate	LT		S	WSC
		Animal				
<i>Heloderma suspectum</i>	Banded Gila Monster	Vertebrate	SC	P		
<i>cinctum</i>		Animal				
<i>Lasiurus blossevillii</i>	Western Red Bat	Vertebrate				WSC
		Animal				

<i>Macrotus californicus</i>	California Leaf-nosed Bat	Vertebrate Animal	SC	S		WSC
<i>Meda fulgida</i>	Spikedace	Vertebrate Animal	LT		S	WSC
<i>Microtus mexicanus</i> <i>hualpaiensis</i>	Hualapai Mexican Vole	Vertebrate Animal	LE			WSC
<i>Myotis thysanodes</i>	Fringed Myotis	Vertebrate Animal	SC	S		
<i>Myotis velifer</i>	Cave Myotis	Vertebrate Animal	SC	S		
<i>Myotis volans</i>	Long-legged Myotis	Vertebrate Animal	SC	S		
<i>Nyctinomops</i> <i>femorosaccus</i>	Pocketed Free-tailed Bat	Vertebrate Animal			S	
<i>Nyctinomops macrotis</i>	Big Free-tailed Bat	Vertebrate Animal	SC	S		
<i>Poeciliopsis occidentalis</i> <i>occidentalis</i>	Gila Topminnow	Vertebrate Animal	LE			WSC
<i>Ptychocheilus lucius</i>	Colorado Pikeminnow	Vertebrate Animal	LEXN			WSC
<i>Rallus longirostris</i> <i>yumanensis</i>	Yuma Clapper Rail	Vertebrate Animal	LE			WSC
<i>Rana chiricahuensis</i>	Chiricahua Leopard Frog	Vertebrate Animal	LT		S	WSC
<i>Rana pipiens</i>	Northern Leopard Frog	Vertebrate Animal			S	WSC
<i>Rana yavapaiensis</i>	Lowland Leopard Frog	Vertebrate Animal	SC		S	WSC
<i>Rhinichthys osculus</i>	Speckled Dace	Vertebrate Animal	SC	S		
<i>Setophaga ruticilla</i>	American Redstart	Vertebrate Animal				WSC
<i>Strix occidentalis lucida</i>	Mexican Spotted Owl	Vertebrate Animal	LT		S	WSC
<i>Thamnophis eques</i> <i>megalops</i>	Northern Mexican Gartersnake	Vertebrate Animal	SC		S	WSC
<i>Thamnophis</i> <i>rufipunctatus</i>	Narrow-headed Gartersnake	Vertebrate Animal	SC		S	WSC
<i>Xantusia arizonae</i>	Arizona Night Lizard	Vertebrate Animal			S	

	<i>Xyrauchen texanus</i>	Razorback Sucker	Vertebrate Animal	LE		S	WSC
<b>Yuma</b>							
	<i>Ardea alba</i>	Western Yellow-billed Cuckoo	Vertebrate Animal	C		S	WSC
	<i>Athene cunicularia hypugaea</i>	Southwestern Willow Flycatcher	Vertebrate Animal	LE		S	WSC
	<i>Coccyzus americanus occidentalis</i>	Yuma Clapper Rail	Vertebrate Animal	LE			WSC
	<i>Egretta thula</i>	Western Burrowing Owl	Vertebrate Animal	SC	S		
	<i>Empidonax traillii extimus</i>	California Black Rail	Vertebrate Animal	SC		S	WSC
	<i>Laterallus jamaicensis coturniculus</i>	California Leaf-nosed Bat	Vertebrate Animal	SC	S		WSC
	<i>Macrotus californicus</i>	Yuma Myotis	Vertebrate Animal	SC			
	<i>Myotis yumanensis</i>	Flat-tailed Horned Lizard	Vertebrate Animal	SC			WSC
	<i>Nyctinomops femorosaccus</i>	Yuma Hispid Cotton Rat	Vertebrate Animal	SC			
	<i>Phrynosoma mcallii</i>	Yuman Desert Fringe-toed Lizard	Vertebrate Animal	SC	S	S	WSC
	<i>Rallus longirostris yumanensis</i>	Great Egret	Vertebrate Animal				WSC
	<i>Sigmodon hispidus eremicus</i>	Snowy Egret	Vertebrate Animal				WSC
	<i>Uma notata rufopunctata</i>	Pocketed Free-tailed Bat	Vertebrate Animal			S	

Appendix F: Private forest acres that contain environmentally important values for each county.

<b>County</b>	<b>Number of Threatened, Endangered, Sensitive, Special Concern Species</b>	<b>Conservation Area (acres)</b>	<b>Public Value (acres)</b>	<b>Threat by Road / Development (acres)</b>
<b>Apache</b>	55	5,540	352,044	95,194
<b>Cochise</b>	153	49,350	69,817	21,401
<b>Coconino</b>	87	137,887	556,511	150,174
<b>Gila</b>	66	8,731	22,254	13,598
<b>Graham</b>	69	4,263	10,853	4,630
<b>Greenlee</b>	44	11,409	14,783	3,920
<b>La Paz</b>	22	675	2,408	117
<b>Maricopa</b>	48	2,567	12,768	5,890
<b>Mohave</b>	73	90,361	269,979	77,093
<b>Navajo</b>	24	43,793	479,983	11,330
<b>Pima</b>	99	3,812	12,464	8,031
<b>Pinal</b>	61	7,272	16,346	8,871
<b>Santa Cruz</b>	121	13,124	21,473	10,702
<b>Yavapai</b>	74	254,226	548,861	126,366
<b>Yuma</b>	13	796	3,340	2,000

Appendix G: Letter sent to Arizona National Forest supervisors, sent via email March 12, 2004.

Dear Forest Supervisor:

The Arizona State Land Department has expressed interested in participating in the federal Forest Legacy Program (FLP). The FLP was established in 1990 by the U.S. Forest Service to protect environmentally sensitive forestlands. This federal program partners the Forest Service with the state lead agency [Arizona State Land Department] to provide funding to states to assist them in securing conservation easements on private forestlands threatened with conversion to non-forest uses. There are currently 33 states and territories active in the FLP and the 2003 budget appropriations were \$68 million, earmarked for 43 projects. This entirely voluntary program was designed to encourage the protection of privately owned forestlands. *For more information visit the FLP web site at:* <http://www.fs.fed.us/spf/coop/programs/loa/flp.shtml>

To participate in the FLP, a state needs to develop an Assessment of Need (AON) in consultation with the State Forest Stewardship Coordinating Committee. The Nature Conservancy was awarded the contract to prepare the Arizona Assessment of Need by the Arizona State Land Department. The AON must document the State's need for a Forest Legacy Program, establish eligibility criteria, set guidelines, and identify priority areas for protection. Such areas must, at a minimum, meet the following criteria:

- Environmentally important forest areas, which include areas important for scenic, recreational, riparian, ecological, cultural, or traditional forest uses, and be
- Threatened by conversion to non-forest uses.

Due to the short time frame of this project (30 June 2004), we are requesting your assistance to identify priority forestlands. Specifically, we are interested in learning about existing in-holdings and adjacent forestlands that are currently threatened by conversion to non-forest uses. We are also interested in information regarding whether conservation easements already exist or if the USFS is planning on purchasing certain parcels; such information would be helpful in our analysis. Any information you could share would be appreciated, however, spatially explicit information would be most useful. We hope to have this information gathered by the end of March so we can include is information in the Assessment of Need. Please feel free to contact us. We will follow-up this email with a phone call during the week of March 29<sup>th</sup>.

Thank you for your assistance in the Forest Legacy Program.

Sincerely,

The Nature Conservancy, Arizona Chapter  
Heather Schussman, Fire Science Specialist, 520-622-3861 x3440, [hschussman@tnc.org](mailto:hschussman@tnc.org)  
Dana Backer, Conservation Ecologist, 520-622-3861 x3473, [dbacker@tnc.org](mailto:dbacker@tnc.org)

Appendix H: Sample article of Forest Legacy Program featured in The Nature Conservancy's spring 2004 newsletter.



*The Scenery and Solitude of the season encourage a quiet mind to remember that it's the little things—often invisible to the eye—that make the world go around.*

— MARK PRETTI, RAMSEY CANYON NATURALIST

## Preserving Forested Lands

Preserving the function of whole systems, not just small patches of land, is key to the health of our forests and other habitats—a concept that drove the creation of the U.S. Forest Service's **Forest Legacy Program**. This program provides funds to states for conservation easements on private forested lands important to the integrity of our forests and to the natural processes — like fire — that can keep them healthy.

Contrary to the common perception of Arizona as a desert state, almost 30% is forested land — mostly mixed conifer and ponderosa pine, oak and pinyon pine-juniper woodlands. Most are state, tribal or federal lands, but 2.6 million acres of our forests are in private hands. And through the years, when people bought their chunk of earth to work, live, or vacation on, they naturally looked for appealing and rich lands — often blessed with waterways and abundant wildlife. Some private lands connect state or national forests. It is here on these key private lands, where Forest Legacy funding could help keep the forest functioning. Legacy funds can be used for conservation easements that might keep these lands undeveloped, keeping movement corridors open for wildlife and allowing beneficial fires to burn through.

However, Arizona doesn't qualify for these funds. *Yet*. In order to qualify, the State needs to submit an assessment of private forested lands that evaluates threatened and endangered species, water and land resources, cultural resources, scenic views, and other elements. This is where we come in. The State Land Department has contracted with The Nature Conservancy to assess data on the various criteria and identify private lands that are eligible for funding under the Forest Legacy Program. In January, we began evaluating available information and applying that to our regional analyses and other available data to identify and prioritize Forest Legacy areas. Conservancy staff will also visit field sites to verify the recommendations. With a final assessment and recommendations in hand this summer, the state can apply for program funds. Last year, New Mexico received nearly \$2 million from the Forest Legacy Program to help save forests, while protecting wildlife habitat, and recreational opportunities.

The information we gather will also contribute to the “big picture” for The Nature Conservancy's work in Arizona. It is likely that the Forest Legacy funds will also help protect some high priority riparian habitats in our forests. Conservation Science staff Heather Schussman and Dana Backer lead this project for the Conservancy, working closely with the Forest Service.

## Appendix I: Economic data, forest descriptions and demographics by County

### Apache County

#### General Description

Apache County includes all or part of the Navajo, Hopi, and Fort Apache Indian reservations, Sitgreaves National Forest, Petrified Forest National Park, Canyon De Chelly National Monument, as well as private, state and BLM lands. All of Chinle Creek and the headwaters of the Little Colorado and Black Rivers are within this County.

Vegetation within the county ranges from Great Basin grasslands and pinyon-juniper woodlands in the northern region to mixed conifer forest in the southern region with strands of riparian forest vegetation along perennial water courses. These forestlands support several native fish populations such as, desert (*Catostomus clarki*), Sonoran (*Catostomus insignis*), and Little Colorado sucker (*Catostomus sp. 3*) and obligate riparian bird species like the Southwestern willow flycatcher and Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*). The mixed conifer forests are key habitats for Northern goshawk and American peregrine falcon (*Falco peregrinus anatum*) populations and herbaceous plant species such as White Mountain clover (*Trifolium neurophyllum*) and paintbrush (*Castilleja mogollonica*).

In total there are 55 threatened, endangered, sensitive or of special concern species within this County. Apache County is 7.2 million acres in size and of all the private forestlands, 5,540 acres are within a TNC conservation area, 352,044 acres are publicly important, and 95,194 acres are currently threatened by roads and/or development.

#### Growth and Development Patterns

Apache County was carved from Yavapai County – one of Arizona’s original four counties – in 1879. The Apache and Navajo Indian reservations cover more than 65% of the county, and 25% of the state’s Native Americans live here. Approximately 21% of the county is public land while 13.2% is privately owned.

The forested White Mountains and higher elevation grasslands in the south of the county contrast sharply with the high, dry, colorful plateau region of the north. National Parks and Monuments (Petrified Forest and Canyon de Chelly respectively), the Painted Desert, and Native American craft centers such as the Hubbell Trading Post (National Historic Site) are great tourist attractions in the northern part of the county. Excellent fishing, hunting, and skiing make the White Mountains a year-round recreation area. Other tourist opportunities include the numerous archaeological sites, which are open to the public.

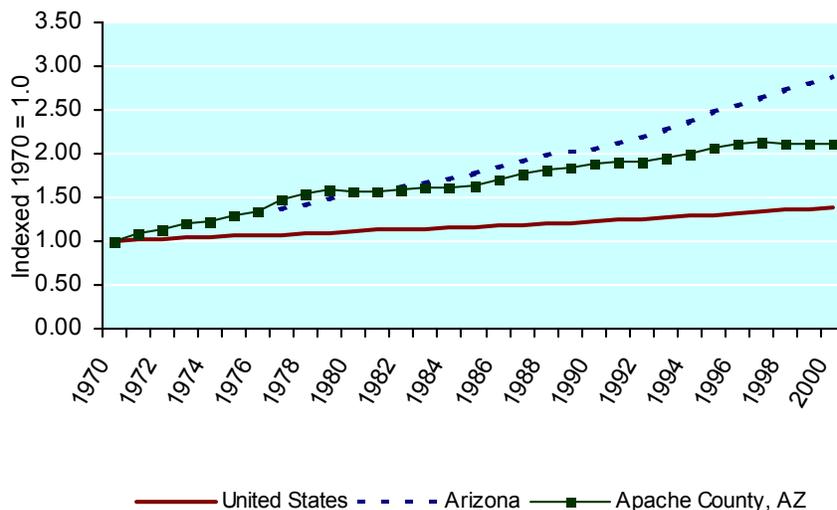
Since 1970, the population of Apache County has grown by 36,342 people, a 111% increase. This growth has been slower than the rest of the state average but is faster than the national average (Figure 1a). Due to employment increases in government jobs and services, a growing population has created demand for over 1,000 construction jobs. During the same period, land-based employment (farm, agriculture, services and manufacturing) has declined significantly, creating only 17 new jobs (Figure 1b and 1c).

The significant increase in population and job growth may have resulted in important economic improvement in the short run. However, with this growth has come the need to convert agriculture and other open lands into development for homes and service-related businesses. Given the importance of tourism to this county, the transformation of scenic to commercial development is likely to have an overall negative impact on the county's economic and environmental future over the long run.

#### Goals and Objectives

- 1) Decrease fragmentation from development within the pinyon-juniper woodlands and mixed conifer forests by protecting private forestlands within and bordering the Sitgreaves and Apache National Forests.
- 2) Protect public values in riparian forests and native fish habitat by protecting private forest along perennial water.

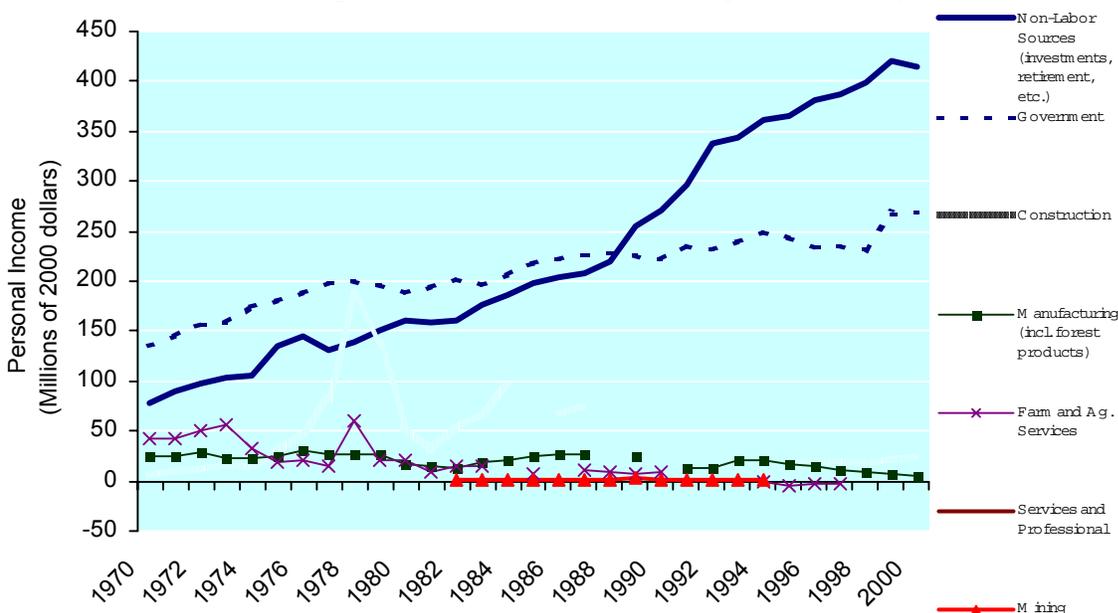
**Figure 1a - Population Compared to the State and Nation, Apache County**



**Figure 1b - Employment by industry, Apache County**

	1970	% of Total	2000	% of Total	New Employment	% of New Employment
<b>Total Employment</b>	10,517		23,060		<b>12,543</b>	
<b>Farm and Agricultural Services</b>	296	2.8%	#N/A	#N/A	#N/A	#N/A
<b>Farm</b>	272	2.6%	289	1.3%	<b>17</b>	<b>0.1%</b>
<b>Ag. Services</b>	24	0.2%	#N/A	#N/A	#N/A	#N/A
<b>Manufacturing (incl. forest products)</b>	725	6.9%	164	0.7%	<b>-561</b>	<b>NA</b>
<b>Services and Professional</b>	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
<b>Construction</b>	133	1.3%	1,178	5.1%	<b>1,045</b>	<b>8.3%</b>
<b>Government</b>	3,924	37.3%	6,738	29.2%	<b>2,814</b>	<b>22.4%</b>

**Figure 1c - Personal income, Apache County**



1

<sup>1</sup> Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

## Cochise County

### General Description

Cochise County includes all or part of the Coronado National Forest, Coronado National Memorial, Chiricahua National Monument, Fort Huachuca Military Reservation, San Bernardino National Wildlife Refuge; and Baker Canyon, Dos Cabezas Mountains, Peloncillo Mountains, Redfield Canyon wilderness areas; private, state, and other BLM lands . Large portions of the San Pedro watershed and the river itself are within Cochise County. There are several other small perennial creeks and streams, most notably Leslie Creek.

The dominant vegetation is mixed conifer and Madrean oak woodland mountains connected by semi-desert grassland seas. Intermingled with these two vegetation types are riparian gallery forests found along perennial or intermittent water sources. This county is part of a greater geographic region referred to as the Madrean Archipelago, which has recently been added to Conservation International's list of the world's hotspots for biodiversity (Andrew Smith personal communication). Its forest lands are home to a large array of species ranging from the endangered Huachuca water umbel (*Lilaeopsis schaffneriana* var. *recurva*) to the Mexican spotted owl. Several species of bats and hummingbirds migrate through this area while some animals, like the elegant trogon (*Trogon elegans*) and jaguar (*Panthera onca*) reach their northern limits in these forests.

There are 153 threatened, endangered, sensitive or of special concern species recorded within this county. With close to 4 million acres, Cochise County is as big as Rhode Island and Connecticut combined. There are 49,350 acres of private forest within a conservation area, 69,817 acres of publicly important private forest, and 21,401 acres of private forest currently threatened by roads and/or development.

### Growth and Development Patterns

Cochise County was named for the renowned Apache chief, when it was established in 1881. Archeological finds date civilization along the San Pedro River to 9000-6000 B.C., when members of the Clovis civilization inhabited the area. Tombstone and Bisbee were cities created from famous silver and copper mining operations in the late 19<sup>th</sup> Century. Today, they are busy tourist destinations. Sierra Vista, the largest city in the county is home to Fort Huachuca, one of the largest civilian employers in southern Arizona, and a rapidly growing population of retirees – many of whom have built winter residences in the area.

Cochise County is also an important agricultural area. Once known as the Cattle Capital of the nation, Willcox is the home of the largest weekly cattle auction in Arizona. Specialty crops and livestock, including exotic animals play an important role in the local economy. Individual and corporate ownership accounts for 40% of the land; the State of Arizona, 34.6%; the U.S. Forest Service and Bureau of Land Management, 22.2%; and other public lands comprise the remaining 3.2%.

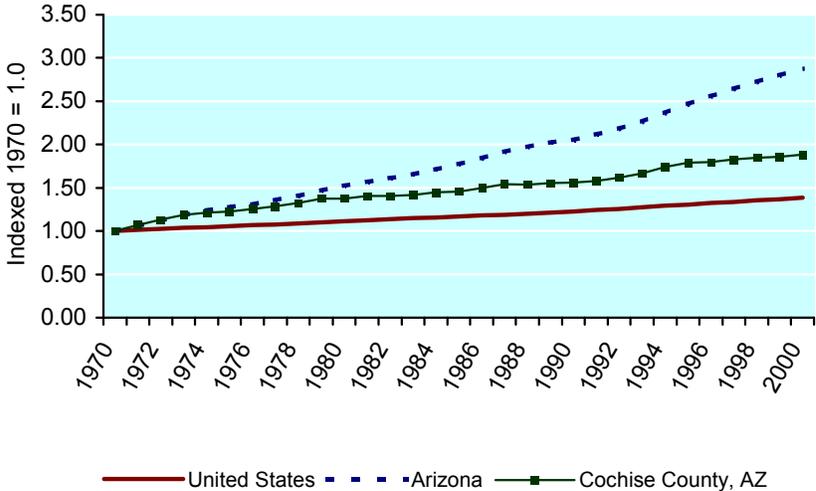
Since 1970, the population of Cochise County has grown by 55,341 people, an 88% increase. Similar to Apache County, growth has been slower than the state average and faster than the national average (Figure 2a). This growth can be largely attributed to three factors: (1) more than an 18% increase in employment at Fort Huachuca; (2) an influx of retirees who enjoy the county's mild winter climate; and (3) a 78% increase in business and services that support these newcomers (Figure 2b and 2c). While past population growth has not been as dynamic as some other counties in Arizona, the on going "war on terror" is likely to demand even more military personnel. And the flood of "baby boomers" retirees will most certainly cause the population of this county to skyrocket because of its great scenic beauty and moderate high elevation climate. As an indication of this growth, the town of Sierra Vista recently approved a single development that will add 15,000 to 20,000 people to the current community population of 40,000.

When the 9% growth of housing and commercial development construction jobs is compared to a less than 5% growth in farm and agriculture services, it becomes clear that land needing to be conserved for biodiversity and natural resource purposes is likely to fall victim to homes, offices, and stores.

#### Goals and Objectives

- 1) Protect public and ecological values as well as riparian forest and native fish habitat. Focus on riparian forest along perennial stream reaches but also areas ephemeral reaches with shallow groundwater.
- 2) Decrease fragmentation within Coronado National Forest by protecting key Madrean oak woodlands that border or are within USFS boundary.

**Figure 2a - Population compared to the state and nation, Cochise County**

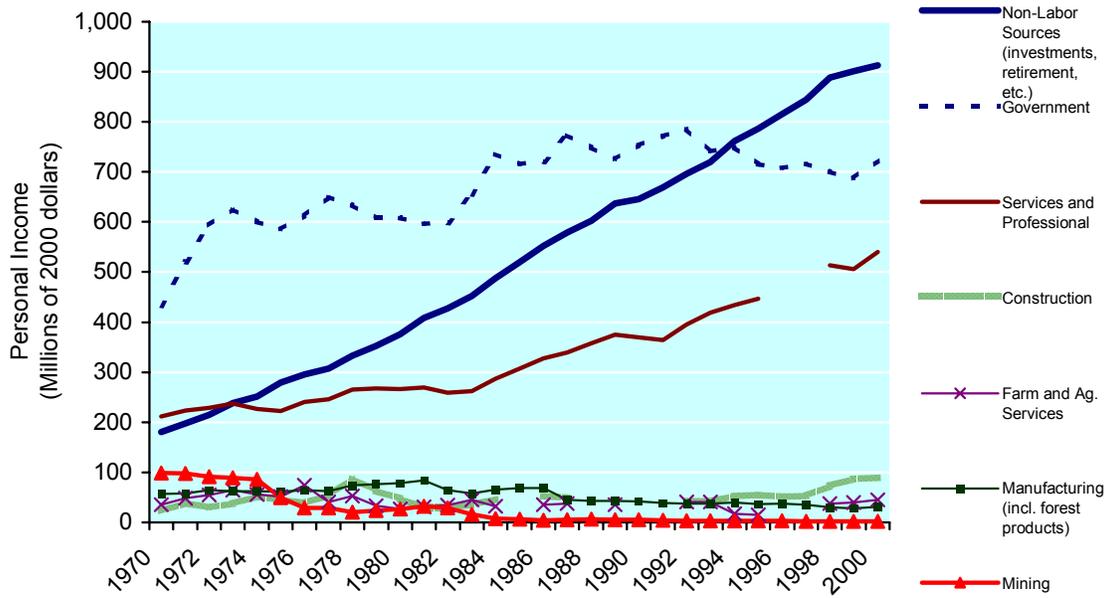


**Figure 2b - Employment by industry, Cochise County**

	1970	% of Total	2000	% of Total	New Employment	% of New Employment
<b>Total Employment</b>	26,167		50,041		<b>23,874</b>	
<b>Farm and Agricultural Services</b>	1,502	5.7%	2,373	4.7%	<b>871</b>	<b>3.6%</b>
<b>Farm</b>	1,276	4.9%	1,575	3.1%	<b>299</b>	<b>1.3%</b>
<b>Ag. Services</b>	226	0.9%	798	1.6%	<b>572</b>	<b>2.4%</b>
<b>Manufacturing (incl. forest products)</b>	1,594	6.1%	1,285	2.6%	<b>-309</b>	<b>NA</b>
<b>Services and Professional</b>	8,845	33.8%	27,484	54.9%	<b>18,639</b>	<b>78.1%</b>
<b>Construction</b>	645	2.5%	2,849	5.7%	<b>2,204</b>	<b>9.2%</b>
<b>Government</b>	11,633	44.5%	15,986	31.9%	<b>4,353</b>	<b>18.2%</b>

*Agricultural Services* include soil preparation services, crop services, etc. It also includes forestry services, such as reforestation services, and fishing, hunting, and trapping

**Figure 2c - Personal income by industry, Cochise County**



1

<sup>1</sup> Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

## Coconino County

### General Description

Coconino County includes all or part of the Navajo, Hopi, Hualapai, and Havasupai Indian Reservations, Coconino and Kaibab National Forests, Grand Canyon National Park, Wupatki and Sunset Crater Volcano National Monuments, Paria Canyon Vermilion Cliffs Wilderness Area, private, state, and other BLM lands. Other attractions are Oak Creek Canyon, prehistoric Indian ruins at Wupatki, Walnut Canyon, the Navajo National Monument, the San Francisco Peak (Arizona's highest point at 3850 m), and Lake Powell, with 1,960 miles of shoreline. Portions of the Colorado River and Clear Creek also flow through this county.

Vegetation within the county is a mixture of Great Basin grassland and pinyon-juniper woodlands along with mixed conifer forests in the upper elevations. These forest lands are key habitat for many raptors, such as the Northern goshawk, Ferruginous hawk (*Buteo regalis*), Western burrowing owl (*Athene cunicularia hypugaea*), Mexican spotted owl, and the American peregrine falcon. They also support a host of plant species such as the San Francisco Peaks groundsel (*Senecio franciscanus*) and Flagstaff beard tongue (*Penstemon nudiflorus*).

Coconino County (11.9 million acres) is the second largest county in the United States and the largest in Arizona - characterized by rugged mountains, deep canyons and thick forests of pine, spruce, aspen, and oak. A total of 87 threatened, endangered, sensitive or of special concern species are within this county. There are 137,887 acres of private forest within a conservation area, 556,511 acres of publicly important private forest, and 150,174 acres of private forest currently threatened by roads and/or development.

### Growth and Development Patterns

The 16th Territorial Assembly created Coconino County, also carved out of Yavapai County in 1891. Coconino County lies in the central region of northern Arizona, which was crossed by Spanish expeditions during the 16th, 17<sup>th</sup>, and 18th centuries, and by fur trappers and traders in the 1820s and 1830s. Cattle and sheep ranching started in the 1870s and when the railroad began serving the area a decade later, the lumber business boomed. Flagstaff, home of Northern Arizona University, remains the county seat. Today, this county is considered a year-round Mecca for outdoor activities.

Indian reservations comprise 38.1% of the land, while the U.S. Forest Service and Bureau of Land Management control 32.3% of the land; the state of Arizona owns 9.5%; other public lands comprise 6.8 %; and the remaining 13.3% is owned by individuals or corporations. The central corridor of Coconino County has been designated as an Enterprise Zone, as well as the central corridor of the City of Flagstaff.

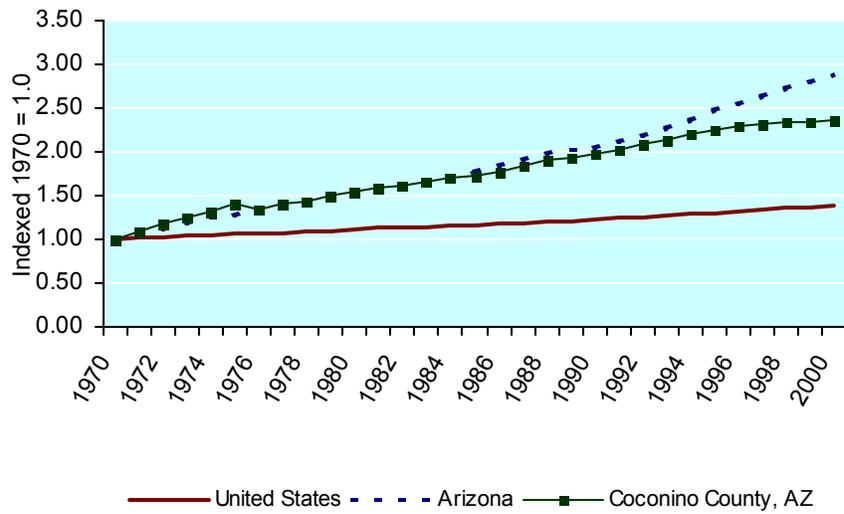
Since 1970, the population of Coconino County has grown by 67,463 people, a 137% increase. This growth has been slower than the state and faster than the nation (Figure 3a). Coconino County is expected to add more than 54,000 residents in the next 20 years.

Given the large amount of open land in this county, one might be inclined to dismiss the impact of population growth. However, the population is concentrated into one main area of the county – near the Coconino National Forest. Within this area, Flagstaff is the third largest city in the state, and Sedona has become a destination for tourism and expensive retirement and recreation homes. The following table and graph support this trend in the transformation of forested land for housing and commercial development. They show a loss of farm jobs while construction has grown by nearly 7% in support of 71% increase in service and professional jobs, and an 18 % increase in government employment (Figure 3b). Also, personal income gains coming from non-labor sources – a prime indicator of retiree and wealthy non-retiree immigration in the county – are large (Figure 3c).

#### Goal and Objectives

- 1) Decrease forest fragmentation around Flagstaff and along Interstate 40 by protecting mixed conifer forest within and bordering Coconino National Forest.
- 2) Protect traditional forest uses by focusing attention on pinyon-juniper woodlands in the west central portion of this county.

**Figure 3a - Population compared to state and nation, Coconino County**

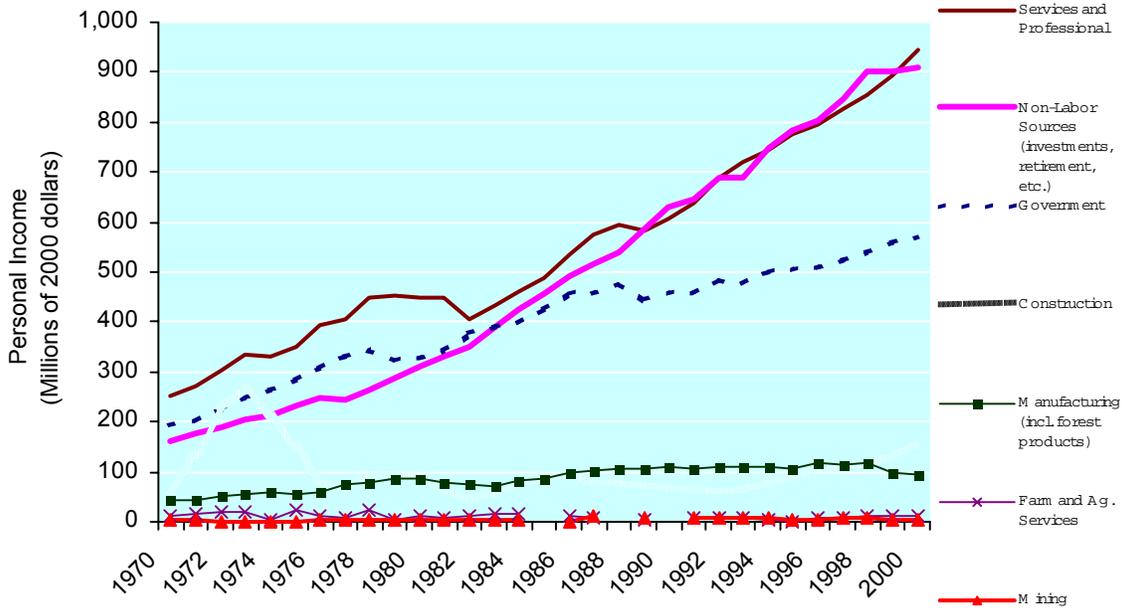


**Figure 3b - Employment by industry, Coconino County**

	1970	% of Total	2000	% of Total	New Employment	% of New Employment
<b>Total Employment</b>	20,145		70,657		<b>50,512</b>	
<b>Farm and Agricultural Services</b>	338	1.7%	810	1.1%	<b>472</b>	<b>0.9%</b>
<b>Farm</b>	283	1.4%	239	0.3%	<b>-44</b>	<b>NA</b>
<b>Ag. Services</b>	55	0.3%	571	0.8%	<b>516</b>	<b>1.0%</b>
<b>Manufacturing (incl. forest products)</b>	1,577	7.8%	2,919	4.1%	<b>1,342</b>	<b>2.7%</b>
<b>Services and Professional</b>	10,915	54.2%	46,928	66.4%	<b>36,013</b>	<b>71.3%</b>
<b>Construction</b>	1,271	6.3%	4,690	6.6%	<b>3,419</b>	<b>6.8%</b>
<b>Government</b>	5,944	29.5%	15,157	21.5%	<b>9,213</b>	<b>18.2%</b>

*Agricultural Services* include soil preparation services, crop services, etc. It also includes forestry services, such as reforestation services, and fishing, hunting, and trapping

**Figure 3c - Personal income by industry, Coconino County**



1

<sup>1</sup> Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

## **Gila County**

### **General Description**

Gila County includes all or part of the Fort Apache and San Carlos Indian Reservations, Tonto National Forest, Needle's Eye Wilderness Area and some private, state, and other BLM lands. The county is 3.1 million acres in size and contains the free-flowing portions of the Salt River, all of Cherry Creek and parts of the East Verde River.

Vegetation within this county is dominated by pinyon-juniper woodlands with semi-desert grasslands at lower elevations and mixed conifer forests at the upper elevations. These forest are key habitat for several bat species as well as many raptors, such as the Northern goshawk, Ferruginous hawk, Western burrowing owl, Mexican spotted owl, and the American peregrine falcon. Riparian forest vegetation and the supporting perennial water provides habitat for several native fish, including the razorback sucker (*Xyrauchen texanus*), speckled dace (*Rhinichthys osculus*), Gila topminnow (*Poeciliopsis occidentalis*), and Gila (*Gila intermedia*) and roundtail chub (*Gila robusta*). Other species in the riparian areas of this county include the northern (*Rana pipiens*), lowland (*Rana yavapaiensis*) and Chiricahua (*Rana chiricahuensis*) leopard frogs and Southwestern willow flycatchers.

In total there are 66 threatened, endangered, sensitive or of special concern species within this county. There are 8,731 acres of private forest within a conservation area, 22,254 acres of publicly important private forest, and 13,598 acres of private forest currently threatened by roads and/or development.

### **Growth and Development Patterns**

Gila County was created in 1881 from portions of Maricopa and Pinal counties, and later included parts of Yavapai County. The Globe Mining District, originally located on the San Carlos Indian Reservation, was reallocated to Gila County. Silver first attracted people to this area in the late 19th century. When the silver resources were depleted, copper emerged and has kept mining alive to this day. Globe is the county seat.

Some of the attractions in Gila County include the Salt River Canyon, Tonto National Monument, the Mogollon Rim, Tonto Natural Bridge State Park, Coolidge Dam, Roosevelt Dam, and Roosevelt Lake. Both desert terrain and mountain ranges spread across the county's landscape. Elevations range from 2,000 to 7,000 feet above sea level. In addition to copper production, tourism, recreation and commerce comprise the county's major industries. The U.S. Forest Service manages 55.5% of the land in Gila County. Approximately 37% belongs to the Apache Tribe; individuals and corporations own 3.7% of the land; the U.S. Bureau of Land Management, 1.9%; and the state of Arizona, 1%.

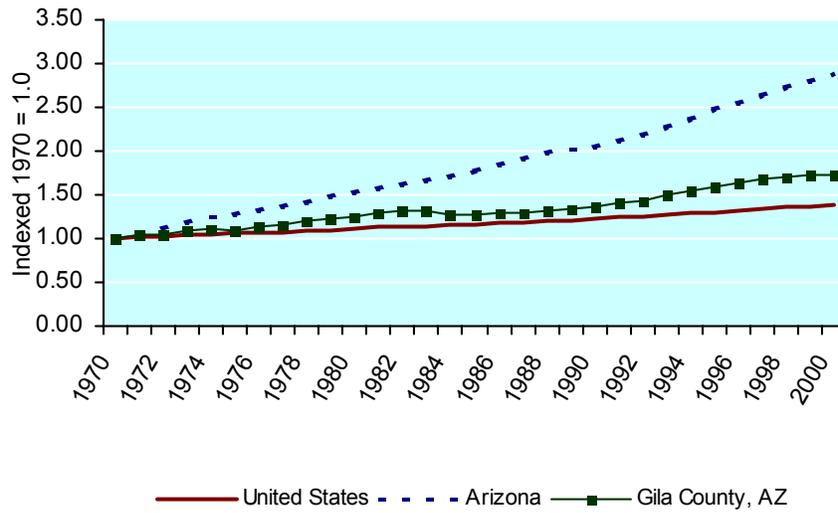
Since 1970, the population of Gila County has grown by 21,8233 people, a 74% increase. This growth has been slower than the state and faster than the nation (Figure 4a). Population growth seems to have had less impact on the county than many others in the

state. There has been a slight increase in farm jobs with the largest increase coming in services and government sector. Construction employment has been almost negligible, suggesting that there is minimal transformation of land into housing and commercial development in this county (Figure 4b and 4c).

#### Goals and Objectives

- 1) Decrease forest fragmentation within and bordering Tonto National Forest, focusing around Payson and along State Highway 260 as well as along the East Verde river.
- 2) Protect public and ecological values along with riparian forest and native fish habitat by focusing on riparian forest along perennial water.

**Figure 4a - Population compared to state and nation, Gila County**

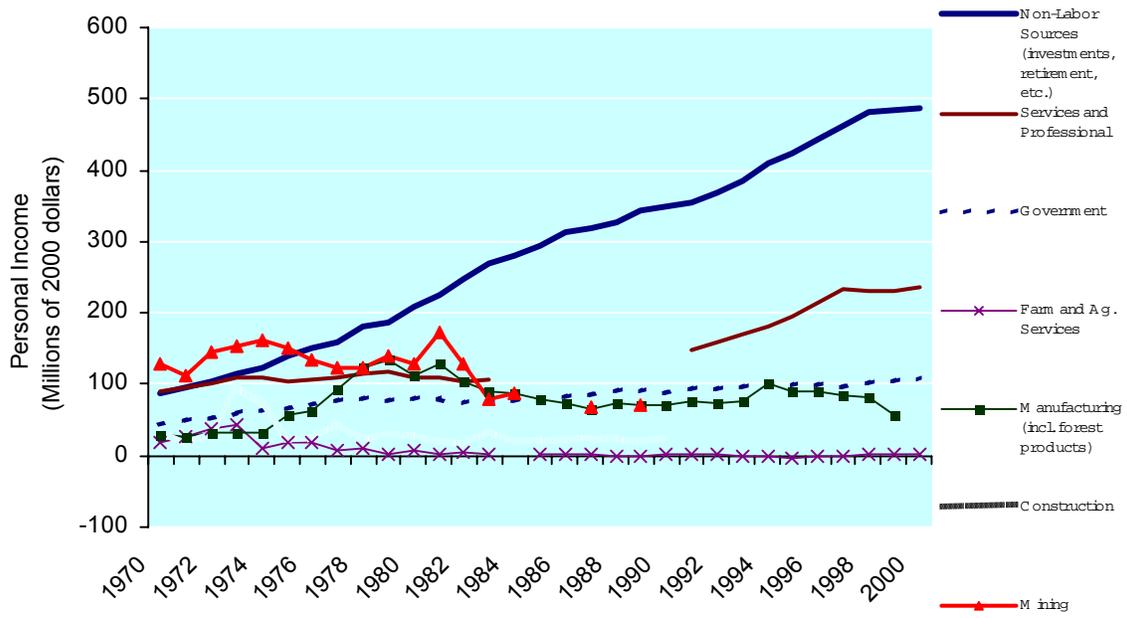


**Figure 4b - Employment by industry, Gila County**

	1970	% of Total	2000	% of Total	New Employment	% of New Employment
<b>Total Employment</b>	10,453		20,415		<b>9,962</b>	
<b>Farm and Agricultural Services</b>	187	1.8%	458	2.2%	<b>271</b>	<b>2.7%</b>
<b>Farm</b>	174	1.7%	252	1.2%	<b>78</b>	<b>0.8%</b>
<b>Ag. Services</b>	13	0.1%	206	1.0%	<b>193</b>	<b>1.9%</b>
<b>Manufacturing (incl. forest products)</b>	780	7.5%	#N/A	#N/A	#N/A	#N/A
<b>Services and Professional</b>	4,083	39.1%	13,052	63.9%	<b>8,969</b>	<b>90.0%</b>
<b>Construction</b>	699	6.7%	#N/A	#N/A	#N/A	#N/A
<b>Government</b>	1,578	15.1%	3,346	16.4%	<b>1,768</b>	<b>17.7%</b>

*Agricultural Services* include soil preparation services, crop services, etc. It also includes forestry services, such as reforestation services, and fishing, hunting, and trapping

**Figure 4c - Personal income by industry, Gila County**



1

<sup>1</sup> Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

## Graham County

### General Description

Graham County includes all or part of the San Carlos Indian Reservation, Coronado National Forest and the following wilderness areas: Aravaipa Canyon, Fish Hooks, North Santa Teresa, Peloncillo Mountains, and Redfield Canyon. Private, state, and other BLM lands are also within this county. It also contains perennial portions of the Gila River and Ash Creek.

Vegetation within the county is dominated by mixed conifer and Madrean oak woodland mountains connected by semi-desert grassland seas. These forests are vital habitat for animals such as the Mount Graham red squirrel and Pinaleno Mountain snail. Intermingled with the above mentioned vegetation types are riparian gallery forests along perennial water or near perennial stream reaches. These riparian areas include many aquatic animal populations associated with perennial water such as the Sonoran and desert suckers, Apache trout (*Oncorhynchus apache*), roundtail chub, spinedace (*Meda fulgida*), speckled dace, longfin dace (*Agosia chrysogaster*), and desert pup fish (*Cyprinodon macularius*), as well as the Chiricahua and lowland leopard frogs. The county is part of a greater geographic region referred to as the Madrean Archipelago, which has recently been added to Conservation International's list of the world's hotspots for biodiversity (Andrew Smith personal communication).

In total there are 69 threatened, endangered, sensitive or of special concern species within this county. Graham County, which is just under 3 million acres, contains private forest in conservation areas (4,263 acres), publicly important private forest (10,853 acres) and private forest lands threatened by development (4,630 acres).

### Growth and Development Patterns

Graham County, was created in 1881 from parts of Apache and Pima counties. The county's early history was one of exploration rather than settlement – there were no notable Spanish or Mexican communities. Most of its inhabitants were Apaches. In the 1870s, farming communities began to appear along the Gila River, which traverses the county from east to west. The area comprising Thatcher, Eden, Central, and Bylas was, and is today, a rich agricultural area. Safford is the county seat.

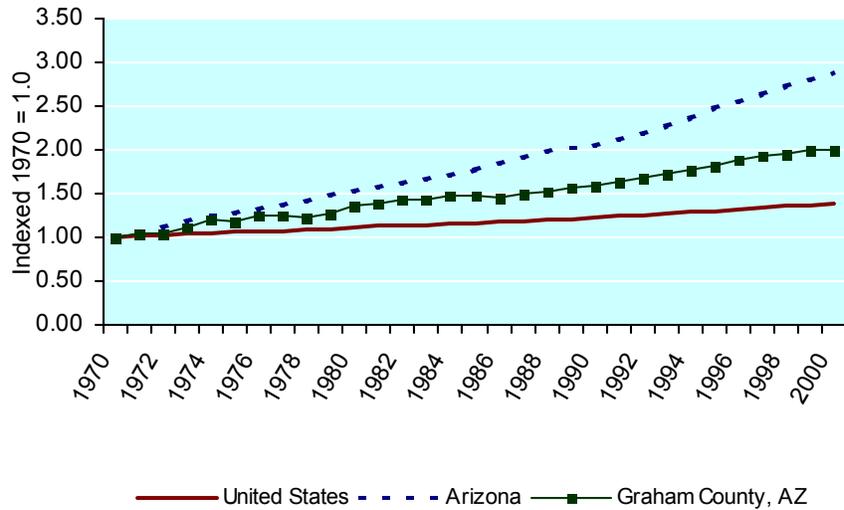
Graham County was almost twice its present size prior to the formation of Greenlee County. The San Carlos Indian Reservation covers approximately one-third of the land, with San Carlos Lake a popular site for its excellent fishing and camping. Recreation and tourism follow farming and ranching as the principal industries in Graham County.

Individual or corporate ownership accounts for 9.9% of land ownership; the U.S. Forest Service and Bureau of Land Management, 38 %; the State of Arizona, 18%; and Indian reservations, 36%. Since 1970, the population of Graham County has grown by 16,782 people, a 100 % increase. Growth in Graham County has been slower than the state average growth and faster than the national average (Figure 5a). This county lost 170 farm jobs and gained 2,000 government jobs over the last 30 years. (Figure 5b and 5c).

#### Goals and Objectives

- 1) Decrease riparian forest fragmentation by preventing development along I 70 corridor between Bylas and Safford.
- 2) Protect public and ecological values as well as riparian forest and native fish habitat by decreasing forest fragmentation within and bordering Coronado National Forest, focusing on forest surrounding perennial or near perennial stream reaches.

**Figure 5a - Population compared to state and nation, Graham County**

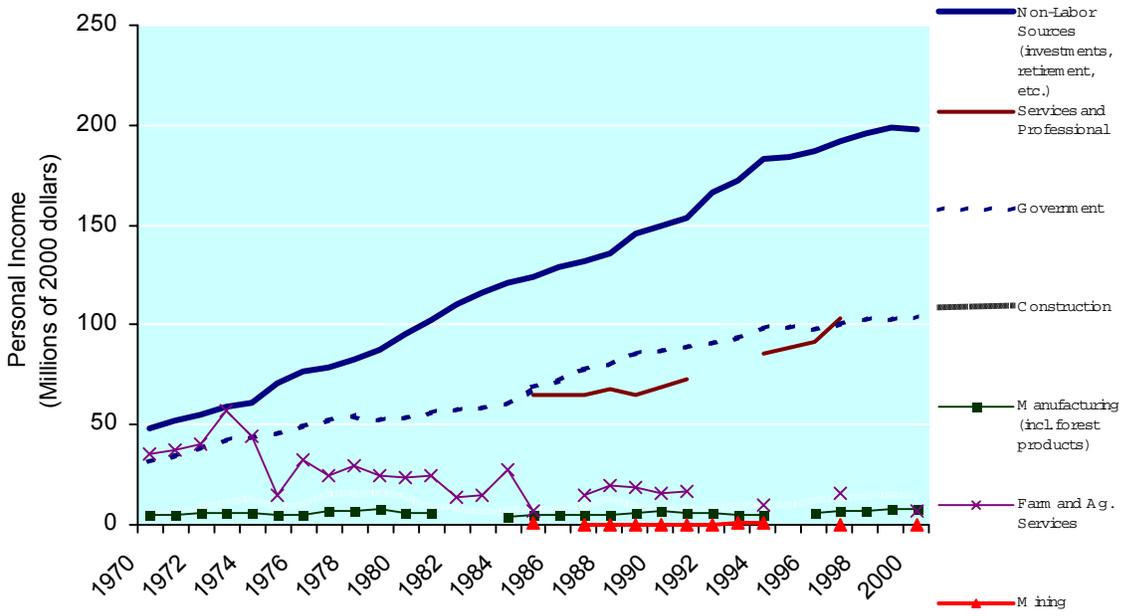


**Figure 5b - Employment by industry, Graham County**

	1970	% of Total	2000	% of Total	New Employment	% of New Employment
<b>Total Employment</b>	4,793		11,028		<b>6,235</b>	
<b>Farm and Agricultural Services</b>	807	16.8%	982	8.9%	<b>175</b>	<b>2.8%</b>
<b>Farm</b>	704	14.7%	534	4.8%	<b>-170</b>	<b>NA</b>
<b>Ag. Services</b>	103	2.1%	448	4.1%	<b>345</b>	<b>5.5%</b>
<b>Manufacturing (incl. forest products)</b>	195	4.1%	340	3.1%	<b>145</b>	<b>2.3%</b>
<b>Services and Professional</b>	#N/A	#N/A	6,058	54.9%	<b>#N/A</b>	<b>#N/A</b>
<b>Construction</b>	158	3.3%	438	4.0%	<b>280</b>	<b>4.5%</b>
<b>Government</b>	1,135	23.7%	3,191	28.9%	<b>2,056</b>	<b>33.0%</b>

*Agricultural Services* include soil preparation services, crop services, etc. It also includes forestry services, such as reforestation services, and fishing, hunting, and trapping

**Figure 5c - Personal income by industry, Graham County**



1

<sup>1</sup> Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

## **Greenlee County**

### **General Description**

Greenlee County includes all or part of the Apache National Forest, Gila Box National Conservation Area, Peloncillo Mountains Wilderness Area, Phelps Dodge's Morenci copper mine, as well as other private, state, and BLM lands. It also contains all of the Blue River and a large portion of the Eagle Creek drainage.

Vegetation within the county is dominated by mixed conifer and Madrean oak woodland mountains connected by semi-desert grassland seas. The forest supports many bat and raptor populations including the Mexican spotted owl. Intermingled with these two vegetation types are riparian gallery forests along perennial land intermittent waterways with shallow ground water. These forests and the associated water are key habitat for many native fish and other riparian species, such as the Sonoran, razor and desert suckers, Gila chub, Gila trout (*Oncorhynchus gilae*), roundtail chub, spikedace, speckled dace, longfin dace, and loach minnow (*Tiaroga cobitis*), as well as the Chiricahua, northern and lowland leopard frogs and southwestern willow flycatchers. The county is part of a greater geographic region referred to as the Madrean Archipelago, which has recently been added to Conservation International's list of the world's hotspots for biodiversity (Andrew Smith, personal communication).

In total there are 44 threatened, endangered, sensitive or of special concern species within this county. Greenlee County is the second smallest county in Arizona with just under 1.2 million acres. There are 11,409 acres of private forest within a conservation area, 14,783 acres of publicly important private forest, and 3,920 acres of private forest currently threatened by roads and/or development.

### **Growth and Development Patterns**

Greenlee County, Arizona's 14<sup>th</sup> county was formed from the eastern portion of Graham County in 1909. There was significant resistance to the formation of the county because Graham County would lose considerable revenue as a result. As a compromise, Greenlee County was considerably smaller than originally proposed. Clifton is, and has always been, the county seat.

Copper ore was discovered in the Clifton area in 1869, and claims and mines were established two years later. By 1918, most of the early copper mines – the King, Longfellow and Shannon Copper Company - had been absorbed by the Arizona Copper Company. Later, Arizona Copper was purchased by Phelps Dodge Corporation, which remains a major employer in the county. In addition to the major contribution copper makes to the county's economy, ranching, agriculture and tourism are important factors as well. Apache National Forest in the northern half of the county is home to deer, elk, antelope and bear. Hannagan Meadow, at 2270 m, and the Blue Range Primitive Area are popular with hunters and campers.

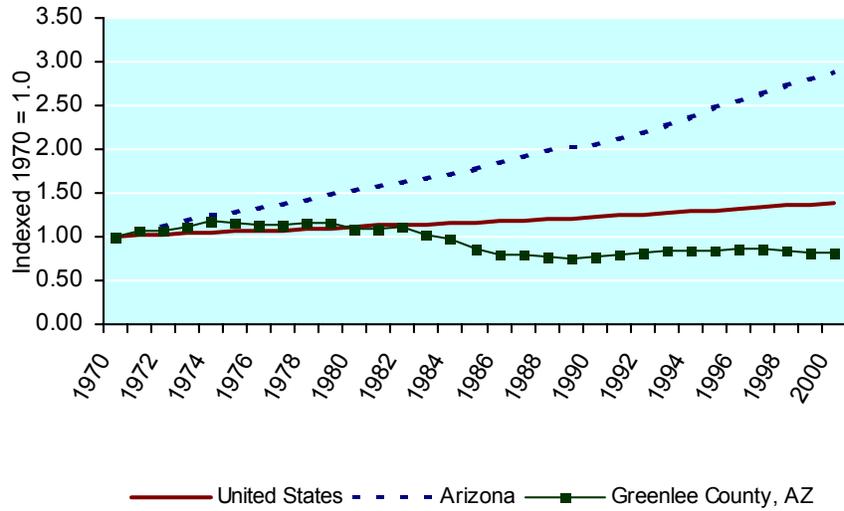
The topography consists of high mountain ranges, river valleys, and desert terrain. The famed Coronado Trail (U.S. 191) twists and turns 117 miles from Clifton (elevation 1050 m) north to Springerville in Apache County (elevation 2090 m) and affords breathtaking, panoramic views. The vast majority of land is government-owned; the U.S. Forest Service manages 63.5%; the U.S. Bureau of Land Management 13.6%; the State of Arizona, 14.8%; and individual or corporate ownership, only 8.1%.

Since 1970, the population of Greenlee County has fallen by 1,917 people, an 18% decline. This growth has been slower than the state average and faster than the national average (Figure 6a). Needless to say, the population and economic indicators presented below indicate development threats are lower in this county as compared to others in the state (Figure 6b and 6c).

#### Goals and Objectives

- 1) Protect public and ecological values as well as riparian forest and native fish habitat by decreasing forest fragmentation within and bordering Apache National Forest, focusing on forest surrounding perennial water.

**Figure 6a - Population compared to state and nation, Greenlee County**

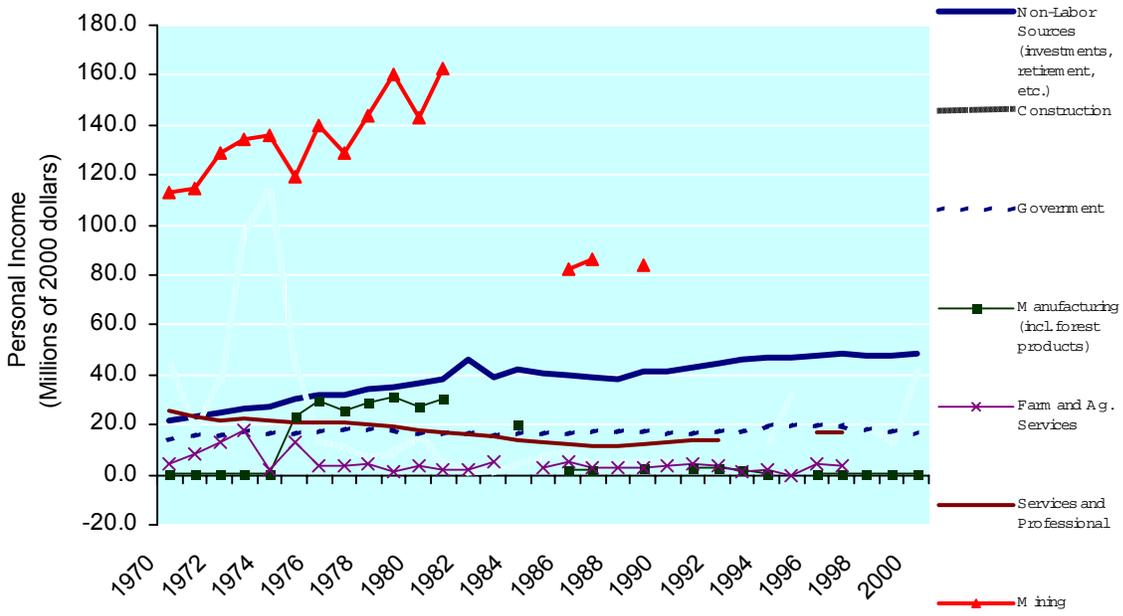


**Figure 6b - Employment by industry, Greenlee County**

	1970	% of Total	2000	% of Total	New Employment	% of New Employment
<b>Total Employment</b>	4,653		5,328		<b>675</b>	
<b>Farm and Agricultural Services</b>	186	4.0%	#N/A	#N/A	#N/A	#N/A
<b>Farm</b>	181	3.9%	167	3.1%	<b>-14</b>	<b>NA</b>
<b>Ag. Services</b>	5	0.1%	#N/A	#N/A	#N/A	#N/A
<b>Manufacturing (incl. forest products)</b>	10	0.2%	21	0.4%	<b>11</b>	<b>1.6%</b>
<b>Services and Professional</b>	951	20.4%	#N/A	#N/A	#N/A	#N/A
<b>Construction</b>	809	17.4%	882	16.6%	<b>73</b>	<b>10.8%</b>
<b>Government</b>	452	9.7%	616	11.6%	<b>164</b>	<b>24.3%</b>

*Agricultural Services* include soil preparation services, crop services, etc. It also includes forestry services, such as reforestation services, and fishing, hunting, and trapping.

**Figure 6c - Personal income by industry, Greenlee County**



1

<sup>1</sup> Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

## La Paz County

### General Description

La Paz County includes all or part of the Colorado River Indian reservation, Yuma Proving Ground, the Bill Williams, Kofa, Cibola, and Imperial National Wildlife Refuges; Arrastra Mountains, Eagletail Mountains, East Cactus Plains, Gibraltar Mountains, Harcuvar Mountains, Harquahala Mountains, New Water Mountains, Rawhide Mountains, Swan Sea, and Trigo Mountains Wilderness Areas, as well as private, state, and other BLM lands. It also contains portions of the lower Colorado River and all of the Bill Williams River.

La Paz County, at 2.9 million acres is dominated by Sonoran desert communities that transition into Mohave desert communities. Riparian forests are also present in this county along perennial water. These forests are vital habitat for native fish as well as many riparian birds such as the Southwestern willow flycatcher, Western yellow-billed cuckoo, California black rail (*Laterallus jamaicensis coturniculus*), and Yuma Clapper rail (*Rallus longirostris yumanensis*).

In total there are 22 threatened, endangered, sensitive or of special concern species within this county. There are 675 acres of private forest within a conservation area, 2,408 acres of publicly important private forest, and 117 acres of private forest currently threatened by roads and/or development.

### Growth and Development Patterns

La Paz County was created 1983, when Yuma County residents voted to split their county into two sections. La Paz, which means "the peace" in Spanish, has historic significance as the name of a boomtown on the Colorado River. The Colorado River town of La Paz was founded in 1862, after the discovery of rich gold deposits nearby. By 1863, there were probably 5,000 men working in the gold mines, making La Paz one of the largest settlements in what was to become the Arizona Territory. The decline of La Paz was caused by two factors – the mines dried up and the Colorado River changed its course in 1870, leaving the town "high and dry."

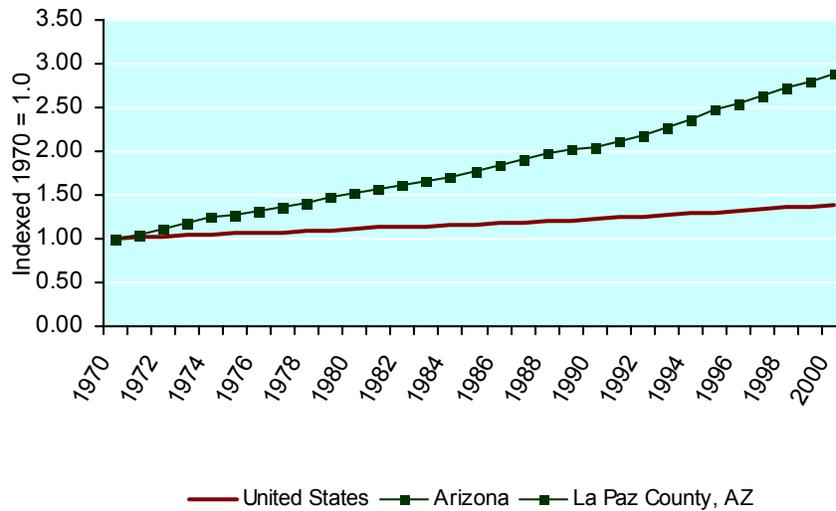
La Paz County has the lowest population density with slightly more than four persons per square mile. The U.S. Bureau of Land Management manages 58.3% of the land; the State of Arizona, 8.8%; other public lands, 19.5%; and 5.3% of the land is owned privately or by corporations. The Colorado River Indian Tribe owns 8.1% of the land.

The county's rugged landscape and the Colorado River attract thousands of visitors annually, making tourism the number one industry with 1998 tourism revenues of \$103 million. Agriculture adds approximately \$83 million to the county's economy. Since 1983, the population of La Paz County has grown by 6,660 people, a 51% increase. This growth has been slower than the state and faster than the nation (Figure 7a). Tourism - which appears to be responsible for the huge increase in the non-labor source of personal income (Figure 7b and 7c), that could effect the overuse of scenic and recreational lands in this county.

### Goals and Objectives

- 1) Protect public and ecological values as well as riparian forest and native fish habitat by protecting riparian forest along the Colorado and Bill Williams Rivers.

**Figure 7a - Population compared to state and nation, La Paz County**

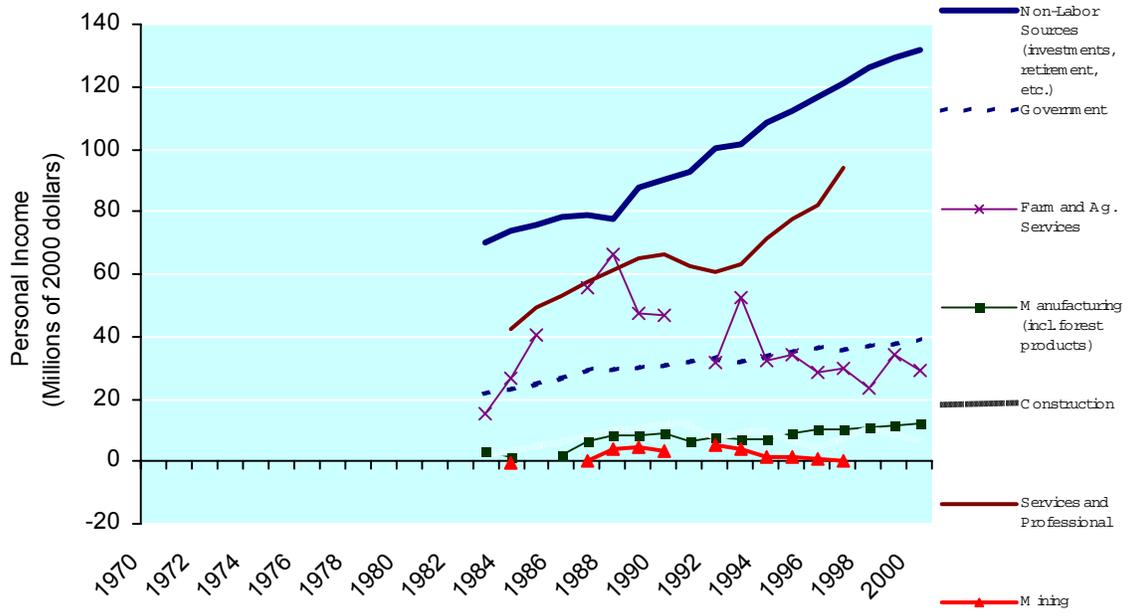


**Figure 7b - Employment by industry, La Paz County**

	1983	% of Total	2000	% of Total	New Employment	% of New Employment
<b>Total Employment</b>	3,697		7,542		<b>3,845</b>	
<b>Farm and Agricultural Services</b>	493	13.3%	884	11.7%	<b>391</b>	<b>10.2%</b>
<b>Farm</b>	352	9.5%	388	5.1%	<b>36</b>	<b>0.9%</b>
<b>Ag. Services</b>	141	3.8%	496	6.6%	<b>355</b>	<b>9.2%</b>
<b>Manufacturing (incl. forest products)</b>	100	2.7%	403	5.3%	<b>303</b>	<b>7.9%</b>
<b>Services and Professional</b>	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
<b>Construction</b>	145	3.9%	249	3.3%	<b>104</b>	<b>2.7%</b>
<b>Government</b>	665	18.0%	1,159	15.4%	<b>494</b>	<b>12.8%</b>

**Agricultural Services** include soil preparation services, crop services, etc. It also includes forestry services, such as reforestation services, and fishing, hunting, and trapping. **Note:** There is no available census data for this county prior to 1983.

**Figure 7c - Personal income by industry, La Paz County**



1

<sup>1</sup> Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

## Maricopa County

### General Description

Maricopa County includes all or part of the Ak Chin, Fort McDowell, Gila Bend, and Salt River Indian reservations, Tonto National Forest, Barry M. Goldwater Air Force Range; Big Horn Mountains, Eagletail Mountains, Harcuvar Mountains, Harquahala Mountains, Hells Canyon, Hummingbird Springs, North and South Maricopa Mountains, Sierra Estrella, Signal Mountain, Table Top, and Woolsey Peak Wilderness Areas, as well as private, state, and other BLM lands. It also contains portions of the Agua Fria, Gila, Hassayampa, and Verde Rivers.

Large portions of the 5.9 million acres in Maricopa County are urbanized while small patches of vegetation primarily Sonoran desert scrub and semi-desert grasslands in the upper elevations still exist. Riparian forests are also present in this county along perennial waterways. These forests are key habitat for many native fish and other riparian species, such as the Sonoran and desert suckers, Colorado pike minnow (*Ptychocheilus lucius*), roundtail and bonytail chub, longfin dace, desert pupfish, and Gila topminnow, as well as lowland leopard frogs, Southwestern willow flycatchers, and Yuma clapper rails.

In total there are 48 threatened, endangered, sensitive or of special concern species within this county. There are 2,567 acres of private forest within a conservation area, 12,768 acres of publicly important private forest, and 5,890 acres of private forest currently threatened by roads and/or development.

### Growth and Development Patterns

Maricopa County, named after the Maricopa Tribe, was created from portions of Pima and Yavapai counties in 1871. It was the fifth county formed in Arizona, and eventually portions were used to create Gila and Pinal counties. In 1889, Phoenix became the final site of the territorial capital and retains its status as Arizona's capital city.

More than half of the state's population resides in Maricopa County. This metropolitan area is the state's major center of political and economic activity. In addition to housing the state capital, the county is home to a growing high-tech industry, manufacturing and agricultural industries, institutions of higher learning, professional sports franchises, various cultural attractions and the fifth busiest airport in the world with over 1,300 daily flights.

Twenty-nine percent of Maricopa County area is owned individually or by corporations. The U.S. Bureau of Land Management manages 28%, U.S. Forest Service and Arizona State Land Department each manage 11% of the county; and an additional 16% is publicly owned. Almost 5% is Indian reservation land.

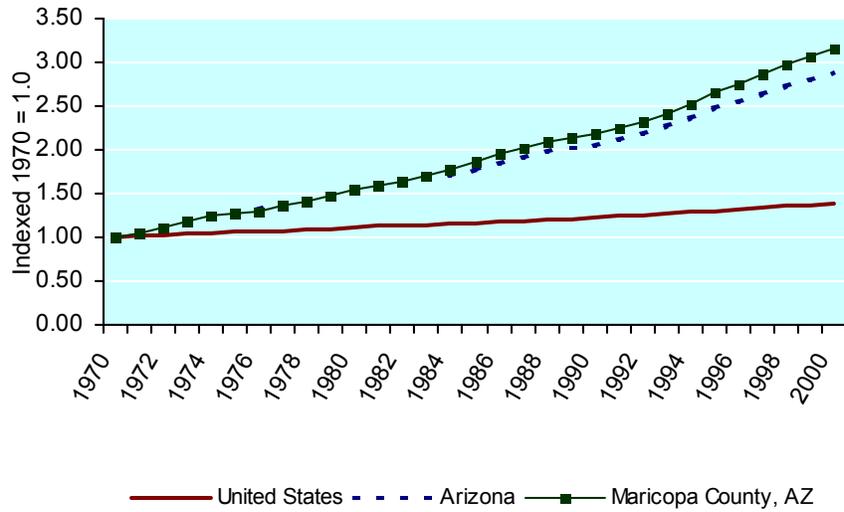
Since 1983, the population of Maricopa County has grown by 2,114,773 people, a 216% increase. This growth has been greater than the state average and greater than the national average (Figure 8a). Maricopa County has been one of the fastest growing counties in the U.S. for the past decade; its population is expected to grow to 5 million by 2025. Phoenix was the fastest growing city in the country for the 1990s.

Demographic and economic statistics for the county show a direct correlation between population growth and land transformation. The loss of 1,800 farm jobs versus an increase of 1.1 million service and professional jobs and 115,000 construction jobs depicts the obvious – land is being lost to commercial development and housing (Figure 8b and 8c). A startling figure is that Maricopa County development consumes one acre an hour; this is nearly 9,000 acres per year.

#### Goals and Objectives

- 1) Protect public and ecological values as well as riparian forest and native fish habitat by protecting riparian forest along the Gila and Hassayampa Rivers.

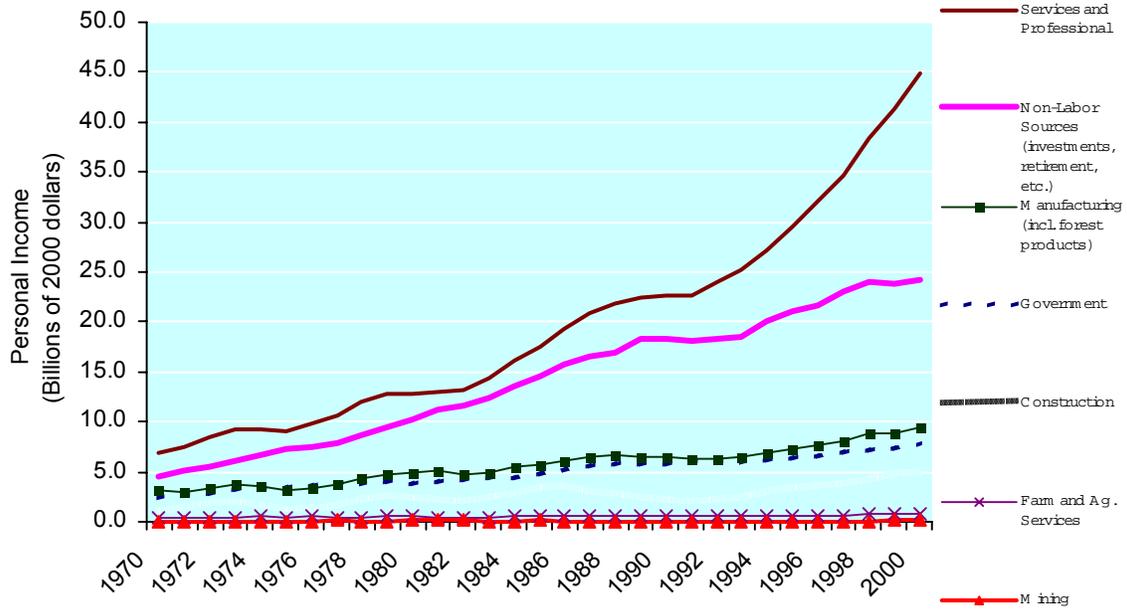
**Figure 8a - Population compared to state and nation, Maricopa County**



**Figure 8b - Employment by industry, Maricopa County**

	1970	% of Total	2000	% of Total	New Employment	% of New Employment
<b>Total Employment</b>	430,567		1,896,035		<b>1,465,468</b>	
<b>Farm and Agricultural Services</b>	14,302	3.3%	32,095	1.7%	<b>17,793</b>	<b>1.2%</b>
<b>Farm</b>	9,391	2.2%	7,515	0.4%	<b>-1,876</b>	<b>NA</b>
<b>Ag. Services</b>	4,911	1.1%	24,580	1.3%	<b>19,669</b>	<b>1.3%</b>
<b>Manufacturing (incl. forest products)</b>	73,272	17.0%	168,487	8.9%	<b>95,215</b>	<b>6.5%</b>
<b>Services and Professional</b>	244,820	56.9%	1,361,536	71.8%	<b>1,116,716</b>	<b>76.2%</b>
<b>Construction</b>	26,603	6.2%	142,288	7.5%	<b>115,685</b>	<b>7.9%</b>
<b>Government</b>	71,106	16.5%	188,730	10.0%	<b>117,624</b>	<b>8.0%</b>

**Figure 8c - Personal income by industry, Maricopa County**



1

<sup>1</sup> Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

## **Mohave County**

### General Description

Mohave County includes all or part of the Fort Mohave, Hualapai, and Kaibab Paiute Indian Reservations, Grand Canyon National Park, Havasu National Wildlife Refuge and the following wilderness areas: Arrastra Mountains, Aubrey Peak, Beaver Dam Mountains, Cottonwood Point, Grand Wash Cliffs, Kanab Creek, Mount Nutt, Mount Tipton, Mount Wilson, Mount Logan, Mount Trumbull, Paiute, Rawhide Mountains, Swansea, Upper Burro Creek, Wabayuma Peak, and Warm Springs. The remaining portions of Mohave county include private, state, and other BLM lands. Perennial, intermittent, and ephemeral stretches of the Big Sandy, Colorado, and Virgin Rivers and Trout creek are in this county.

Vegetation within the county is variable. Mohave desert dominates the western edge of the region with Great Basin grasslands and pinyon-juniper woodlands occupying the upper elevations of the central and eastern portions of the county. The upper elevation forests support several endangered population such as the Hualapai Mexican vole (*Microtus mexicanus hualpaiensis*), Mexican spotted owl, as well as populations of Mount Trumbull beardtongue (*Penstemon distans*). Riparian forest is also found along perennial and some intermittent stream reaches and is key habitat for many riparian birds (i.e., Yuma clapper rail, Southwestern willow flycatcher, and Western yellow-billed cuckoo). The perennial reaches of the streams support native fish populations including the virgin spinedace (*Lepidomeda mollispinis mollispinis*), virgin river (*Gila seminuda*) and humpback (*Gila cypha*) chub.

In total there are 73 threatened, endangered, sensitive or of special concern species within this county. Mohave County encompasses 8.6 million acres within which there are 90,361 acres of private forest in a conservation area, 269,979 acres of publicly important private forest, and 77,093 acres of private forest currently threatened by roads and/or development.

### Growth and Development Patterns

Mohave County was created in 1864 and included portions of present day Nevada. The forces that led to the establishment of communities in the county – mining, the Colorado River, and the railroad – are still important to the county’s economy and with 1,000 miles of shoreline, water related recreation is very popular. The Colorado River and two man-made lakes, Lake Mohave and Lake Havasu, play an important role in the growth of Lake Havasu and Bullhead cities.

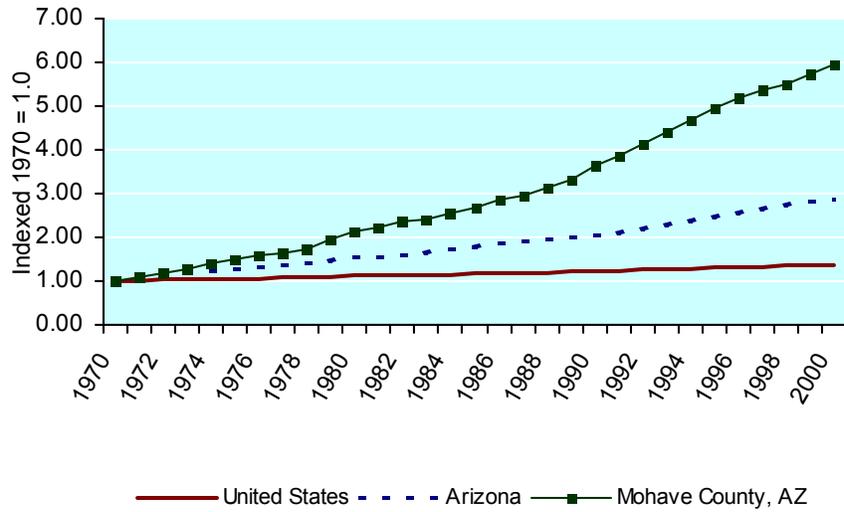
The U.S. Forest Service and Bureau of Land management own 55.2% of the land; Indian reservations, 6.7%; the State of Arizona, 6.6%; individual or corporate, 17.2%; and other public lands, 14.3%. Since 1970, the population of Mohave County has grown by 130,052 people, a 494% increase (Figure 9a). This growth has been faster than both the state and national averages. The extraordinary growth of this rural area can be attributed to the recreational draw created by the lakes, close proximity to Las Vegas, and scenic National Parks such as the internationally known Grand Canyon. A large influx in the indigenous population combined with an every increasing transient population that uses the land and water for recreational purposes, places a dynamic strain on the conservation of these natural resources.

Historically, land transformation was mostly done for purposes of water conservation and downstream agriculture use. However, more than 32,000 service-oriented jobs have been created to support recreation - creating about 3,700 housing and commercial development construction jobs (Figure 9b). The income information provided shows a close correlation between the inflow of recreation dollars and the service and professional people needed to support recreation (Figure 9c).

#### Goals and Objectives

- 1) Protect traditional forest uses, ranching, by focusing attention on pinyon-juniper woodlands east of Kingman.
- 2) Protect public and ecological values as well as riparian forest and native fish habitat by protecting riparian forest along the Big Sandy River and Trout Creek.

**Figure 9a - Population compared to state and nation, Mohave County**

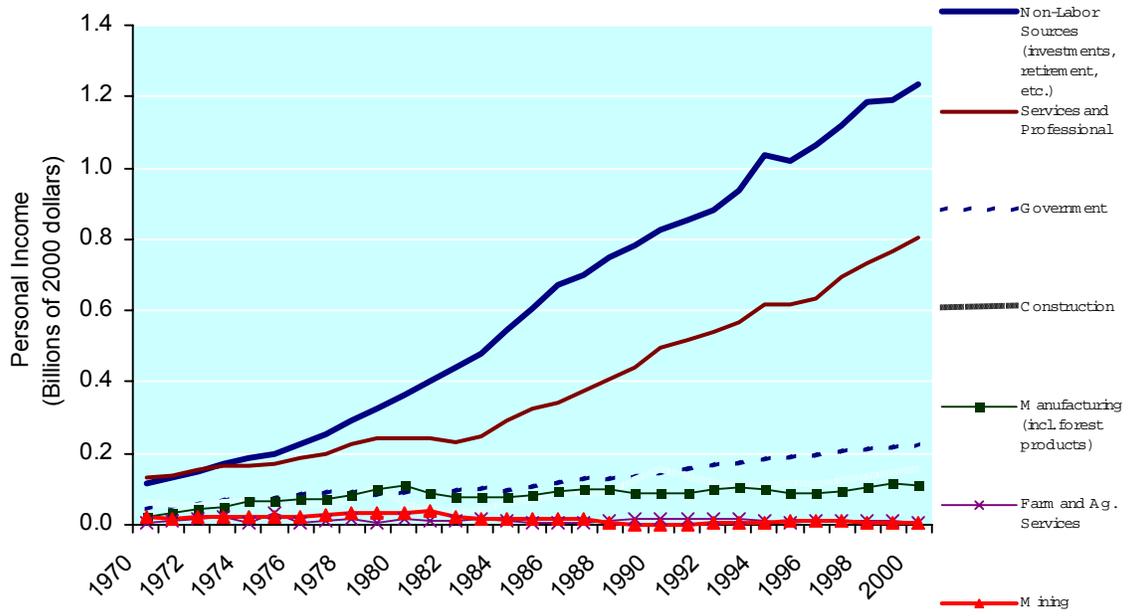


**Figure 9b - Employment by industry, Mohave County**

	1970	% of Total	2000	% of Total	New Employment	% of New Employment
<b>Total Employment</b>	9,295		54,017		44,722	
<b>Farm and Agricultural Services</b>	334	3.6%	956	1.8%	622	1.4%
<b>Farm</b>	293	3.2%	338	0.6%	45	0.1%
<b>Ag. Services</b>	41	0.4%	618	1.1%	577	1.3%
<b>Manufacturing (incl. forest products)</b>	575	6.2%	3,503	6.5%	2,928	6.5%
<b>Services and Professional</b>	5,287	56.9%	37,751	69.9%	32,464	72.6%
<b>Construction</b>	1,137	12.2%	4,891	9.1%	3,754	8.4%
<b>Government</b>	1,437	15.5%	6,767	12.5%	5,330	11.9%

*Agricultural Services* include soil preparation services, crop services, etc. It also includes forestry services, such as reforestation services, and fishing, hunting, and trapping.

**Figure 9c - Personal income by industry, Mohave County**



1

<sup>1</sup> Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

## Navajo County

### General Description

Navajo County includes all or part of the Fort Apache, Hopi, and Navajo Indian reservations, Sitgreaves National Forest, as well as private, state, and BLM lands. It also contains portions of the Little Colorado River and Chevelon and Clear creeks.

The Mogollon Rim divides the county into two distinct parts. Vegetation in the lower elevations is a mix of Great Basin grasslands with pinyon- juniper grading into mixed conifer forest at the higher elevations. These forests support many raptor species such as the Mexican spotted owl, American peregrine falcon, and osprey (*Pandion haliaetus*) as well as many bat species. Riparian forests are also present within this county along perennial and some intermittent stream reaches and are key habitat for many aquatic populations including desert and Little Colorado suckers, Little Colorado spikedace and longfin dace, as well as northern and Chiricahua leopard frogs.

In total there are 24 threatened, endangered, sensitive or of special concern species within this county (figure does not include species on tribal lands). Although Navajo County is fairly large (6.4 million acres) most of the county is tribal lands and not currently eligible under the Arizona's Forest Legacy Program. There are 43,793 acres of private forest within a conservation area, 479,983 acres of publicly important private forest, and 11,330 acres of private forest currently threatened by roads and/or development.

### Growth and Development Patterns

Navajo County was formed in 1895, but the railroad had already crossed the county for more than a decade, and North America's third largest ranch, the Aztec Land and Cattle Company had been established. Backed by eastern dollars, Aztec bought 1 million acres of land from the railroad at 50 cents an acre and brought 33,000 longhorn cattle and 2,200 horses into northern Arizona from Texas.

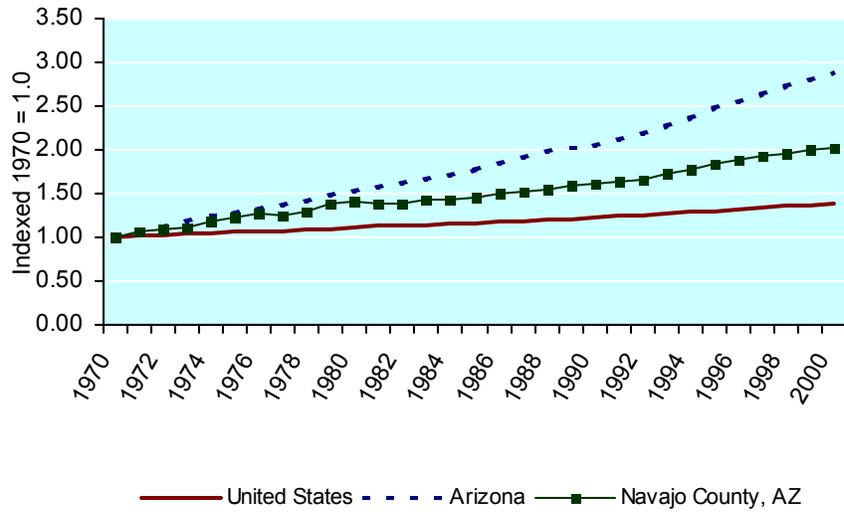
In the north is Kayenta, founded in 1909 as a trading post, and now the gateway to the Navajo Tribal Park at Monument Valley - and a thriving Navajo community. Farther south is the Hopi Indian Reservation, which is completely surrounded by the Navajo Reservation. The Hopi Pueblo of Oraibi is one of the oldest continuously inhabited settlements in the United States. Today, Navajo County's principal industries are tourism, coal mining, manufacturing, timber production and ranching. Almost 66% of Navajo County is Indian Reservation; individual and corporate ownership accounts for 18%; the U.S. Forest Service and U.S. Bureau of Land Management together manage 9%; and the State of Arizona owns 5.9%.

Since 1970, the population of Navaho County has grown by 49,774 people, a 103% increase (Figure 10a). This growth has been slower than the state average and faster than the national average. Service and professional jobs have grown by nearly 16,000 and government jobs have increased by nearly 5,000 (Figure 10b and 10c). With an increasing population of retirees and service needs, development pressure on the surrounding lands also increases. Likewise, as with other Arizona counties that rely heavily on tourism for much of their economy, careful attention has to be paid to potential degradation of natural resources.

### Goals and Objectives

- 1) Protect public and ecological values as well as riparian forest and native fish habitat by protecting riparian forest along the Little Colorado River and Chevelon and Clear Creeks.
- 2) Protect traditional forest uses, ranching, by focusing attention on pinyon-juniper woodlands in the southeast portion of this county.
- 3) Decrease fragmentation from development within the pinyon-juniper and mixed conifer forests by protecting private forestland within and bordering the Sitgreaves National Forest.

**Figure 10a - Population compared to state and nation, Navajo County**

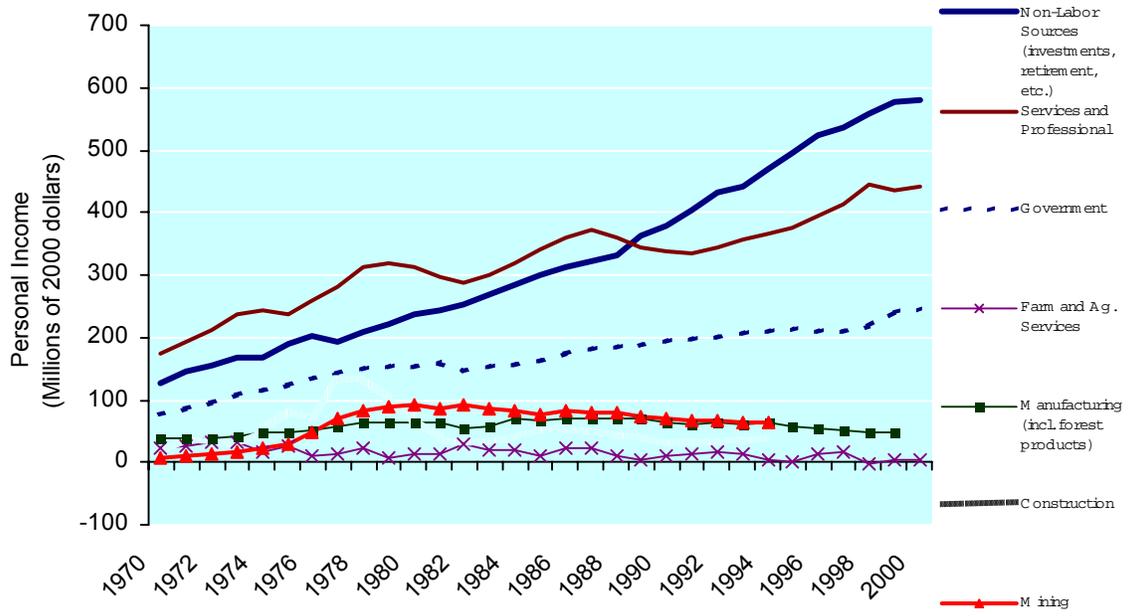


**Figure 10b - Employment by industry, Navajo County**

	1970	% of Total	2000	% of Total	New Employment	% of New Employment
<b>Total Employment</b>	11,544		33,863		<b>22,319</b>	
<b>Farm and Agricultural Services</b>	293	2.5%	805	2.4%	<b>512</b>	<b>2.3%</b>
<b>Farm</b>	230	2.0%	506	1.5%	<b>276</b>	<b>1.2%</b>
<b>Ag. Services</b>	63	0.5%	299	0.9%	<b>236</b>	<b>1.1%</b>
<b>Manufacturing (incl. forest products)</b>	1,292	11.2%	#N/A	#N/A	<b>#N/A</b>	<b>#N/A</b>
<b>Services and Professional</b>	6,833	59.2%	21,401	63.2%	<b>14,568</b>	<b>65.3%</b>
<b>Construction</b>	448	3.9%	#N/A	#N/A	<b>#N/A</b>	<b>#N/A</b>
<b>Government</b>	2,542	22.0%	7,176	21.2%	<b>4,634</b>	<b>20.8%</b>

*Agricultural Services* include soil preparation services, crop services, etc. It also includes forestry services, such as reforestation services, and fishing, hunting, and trapping

**Figure 10c - Personal income by industry, Navajo County**



1

<sup>1</sup> Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

## Pima County

### General Description

Pima County, which encompasses 5.9 million acres in the southern portion of the state, includes all or part of the San Xavier and Tohono O'odham Indian reservations, Coronado National Forest, Saguaro National Park, Organ Pipe National Monument, Cabeza Prieta and the following wilderness areas: Buenos Aires National Wildlife Refuges, Barry M. Goldwater Air Force Range, Baboquivari Peak and Coyote Mountains; as well as private, state, and other BLM lands. It also contains portions of the San Pedro and Santa Cruz Rivers.

Vegetation within this county is variable. Sonoran desert dominates the western half of the county with the eastern region being dominated by mixed conifer and Madrean oak woodland mountains connected by semi-desert grassland seas. Intermingled with these latter two vegetation types are riparian gallery forests along perennial water and many intermittent stream reaches. The county's forestlands are home to a large array of species ranging from the endangered Kearney's blue star (*Amsonia kearneyana*) to the Mexican spotted owl. Several species of bats and hummingbirds migrate through this area while some animals, like the tropical kingbird (*Tyrannus melancholicus*) and jaguar reach their northern limits in these forests. The county is part of a greater geographic region referred to as the Madrean Archipelago, which has recently been added to Conservation International's list of the world's hotspots for biodiversity (Andrew Smith, personal communication).

In total there are 99 threatened, endangered, sensitive or of special concern species within this county. There are 3,812 acres of private forest within a conservation area, 12,464 acres of publicly important private forest, and 8,031 acres of private forest currently threatened by roads and/or development.

### Growth and Development Patterns

Pima County was created in 1864 and included all of southern Arizona acquired from Mexico by the Gadsen Purchase. Settlement of the region goes back to the arrival of the Spanish in the 1690's who encountered Native Americans already living there. About the middle of the 18th century, silver and gold were discovered and prospectors from Mexico entered the area in droves. The latter part of the century saw expansion of mining and ranching in Pima County and an increase in population. Land conservation has been a long time priority in this county including set asides for two cactus forests – Saguaro National Park to the northeast and/organ Pipe Cactus National Monument in the southwestern portion – and numerous state parks in the adjacent mountain ranges.

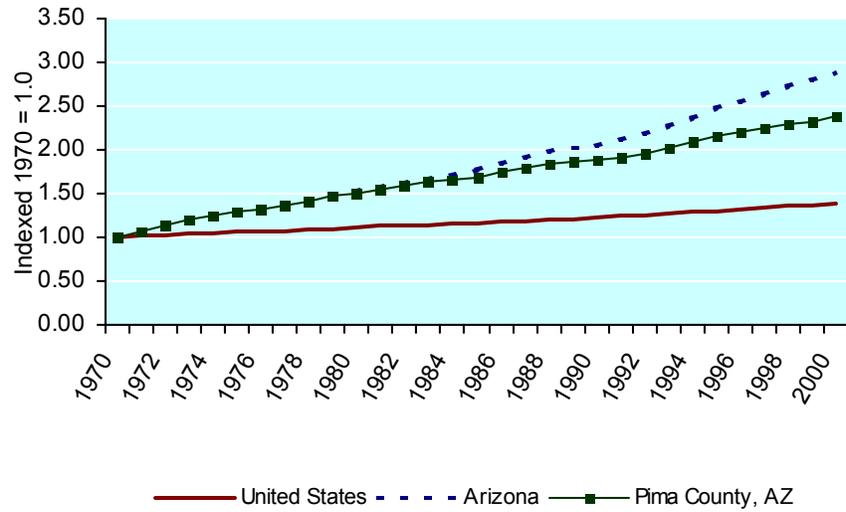
The San Xavier, Pascua Yaqui and Tohono O'odham reservations together account for ownership of 42.1 % of land located in Pima County. The State of Arizona owns 14.9%; the U.S. Forest Service and Bureau of Land Management, 12.1%; other public lands, 17.1%; and individual or corporate ownership, 13.8%. From a population of 395 in 1820, Tucson has grown to be the second largest city in Arizona. Since 1970, the population of Pima County has grown by 492,680 people, a 138% increase. This growth has been slower than the state and faster than the nation (Figure 11a).

Growth has been driven by the strategic importance of Davis-Monthan Air Force Base, a growing science and technology community associated with the University of Arizona as well as service and professional occupations that support a large and growing population of retirees and recreation enthusiasts. Tucson's mild and sunny winters have fostered more than 50 golf courses - many surrounded by new homes sold to full-time and "snowbird" retirees. The creation of more than 17,000 construction jobs (most in new home construction) and parallel growth of non-labor (i.e., retiree and investment) and service/professional income indicates the pressure that housing and commercial land development are placing on the county (Figure 11b and 11c).

#### Goals and Objectives

- 1) Protect public and ecological values as well as riparian forest and native fish habitat. Focus on protecting riparian forest along perennial and intermittent stream reaches.

**Figure 11a - Population compared to state and nation, Pima County**

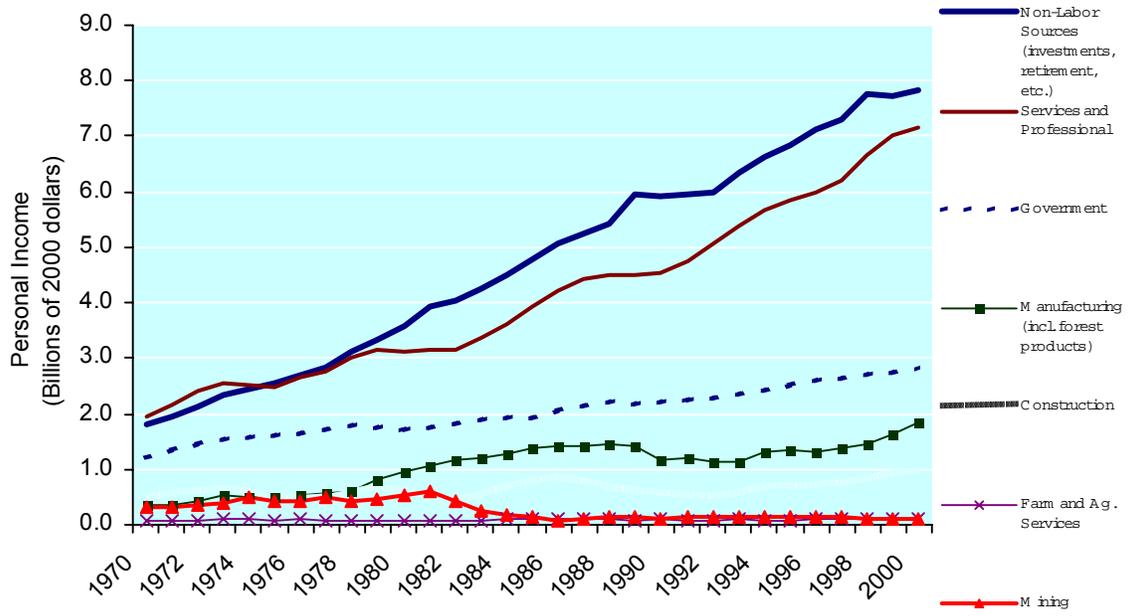


**Figure 11b – Employment by industry, Pima County**

	1970	% of Total	2000	% of Total	New Employment	% of New Employment
<b>Total Employment</b>	144,273		444,118		<b>299,845</b>	
<b>Farm and Agricultural Services</b>	2,054	1.4%	5,983	1.3%	<b>3,929</b>	<b>1.3%</b>
<b>Farm</b>	1,087	0.8%	955	0.2%	<b>-132</b>	<b>NA</b>
<b>Ag. Services</b>	967	0.7%	5,028	1.1%	<b>4,061</b>	<b>1.4%</b>
<b>Manufacturing (incl. forest products)</b>	9,295	6.4%	35,144	7.9%	<b>25,849</b>	<b>8.6%</b>
<b>Services and Professional</b>	78,120	54.1%	297,840	67.1%	<b>219,720</b>	<b>73.3%</b>
<b>Construction</b>	11,064	7.7%	28,081	6.3%	<b>17,017</b>	<b>5.7%</b>
<b>Government</b>	36,768	25.5%	74,660	16.8%	<b>37,892</b>	<b>12.6%</b>

*Agricultural Services* include soil preparation services, crop services, etc. It also includes forestry services, such as reforestation services, and fishing, hunting, and trapping

**Figure 11c - Personal income by industry, Pima County**



1

<sup>1</sup> Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

## **Pinal County**

### **General Description**

Pinal County includes all or part of the Ak Chin, San Carlos, and Tohono O'odham Indian Reservations, Tonto National Forest; Aravaipa Canyon, Needle's Eye, Sierra Estrella, Table Top, and White Canyon Wilderness Areas, as well as private, state, and other BLM lands . It also contains portions of the Gila, San Pedro, and Santa Cruz Rivers.

Vegetation within this county is variable. Sonoran desert dominates the western half of the county with the eastern region being dominated by mixed conifer and Madrean oak woodland mountains connected by semi-desert grassland seas. Intermingled with these latter two vegetation types are riparian gallery forests along perennial water. These forests are vital to habitat for many aquatic animal and plant populations, such as Southwestern willow flycatcher and Western yellow-billed cuckoo as well as many native fish species and the Huachuca water umbel. The county is part of a greater geographic region referred to as the Madrean Archipelago, which has recently been added to Conservation International's list of the world's hotspots for biodiversity (Andrew Smith personal communication).

In total there are 61 threatened, endangered, sensitive or of special concern species within this county. Pinal County is over 3.4 million acres with private forest identified in conservation areas (7,272 acres), publicly important (16,346 acres), and threatened by roads and/or development (8,871 acres).

### **Growth and Development Patterns**

Pinal County was formed in 1875. In both economy and geography, Pinal County has two distinct regions. Mountains, with elevations to 1830 m, and copper mining characterize the eastern part. The western area is primarily low desert valleys and irrigated agriculture. Many of the county's communities have traditionally been active in copper mining, smelting, milling and refining. Others have agriculture based-economies. Some, like Casa Grande, have diversified their economic base to include manufacturing, trade and services - facilitated by their location in the major growth corridor between Phoenix and Tucson near the junction of I-10 and I-8.

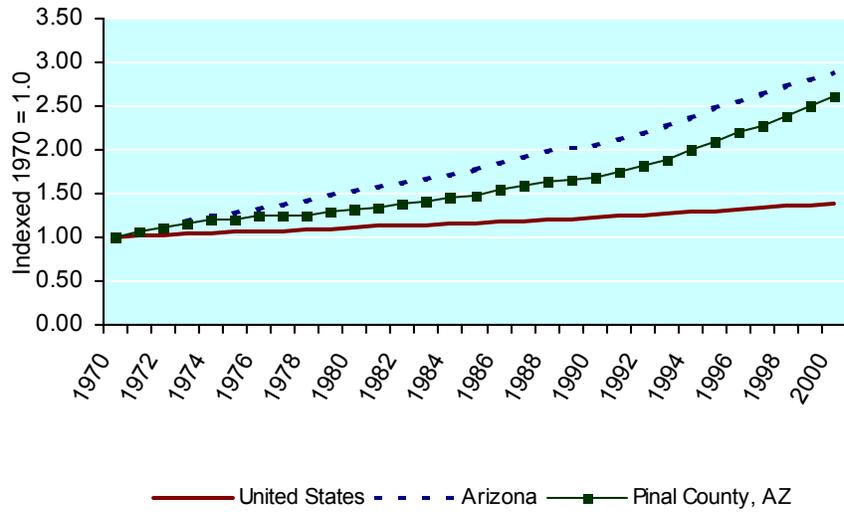
The State of Arizona is the county's largest landholder with 35.3%, followed by individuals and corporations, 25.7%; Indian reservations, 20.0%; the U.S. Forest Service and Bureau of Land Management, 17.5%, and the remaining 1.2% is other public land. Since 1970, the population of Pinal County has grown by 111,939 people, a 161% increase. This growth has been slower than the state average and faster than the national average and is mostly attributable to the county being positioned in the corridor of growth between Phoenix and Tucson (Figure 12a). This area is currently under the greatest pressure from land developers that want to build thousands of homes and commercial centers to support them.

American Farmland Trust's recently released report, *Strategic Ranchland in the Rocky Mountain West Mapping the Threats to Prime Ranchland in Seven Western States*, found with 355,200 acres of important ranch lands at risk, Pinal County ranked as the eighth most endangered county in the seven-state region surveyed for the report (AFT 2004). The charts and graphs below show the dramatic difference between farm employment losses and employment gains of 75% and 36% in the service sector and government (Figure 12b). Furthermore, there is a large increase in personal income that includes retirees – who make up a large and growing part of the I-10 corridor population in the county (Figure 12c).

#### Goals and Objectives

1) Protect public and ecological values as well as riparian forest and native fish habitat. Focus protecting riparian forest along perennial water.

**Figure 12a - Population compared to state and nation, Pinal County**

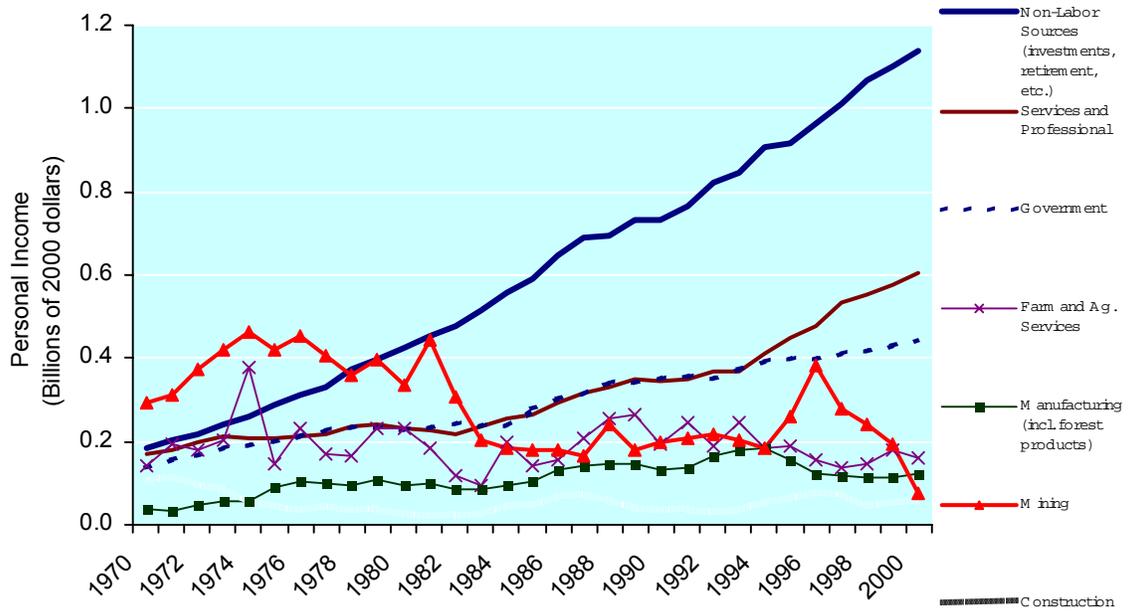


**Figure 12b - Employment by industry, Pinal County**

	1970	% of Total	2000	% of Total	New Employment	% of New Employment
<b>Total Employment</b>	25,980		51,293		<b>25,313</b>	
<b>Farm and Agricultural Services</b>	3,978	15.3%	3,451	6.7%	-527	NA
<b>Farm</b>	3,426	13.2%	2,391	4.7%	-1,035	NA
<b>Ag. Services</b>	552	2.1%	1,060	2.1%	508	2.0%
<b>Manufacturing (incl. forest products)</b>	1,482	5.7%	3,476	6.8%	1,994	7.9%
<b>Services and Professional</b>	7,411	28.5%	26,621	51.9%	19,210	75.9%
<b>Construction</b>	2,117	8.1%	2,046	4.0%	-71	NA
<b>Government</b>	4,906	18.9%	14,276	27.8%	9,370	37.0%

*Agricultural Services* include soil preparation services, crop services, etc. It also includes forestry services, such as reforestation services, and fishing, hunting, and trapping.

**Figure 12c - Personal income by industry, Pinal County**



1

<sup>1</sup> Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

## **Santa Cruz**

### **General Description**

Santa Cruz County includes part of the Coronado National Forest, as well as private, state, and BLM lands. It also contains perennial portions of the Santa Cruz River.

Vegetation within this county is dominated by mixed conifer and Madrean oak woodland mountains connected by semi-desert grassland seas. Intermingled with these latter two vegetation types are riparian gallery forests along perennial and intermittent stream reaches. These forests support a large array of species ranging from the Sabino canyon damselfly (*Argia sabino*) to the endangered jaguar and lesser long-nosed bat (*Leptonycteris curasoae yerbabuena*). This county is part of a greater geographic region referred to as the Madrean Archipelago, which has recently been added to Conservation International's list of the world's hotspots for biodiversity (Andrew Smith personal communication).

In total there are 121 threatened, endangered, sensitive or of special concern species within this county. Although Santa Cruz is the smallest county at 791,000 acres, there are 13,124 acres of private forest within a conservation area, 21,473 acres of publicly important private forest, and 10,702 acres of private forest currently threatened by roads and/or development.

### **Growth and Development Patterns**

Santa Cruz County was created in 1899 and was named after the river that flows into Mexico from Arizona before winding back into Santa Cruz and Pima Counties. Friendly Pima Indians populated the fertile Santa Cruz Valley when the Spaniards first arrived in the 1690s and established several missions, one of which, Tumacacori, is a National Historic Park.

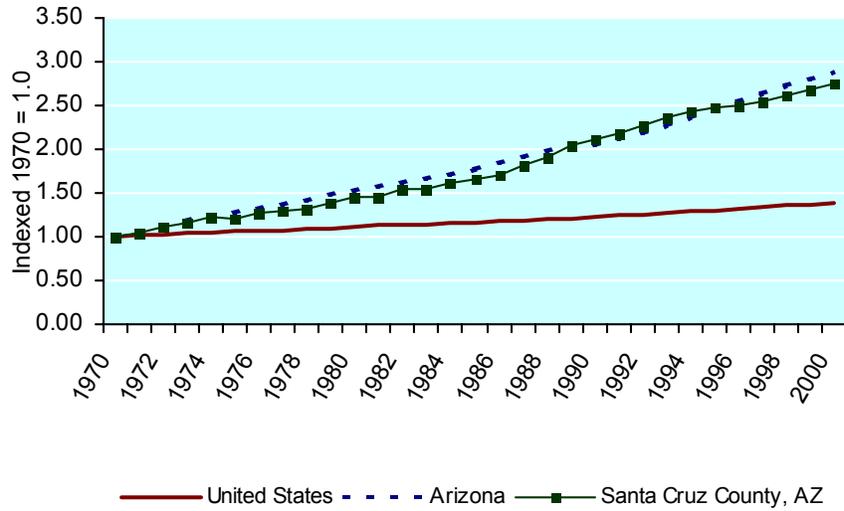
Nogales, the largest community in the county, has strong commercial, religious and cultural ties with its sister city across the border, Nogales, Sonora - serving as a major gateway between the U.S. and Mexico and it is expected to grow in importance because of the North American Free Trade Agreement. Given its border location, tourism, international trade, manufacturing and services are the county's principal industries.

The U.S. Forest Service and Bureau of Land Management own 54.6% of the land; the State of Arizona, 7.8%; and individual or corporate ownership, 37.5%. Since 1970, the population of Santa Cruz County has grown by 24,535 people, a 174% increase. This growth has been slower than the state average and faster than the national average (Figure 13a). Commerce and international trade along with an influx of retirees provide the impetus for growth in the county and are primarily responsible for the 60% increase in service and professional jobs, and the 24% growth in government jobs (Figure 13b and 13c). The population increase and economic drivers have focused development in and around several areas. Nogales and Tubac on the western edge, and Sonoita and Elgin on the northeastern edge are at greatest risk to negative impacts due to development.

### Goals and Objectives

- 1) Protect public and ecological values as well as riparian forest and native fish habitat. Focus on riparian forest along perennial water.
- 2) Decrease fragmentation within Coronado National Forest by protecting key Madrean oak woodlands that border or are within USFS boundary.

**Figure 13a - Population compared to state and nation, Santa Cruz County**

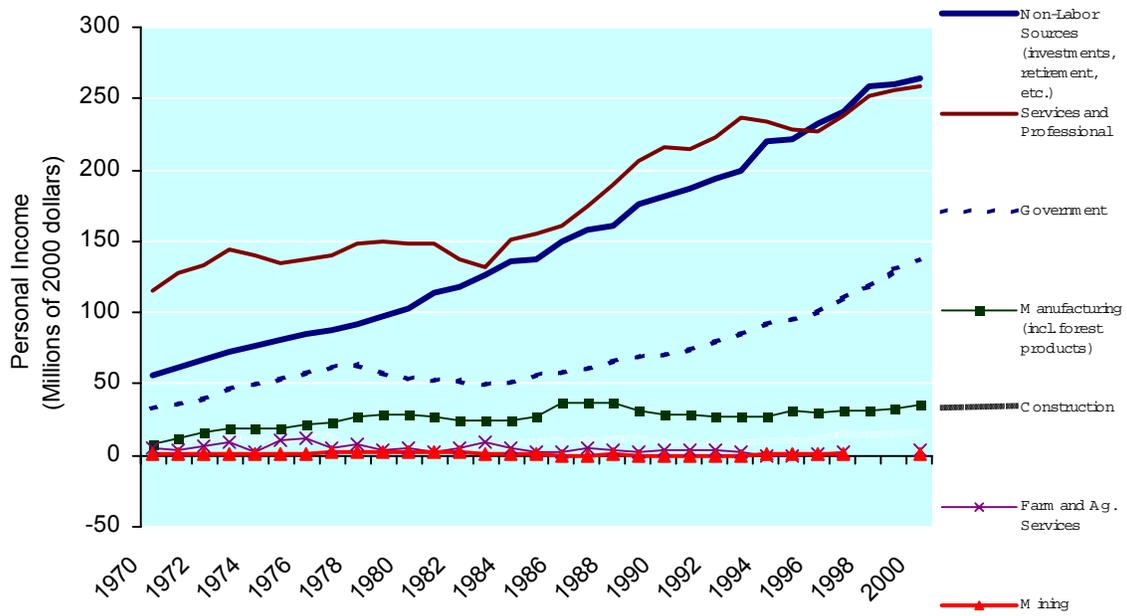


**Figure 13b - Employment by industry, Santa Cruz County**

	1970	% of Total	2000	% of Total	New Employment	% of New Employment
<b>Total Employment</b>	5,978		15,956		<b>9,978</b>	
<b>Farm and Agricultural Services</b>	274	4.6%	442	2.8%	<b>168</b>	<b>1.7%</b>
<b>Farm</b>	260	4.3%	191	1.2%	<b>-69</b>	<b>NA</b>
<b>Ag. Services</b>	14	0.2%	251	1.6%	<b>237</b>	<b>2.4%</b>
<b>Manufacturing (incl. forest products)</b>	327	5.5%	1,040	6.5%	<b>713</b>	<b>7.1%</b>
<b>Services and Professional</b>	4,265	71.3%	10,683	67.0%	<b>6,418</b>	<b>64.3%</b>
<b>Construction</b>	265	4.4%	640	4.0%	<b>375</b>	<b>3.8%</b>
<b>Government</b>	788	13.2%	3,133	19.6%	<b>2,345</b>	<b>23.5%</b>

*Agricultural Services* include soil preparation services, crop services, etc. It also includes forestry services, such as reforestation services, and fishing, hunting, and trapping

**Figure 13c - Personal income by industry, Santa Cruz County**



1

<sup>1</sup> Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

## Yavapai County

### General Description

Yavapai County includes all or part of the Prescott and Coconino National Forests; Hassayampa River Canyon, Hells Canyon, Tres Alamos, and Upper Burro Creek Wilderness Areas, as well as private, state, and other BLM lands. It also contains portions of the Agua Fria, Hassayampa, and Verde Rivers.

Vegetation within this county is a mix of semi-desert grasslands at the lower elevations with pinyon-juniper woodlands and mixed conifer forests at the higher elevations. These forests provide habitat for many raptor species including Mexican spotted owls, ferruginous hawks and Northern goshawks as well as the endangered Arizona cliff rose (*Purshia subintegra*). Riparian forests also exist along perennial and intermittent waterways and are vital for native fish such as, razorback sucker, spinedace, and Gila chub. Other riparian obligate species include Southwestern willow flycatchers and Yuma clapper rails.

Yavapai County encompasses 5.2 million acres and in total there are 74 threatened, endangered, sensitive or of special concern species within this county. There are 254,226 acres of private forest within a conservation area, 548,861 acres of publicly important private forest, and 126,366 acres of private forest currently threatened by roads and/or development .

### Growth and Development Patterns

Yavapai County was once the largest county and one of the state's oldest counties. Today, it offers many local attractions ranging from natural to cultural and educational. Scenic pine forests provide year-round recreational opportunities, and museums, monuments and rodeos reflect Arizona's tribal and territorial past. Institutions of higher learning include two colleges and an aeronautical university.

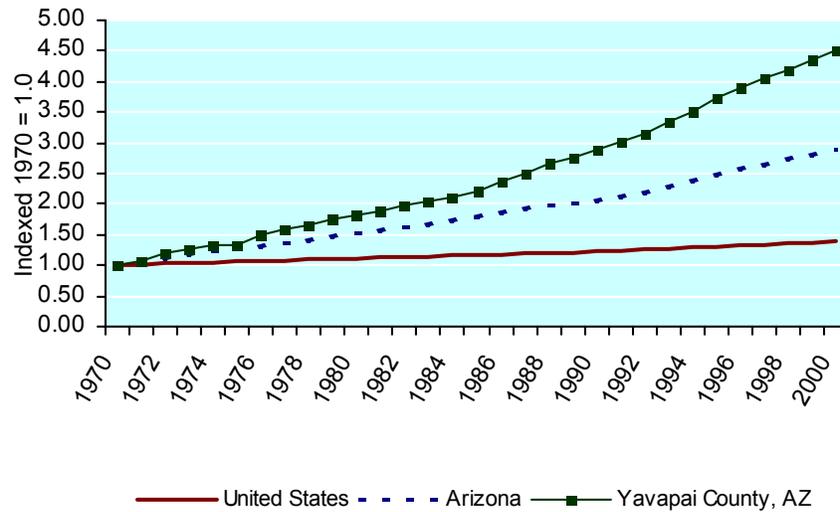
The U.S. Forest Service manages 38% of the land in Yavapai County, including portions of Prescott, Tonto, and Coconino National Forests, while the State of Arizona owns an additional 24.6%. Twenty-five percent is individually or corporately owned, and 11.6% is managed by the BLM. The Yavapai Indian Reservation and public lands each occupy less than 0.5% of the county. Since 1983, the population of Yavapai County has grown by 131,389 people, a 350% increase. This growth has been faster than both the state and national averages (Figure 14a).

Like adjacent Coconino, Mohave and La Paz counties, Yavapai is seen as a haven for retirees and recreational enthusiasts. Their immigration into the county is reflected in a 70% increase in service and professional jobs and an 11% increase in construction (housing and commercial development) (Figure 14b and 14c). Thus, the county faces the same negative impact to land as is being experienced by the surrounding counties.

### Goal and Objectives

- 1) Decrease fragmentation within Prescott National Forest by protecting key Madrean oak woodland and mixed conifer forests that border or are within USFS boundary.
- 2) Protect ecological value and traditional forest uses, ranching, by focusing attention on pinyon-juniper woodlands in the northern portion of this county.
- 3) Protect public and ecological values as well as riparian forest and native fish habitat. Focus on riparian forest along perennial reaches and areas of shallow groundwater.

**Figure 14a - Population compared to state and nation, Yavapai County**

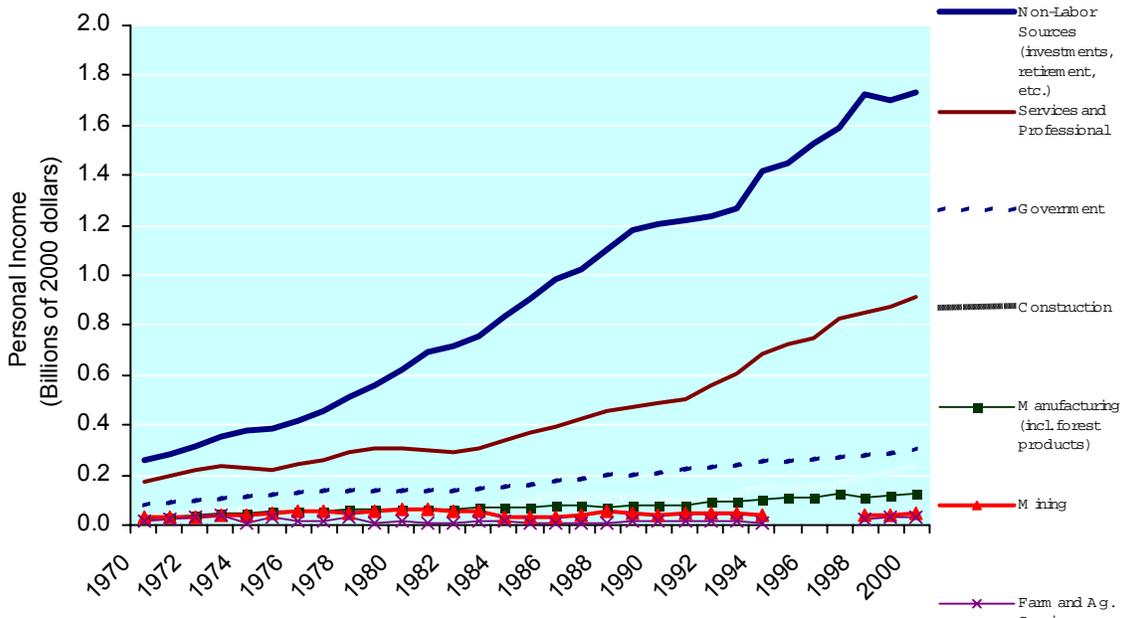


**Figure 14b - Employment by industry, Yavapai County**

	1970	% of Total	2000	% of Total	New Employment	% of New Employment
<b>Total Employment</b>	12,548		71,985		<b>59,437</b>	
<b>Farm and Agricultural Services</b>	688	5.5%	1,749	2.4%	<b>1,061</b>	<b>1.8%</b>
<b>Farm</b>	599	4.8%	735	1.0%	<b>136</b>	<b>0.2%</b>
<b>Ag. Services</b>	89	0.7%	1,014	1.4%	<b>925</b>	<b>1.6%</b>
<b>Manufacturing (incl. forest products)</b>	955	7.6%	4,199	5.8%	<b>3,244</b>	<b>5.5%</b>
<b>Services and Professional</b>	6,944	55.3%	48,491	67.4%	<b>41,547</b>	<b>69.9%</b>
<b>Construction</b>	759	6.0%	7,460	10.4%	<b>6,701</b>	<b>11.3%</b>
<b>Government</b>	2,364	18.8%	8,850	12.3%	<b>6,486</b>	<b>10.9%</b>

*Agricultural Services* include soil preparation services, crop services, etc. It also includes forestry services, such as reforestation services, and fishing, hunting, and trapping.

**Figure 14c - Personal income by industry, Yavapai County**



1

<sup>1</sup> Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

## Yuma County

### General Description

Yuma County includes all or part of the Yuma Proving Ground, Barry M. Goldwater Air Force Range, Kofa and Cabeza Prieta National Wildlife Refuges, Eagletail Mountains and Muggins Mountains Wilderness Areas, as well as private, state, BOR, and other BLM lands . It also contains portions of the lower Colorado and lower Gila Rivers.

Vegetation within this county is a blend of Sonoran and Mohave Desert communities on the western edge of the county with predominantly Sonoran desert on the eastern edge. Riparian forest is present along perennial water. These riparian forests support the endangered Southwestern willow flycatcher and Yuma clapper rail as well as species of concern such as California black rail and Western yellow-billed cuckoo.

In total there are 13 threatened, endangered, sensitive or of special concern species within this county. The valley regions of Yuma County contain an abundance of arable land, which is irrigated with Colorado River water thus little of the County's acreage (3.5 million acres) is private forest lands. There are 796 acres of private forest within a conservation area, 3,340 acres of publicly important private forest, and 2,000 acres of private forest currently threatened by roads and/or development.

### Growth and Development Patterns

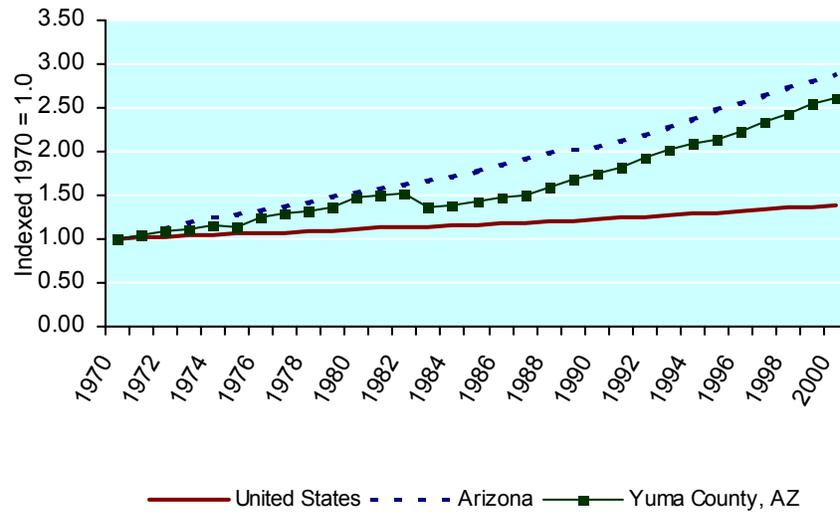
Yuma County was one of the original four counties designated by the First Territorial Legislature. From the 1850s through the 1870s, steamboats on the Colorado River transported passengers and goods to mines, ranches and military outposts in the area. For many years, Yuma served as the gateway to the new western territory of California. In 1870, the Southern Pacific Railroad bridged the river, and Yuma became a hub for the railroad and was selected as the county seat.

Agriculture, tourism, military and government are the county's principal industries. During the winter months, the population grows considerably with part-time residents. The U.S. Bureau of Land Management accounts for 14.8% of land ownership; Indian reservations, 0.2%; the State of Arizona, 7.7%; individual or corporate, 10.5%; and other public lands, 66.8%. Since 1970, the population of Yuma County has grown by 99,692 people, a 162% increase. This growth has been slower than the state average and faster than the national average (Figure 15a). Population growth combined with the creation of more than 2,800 new construction jobs indicates that some land transformation has taken place for new home construction. Service and professional income has also more than doubled in 30 years suggesting that more business and office space is being developed (Figure 15b and 15c). The large loss of farm jobs combined with a 28% increase in agriculture service jobs indicates a lot of small farms have been consolidated into large commercial farms. This may have a negative effect on riparian forests along the Colorado as they cultivate and irrigate right to the river's edge.

### Goals and Objectives

1) Protect public and ecological values as well as riparian forest and native fish habitat by protecting riparian forest along the Colorado River.

**Figure 15a - Population compared to state and nation, Yuma County**

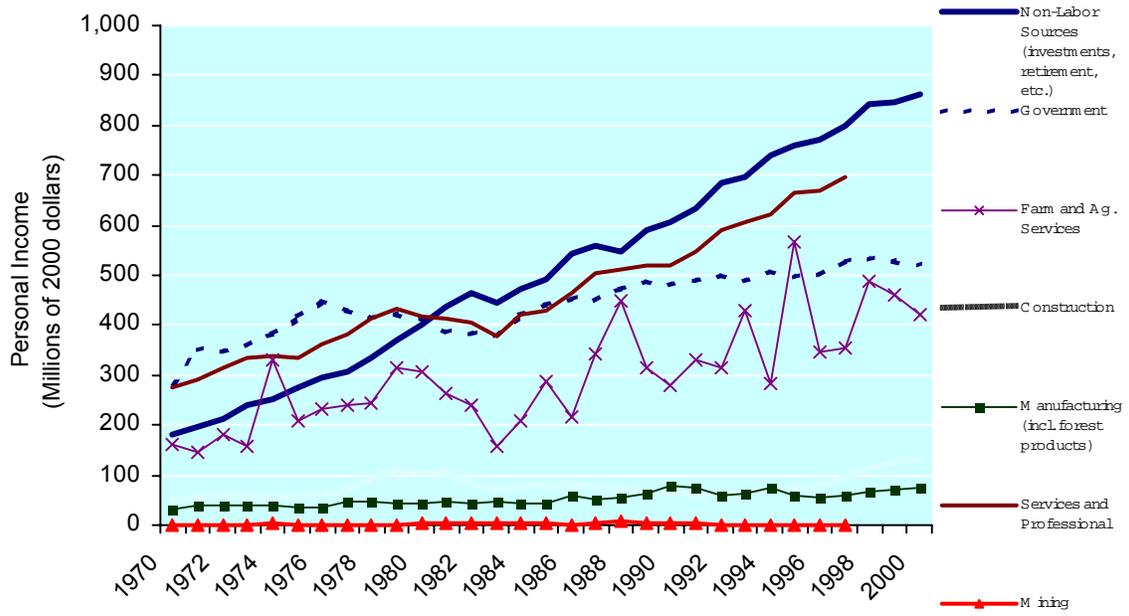


**Figure 15b - Employment by industry, Yuma County**

	1970	% of Total	2000	% of Total	New Employment	% of New Employment
<b>Total Employment</b>	29,741		67,040		<b>37,299</b>	
<b>Farm and Agricultural Services</b>	7,920	26.6%	15,468	23.1%	<b>7,548</b>	<b>20.2%</b>
<b>Farm</b>	6,525	21.9%	3,703	5.5%	<b>-2,822</b>	<b>NA</b>
<b>Ag. Services</b>	1,395	4.7%	11,765	17.5%	<b>10,370</b>	<b>27.8%</b>
<b>Manufacturing (incl. forest products)</b>	1,105	3.7%	2,428	3.6%	<b>1,323</b>	<b>3.5%</b>
<b>Services and Professional</b>	11,403	38.3%	#N/A	#N/A	<b>#N/A</b>	<b>#N/A</b>
<b>Construction</b>	1,162	3.9%	3,395	5.1%	<b>2,233</b>	<b>6.0%</b>
<b>Government</b>	8,122	27.3%	13,532	20.2%	<b>5,410</b>	<b>14.5%</b>

*Agricultural Services* include soil preparation services, crop services, etc. It also includes forestry services, such as reforestation services, and fishing, hunting, and trapping.

**Figure 15c - Personal income by industry, Yuma County**



1

<sup>1</sup> Population and economic data courtesy of The Sonoran Institute's Economic Profile System (EPS) at [www.sonoran.org](http://www.sonoran.org).

**MEMBERSHIP ROSTER OF  
ARIZONA FOREST STEWARDSHIP COMMITTEE  
January, 2005**

Ted & Marilyn Allen  
7818 N. Mohave  
Paradise Valley, AZ 85253  
Phone: 480-991-4384

Sandy Bahr  
Sierra Club Southwest  
202 E. McDowell Road, Suite 277  
Phoenix, AZ 85004  
Phone: 602-254-9330  
Fax: 602-258-6533  
[sandy.bahr@sierraclub.org](mailto:sandy.bahr@sierraclub.org)

Steve Barker  
USDA Natural Resource Conservation Service  
3003 N. Central - Ste. 800  
Phoenix, AZ 85012-2945  
Phone: 602-280-8823  
Fax: 602-280-8805  
[steve.barker@az.usda.gov](mailto:steve.barker@az.usda.gov)

Leroy Brady  
Arizona Department of Transportation  
206 S. 17th Ave., Rm. 228E  
Phoenix, AZ 85007  
Phone: 602-712-7357  
Fax: 602-712-3217  
[lbrady@dot.state.az.us](mailto:lbrady@dot.state.az.us)

Kelly Huckins, Project Evaluation Specialist  
Habitat Branch  
Arizona Game and Fish Department  
2222 W. Greenway  
Phoenix, AZ 85007  
Phone: 602-789-3593  
Fax: 602-789-3920  
[jcarpenter@gf.state.az.us](mailto:jcarpenter@gf.state.az.us)

Lyman Clayton  
Western Regional Office  
USDI Bureau of Indian Affairs  
P.O. Box 10  
Phoenix, AZ 85001  
Phone: 602-379-6798  
Fax: 602-379-6826  
[bigspring@altavista.net](mailto:bigspring@altavista.net)

Tom Collazo  
The Nature Conservancy  
1510 E. Fort Lowell Road  
Tucson, AZ 85719  
Phone: 520-622-3861  
Fax: 520-620-1799  
[tcollazo@tnc.org](mailto:tcollazo@tnc.org)

Henry Dahlberg, Manager  
Mingus Springs Camp  
2946 Darca Drive  
Prescott, AZ 86305  
Phone: 928-445-3778  
Fax: 928-776-1268  
[dahlberg@northlink.com](mailto:dahlberg@northlink.com)

P.J. Daugherty  
School of Forestry  
Northern Arizona University  
Box 4098  
Flagstaff, AZ 86011  
Phone: 928-523-6636  
Fax: 928-523-1080  
[pjd@nau.edu](mailto:pjd@nau.edu)

Ed deSteiguer, Professor  
Forest & Natural Resources Economics, SRNR  
325 Biosciences East  
University of Arizona  
Tucson, AZ 85721-0043  
Phone: 520-621-3241  
Fax: 520-621-8801  
[jedes@ag.arizona.edu](mailto:jedes@ag.arizona.edu)

Al Hendricks, Forestry Section Manager <sup>1</sup>  
Forestry Division  
Arizona State Land Department  
3650 Lake Mary Road  
Flagstaff, AZ 86001  
Phone: 928-774-1425  
Fax: 928-779-2143  
[alhendricks@azstatefire.org](mailto:alhendricks@azstatefire.org)

Macaria Herrera, Executive Director  
Arizona Association of Conservation Districts  
3003 N. Central Ave., Ste. 800  
Phoenix, AZ 85012-2945  
Phone: 602-280-8803  
Fax: 602-280-8779  
[aacd@az.usda.gov](mailto:aacd@az.usda.gov)

John Hinz  
USDA Forest Service, Cooperative Forestry  
Tonto National Forest  
2324 E. McDowell Road  
Phoenix, AZ 85006  
Phone: 602-225-5271  
Fax: 602-225-5295  
[jhinz@fs.fed.us](mailto:jhinz@fs.fed.us)

---

<sup>1</sup> Denotes Committee Chairperson

Herbert Hopper, Arizona State Coordinator  
Four Corners Sustainable Forests Partnership  
Little Colorado River Valley RC&D  
51 West Vista, # 4  
Holbrook, AZ 86025  
Phone: 928-524-6063, ext. 5  
Fax: 928-524-6609  
[hhopper@littlecolorado.org](mailto:hhopper@littlecolorado.org)

John Hunt, Ph.D., Associate Director  
Animal Services Division  
Arizona Department of Agriculture  
1688 W. Adams  
Phoenix, AZ 85007  
Phone: 602-542-7186  
Fax: 602-542-5420  
[john.hunt@agric.state.az.us](mailto:john.hunt@agric.state.az.us)

Peter Jagow  
Arizona Department of Environmental Quality  
3033 N. Central Ave.  
Phoenix, AZ 85012  
Phone: 602-771-4519  
Fax: 602-771-4634  
[ppj@ev.state.az.us](mailto:ppj@ev.state.az.us)

Christopher Jones, Assistant Agent  
Agriculture & Natural Resources, Gila County  
Arizona Cooperative Extension  
1177 Monroe Street  
Globe, AZ 85501-1415  
Phone: 928-425-7179  
Fax: 928-425-0265  
[ckjones@ag.arizona.edu](mailto:ckjones@ag.arizona.edu)

Rose Mari Leon  
USDA Farm Services Agency  
77 E. Thomas Rd., Rm. 240  
Phoenix, AZ 85012  
Phone: 602-640-5200 ext 227  
Fax: 602-640-5180  
[rosemari.leon@az.usda.gov](mailto:rosemari.leon@az.usda.gov)

Kris Randall, Director  
Partners For Fish & Wildlife Program  
U.S. Fish & Wildlife Service  
2321 W. Royal Palm Road, Ste. 103  
Phoenix, AZ 85021-4951  
Phone: 602-242-0210 Ext. 213  
Fax: 602-242-2513  
[kris\\_randall@fws.gov](mailto:kris_randall@fws.gov)

Dick Roberts  
P.O. Box 658  
Snowflake, AZ 85937-0658  
Phone: 928-536-3241  
Fax: Call above # first.  
[djroberts@cybertrails.com](mailto:djroberts@cybertrails.com)

Kirk Rowdabaugh, State Forester  
Forestry Division  
2901 W. Pinnacle Peak Road  
Phoenix, AZ 85027  
Phone: 602-255-4059  
Fax: 602-255-1781  
[kirkrowdabaugh@azstatefire.org](mailto:kirkrowdabaugh@azstatefire.org)

McKinley-Ben Miller, Forester  
USDI Bureau of Land Management  
Arizona State Office  
222 N. Central Avenue, Suite 101  
Phoenix, AZ 85004  
Phone: 602-417-9511  
Fax: 602-417-9554  
[lester\\_tisino@blm.gov](mailto:lester_tisino@blm.gov)

Craig Wilcox, Consultant  
HCO 225W 100S  
Pima, AZ 85543  
Phone: 928-485-2744  
Fax: none  
[sw4ester@yahoo.com](mailto:sw4ester@yahoo.com)

Ray Wrobley, President  
SEC, Inc.  
20 Stutz Bearcat #6  
Sedona, AZ 86336  
Phone: 928-282-7787  
Fax: 928-282-0731  
[rwrobley@sec-landmgt.com](mailto:rwrobley@sec-landmgt.com)

## Janet Napolitano, Governor of Arizona

Forest Health Advisory Council	
<u>Co Chairs</u>	<u>Title/Organization</u>
<b>Taylor McKinnon</b>	Title: Program Officer Org: Grand Canyon Trust
<b>Beth Zimmerman</b>	Title: Recovery Manager Org: Department of Emergency Management
<u>Members</u>	<u>Title/Organization</u>
<b>Steve Campbell</b>	Title: Executive Director Org: Navajo County Cooperative Extension
<b>Wally Covington</b>	Title: Professor of Forest Ecology Org: Northern Arizona University
<b>Carl Edminster</b>	Title: Program Manager Org: USFS, Rocky Mountain Research Sta.
<b>Don Falk</b>	Title: Graduate Research Associate Org: University of Arizona
<b>Deb Hill</b>	Title: County Supervisor Org: Coconino County
<b>Bob Broschied</b>	Title: - Habitat Branch Chief Org: Arizona Game and Fish Department
<b>Robert Lacapa</b>	Title: Forest Manager Org: BIA/Fort Apache
<b>Marty Moore</b>	Title: Executive Director Org: Eastern Arizona Counties Organization
<b>Brian Nowicki</b>	Title: Consultant Org: -
<b>Kirk Rowdabaugh</b>	Title: State Forester Org: Arizona State Land Department
<b>Karl Siderits</b>	Title: Special Assistant to the Regional Forester Org: USDA Forest Service
<b>Ed Smith</b>	Title: Northern Arizona Regional Ecologist Org: The Nature Conservancy
<b>Richard Van Demark</b>	Title: President Org: Southwest Forestry
<b>Thomas Swetnam</b>	Title: Director/Professor Dendrochronology Org: Lab of Tree-Ring Research U of A <a href="http://tree.ltrr.arizona.edu/~tswetnam">http://tree.ltrr.arizona.edu/~tswetnam</a>

## Janet Napolitano, Governor of Arizona

### Governor's Forest Health Oversight Council

<u>Co Chairs</u>	<u>Title/Organization</u>
<b>Honorable Tom O'Halleran</b>	Title: Arizona State Representative Org: Arizona Legislature
<b>Diane Vosick</b>	Title: Associate Director Org: Ecological Restoration Institute
<u>Members</u>	<u>Title/Organization</u>
<b>Kirk Rowdabaugh</b>	Title: State Forester Org: Arizona State Land Department
<b>Richard Collison</b>	Title: Medical Doctor Org: -
<b>Dallas Massey Sr.</b>	Title: Tribal Chairman Org: White Mountain Apache Tribe
<b>Mark C. Herrington</b>	Title: County Supervisor Org: Graham County
<b>Rob Smith</b>	Title: Southwestern Representative Org: Sierra Club
<b>Todd Schulke</b>	Title: Forest Policy Director Org: Center for Biological Diversity
<b>Steve Campbell</b>	Title: Executive Director Org: Navajo County Cooperative Extension
<b>Honorable Joe Donaldson</b>	Title: Mayor Org: City of Flagstaff
<b>Don Foster</b>	Title: Director Org: Apache County Health Department
<b>Michael Neal</b>	Title: Manager, Forestry & Special Programs Org: Arizona Public Service (APS)
<b>Beth Zimmerman</b>	Title: Recovery Manager Org: Department of Emergency Management
<b>Darrell Willis</b>	Title: Fire Chief Org: Prescott Fire Department
<b>Mike Somerville</b>	Title: State Conservationist Org: Natural Resource Conservation Service
<b>Rob Davis</b>	Title: Owner Org: Forest Energy
<b>Alexious C. Becenti Sr.</b>	Title: Forest Manager Org: Navajo Forestry Department

#### Staff for the Governor's Forest Health Oversight Council

Heather Garbarino, Community Planning Specialist, Department of Commerce

# League of Arizona Cities & Towns Executive Committee

League activities are directed by a 25-member Executive Committee, consisting of mayors and councilmembers from across the State.

Committee officers are elected to two-year terms. Committee members are elected to one- or two-year overlapping terms. Members and officers of the Executive Committee are determined by all League members at the League's Annual Conference through a process coordinated by a Nominating Committee.

## **Officers**

### **President**

**James L. Boles**, Mayor, City of Winslow  
Elected President 2004  
Term expires 2006

### **Vice President**

**Douglas Coleman**, Mayor, City of Apache Junction  
Elected Vice President 2004  
Term expires 2006

### **Treasurer**

**Boyd Dunn**, Mayor, City of Chandler  
Elected Treasurer 2004  
Term expires 2006

## **Committee Members**

**Diane Vick**, Mayor of Bullhead City  
**Gilbert Lopez**, Vice Mayor of Coolidge  
**Sandra Burk**, Mayor of Eagar  
**Byron Jackson**, Mayor of Eloy  
**Joe Donaldson**, Mayor of Flagstaff  
**Steve Berman**, Mayor of Gilbert  
**Elaine M. Scruggs**, Mayor of Glendale  
**Stanley M. Gibson**, Mayor of Globe  
**Jim Cavanaugh**, Mayor of Goodyear  
**Bob Whelan**, Mayor of Lake Havasu City  
**Keno Hawker**, Mayor of Mesa  
**Paul Loomis**, Mayor of Oro Valley  
**Phil Gordon**, Mayor of Phoenix  
**Ginny Handorf**, Councilmember of Pinetop-Lakeside  
**Verlyn Michel**, Mayor of Quartzsite  
**Mary Manross**, Mayor of Scottsdale  
**Gerry Whipple**, Councilmember of Show Low  
**Thomas J. Hessler**, Mayor of Sierra Vista  
**Bob Rivera**, Mayor of Thatcher  
**Robert E. Walkup**, Mayor of Tucson  
**Ken Edes**, Mayor of Williams  
**Larry Nelson**, Mayor of Yuma

### **League of Arizona Cities and Towns**

1820 West Washington Avenue Phoenix, Arizona 85007  
Phone: (602) 258-5786 | Fax: (602) 253-3874

Email: [league@mq.state.az.us](mailto:league@mq.state.az.us) | Web: <http://www.azleague.org>

# County Supervisors Association of Arizona

## Member Counties

### [Apache County](#)

P.O. Box 428  
St. Johns, AZ 85936  
Phone (928) 337-4364  
Fax (928) 337-2003  
[Delwin Wengert](#), County Manager

### [Cochise County](#)

1415 W. Melody Ln.  
Bisbee, AZ 85603  
Phone (520) 432-9200  
Fax (520) 432-5016  
[Jody Klein](#), County Administrator

### [Coconino County](#)

219 E. Cherry  
Flagstaff, AZ 86001  
Phone (928) 779-6690  
Fax (928) 779-6687  
[John E. Holmes](#), County Manager

### [Gila County](#)

1400 E. Ash St.  
Globe, AZ 85501  
Phone (928) 425-3231  
Fax (928) 425-0319 or (928) 425-0190  
[John Nelson](#), County Administrator, (928) 402-8754

### [Graham County](#)

921 Thatcher Blvd.  
Safford, AZ 85546  
Phone (928) 428-3250  
Fax (928) 428-5951  
[Terry Cooper](#), County Manager

### [Greenlee County](#)

P.O. Box 908  
Clifton, AZ 85533  
Phone (928) 865-2072  
Fax (928) 865-4417  
[Kay Gale](#), County Administrator

### [La Paz County](#)

1108 Joshua Ave.  
Parker, AZ 85344  
Phone (928) 669-6115  
Fax (928) 669-970  
[Donna J. Hale](#), Interim County Administrator

### [Maricopa County](#)

301 W. Jefferson, 10<sup>th</sup> Fl.  
Phoenix, AZ 85003  
Phone (602) 506-3415  
Fax (602) 506-3328  
[David R. Smith](#), County Administrative Officer

### [Mohave County](#)

P.O. Box 7000  
Kingman, AZ 86402-7000  
Phone (928) 753-0729  
Fax (928) 753-0732  
[Ron Walker](#), County Manager

### [Navajo County](#)

P.O. Box 668  
Holbrook, AZ 86025  
Phone (928) 524-4053  
Fax (928) 524-4239  
[Jimmy Jayne](#), County Manager

### [Pima County](#)

130 W. Congress  
Tucson, AZ 85701  
Phone (520) 740-8751  
Fax (520) 740-8171  
[Charles Huckelberry](#), County Administrator

### [Pinal County](#)

P.O. Box 827  
Florence, AZ 85323  
Phone (520) 866-6211  
Fax (520) 866-6512  
[Stanley D. Griffis](#), County Manager

### [Santa Cruz County](#)

2150 N. Congress Dr.  
Nogales, AZ 85621  
Phone (520) 375-7812  
Fax (520) 761-7843  
[Greg Lucero](#), County Manager

### [Yavapai County](#)

1015 Fair St.  
Prescott, AZ 86305  
Phone (928) 771-3200  
Fax (928) 771-3181  
[James M. Holst](#), County Administrator

### [Yuma County](#)

198 S. Main St.  
Yuma, AZ 85364  
Phone (928) 373-1103  
Fax (928) 373-1120  
[David R. Garcia](#), County Administrator

**Mailing Address:** 1905 W. Washington St., Suite 100, Phoenix, AZ 85009  
**Phone:** (602) 252-5521 **Fax:** (602) 253-3227

ARIZONA STATE LAND DEPARTMENT  
FORESTRY DIVISION  
SERVICE FORESTER ASSIGNMENTS

SERVICE FORESTERS

COUNTIES SERVED

Scott Hunt, Jim Downey, Russ Shumate  
2901 W. Pinnacle Peak Road  
Phoenix, AZ 85027  
Phone 602-255-4059

Gila, LaPaz, Maricopa  
Pinal, Yavapai, Yuma

Lee Ann Beery  
P O Box 2579  
Payson, AZ 85547  
Phone 928-468-6411

Gila

Tom Warfield  
233 North Main Avenue  
Tucson, AZ 85701  
Phone 520-628-6015

Cochise, Graham,  
Greenlee, Pima,  
Santa Cruz

Mike McIntyre, Jeff Sanocki  
3048 White Mountain Blvd.  
Pinetop, AZ 85935  
Phone 928-367-0313

Apache, Navajo

Kevin Boness, Bruce Banke, Dave Sewall, Aaron Green  
3650 Lake Mary Road  
Flagstaff, AZ 86001  
928-774-1425

Coconino, Mohave

## Appendix K: Letters of Support for Forest Legacy Project

## COUNTY ADMINISTRATOR'S OFFICE

PIMA COUNTY GOVERNMENTAL CENTER  
130 W. CONGRESS, TUCSON, AZ 85701-1317  
(520) 740-8661 FAX (520) 740-8171

C. H. HUCKELBERRY  
County Administrator

January 4, 2005

Kirk Rowdabaugh  
Arizona State Forester  
State Land Department  
2901 W. Pinnacle Peak Road  
Phoenix, AZ 85027

**Re: Establishment of Forest Legacy Program in Arizona**

Dear Mr. Rowdabaugh,

I understand that you and your staff are working with the United States Forest Service to establish the Forest Legacy Program here in Arizona. As you are probably aware, Pima County has been working since 1998 on the development of the Sonoran Desert Conservation Plan that will result in the preservation of habitat for 55 priority vulnerable species. Part of the implementation efforts include fee simple acquisition and the use of conservation easements to develop a reserve of protected habitat containing the most biological important lands in eastern Pima County. Since the successful bond election in May 2004, we have been actively acquiring such properties previously identified for their biological importance, and are continually seeking federal and state matching funds to stretch our bond dollars.

I believe that this land protection effort could meet the objectives of Forest Legacy through protection of private lands in the Sky Islands and the connecting riparian corridors as identified in our Sonoran Desert Conservation Plan. Therefore I strongly support the efforts of the State to bring Forest Legacy and the accompanying source of federal conservation funding to Arizona, which could greatly help communities like Pima County meet our land protection objectives.

Please let us know if you have any questions or need additional support to bring the Forest Legacy program to this state.

Sincerely,



C.H. Huckelberry  
County Administrator

c: Jan Leshar, Director, Governor's Southern Arizona Office  
Mark Winkelman, Director, State Land Department



## SKY ISLAND ALLIANCE

P.O. BOX 41165 TUCSON, AZ 85717-1165  
738 N. 5TH AVENUE, SUITE 201, TUCSON AZ 85701  
(520) 624-7080 [info@skyislandalliance.org](mailto:info@skyislandalliance.org)  
[www.skyislandalliance.org](http://www.skyislandalliance.org)

---

January 31, 2005

Kirk Rowdabaugh  
Arizona State Forester  
State Land Department  
2901 W. Pinnacle Peak Road  
Phoenix, AZ 85027

RE: Forest Legacy Program

Dear Mr. Rowdabaugh,

We appreciate this opportunity to convey our enthusiasm for bringing the Forest Legacy Program to Arizona. Sky Island Alliance is a 501c(3) non-profit organization dedicated to the preservation and restoration of native flora and fauna located in the sky island region of the southwestern United States and northwestern Mexico, including southeast Arizona. These mountain islands are among the most diverse ecosystems in North America due to their great topographic complexity and unique location at the meeting point of several major desert and forest biological provinces.

We believe that the implementation of the Forest Legacy Program in Arizona could be an important tool for the protection of privately-owned forested land in Arizona, both in the sky islands of southeastern Arizona and elsewhere around the state. As you know, this part of the state is experiencing rapid growth resulting in large ranches and important habitat being fragmented and lost to development. The options that are possible to private landowners through such programs as Forest Legacy are critical to preserving some of these important lands. I strongly support the state's efforts to establish Forest Legacy in Arizona.

We look forward to the program reaching Arizona and hope that we may collaborate on potential areas appropriate for inclusion. Please do not hesitate to contact us.

Sincerely,

A handwritten signature in black ink, appearing to read "Matt Skroch". The signature is fluid and cursive.

Matt Skroch, Programs Director

Cc: Lori Faeth, Governors Office

THE  
TRUST  
for  
PUBLIC  
LAND



Santa Fe Office  
418 Montezuma Ave.  
Santa Fe, NM  
87501  
T. 505-988-5922  
F. 505-988-5967  
www.tpl.org

December 29, 2004

Kirk Rowdabaugh  
Arizona State Forester  
State Land Department  
2901 W. Pinnacle Peak Road  
Phoenix, AZ 85027

**RE: Forest Legacy Program**

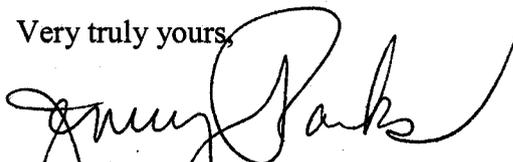
Dear Mr. Rowdabaugh,

The Trust for Public Land is very supportive of the establishment of the federal Forest Legacy Program in Arizona.

TPL currently works with a number of states across the country in assisting with their implementation of Forest Legacy. In particular, I have been working over the past 5 years with Utah's FLP program which is one of the more successful programs in the country and has resulted in protection of over 37,000 acres of private forest lands. Through this experience, we know that Forest Legacy provides an important source of conservation funding for working with willing landowners on the protection of their working ranches and forests through the sale of a conservation easement and preventing loss of important forested lands and associated habitat. I believe that the use of this federal program in Arizona could address an important need for land protection work in the state.

Please let me know if there is any way that I could be of assistance with the Forest Legacy Program or any other conservation initiatives that you are considering.

Very truly yours,



Jenny Parks  
Arizona State Director





## Keep Sedona Beautiful, Inc. It's good business

360 Brewer Road  
P.O.Box 1066 • Sedona, AZ 86339 • 928/282-4938

January 29, 2005

Mr. Kirk Rowdabaugh  
Arizona State Forester  
State Land Department  
2901 W. Pinnacle Peak Road  
Phoenix, AZ 85027

### Our Support for the Forest Legacy Program

Dear Mr. Rowdabaugh,

Keep Sedona Beautiful (KSB), an organization that works to assist in the preservation of Sedona and its surroundings, supports your effort to establish a **Forest Legacy Program** in Arizona. Over recent years, KSB has worked with the US Forest Service to acquire a number of threatened forested ranches around Sedona and add these lands to the public domain (acquisitions for the Coconino National Forest). Such lands are threatened with the rapid growth facing Coconino and Yavapai Counties, and is vital to our community goals to protect wildlife habitat, rivers and creeks and preserve the natural scenic beauty of this region.

We understand that **Forest Legacy** provides funding to acquire conservation easements from willing sellers that own lands with forests and other important resources. We believe this federal program would be of great benefit for KSB's mission and preservation goals, and hope you are successful bringing **Forest Legacy** to Arizona.

Sincerely,

Bill Pumphrey, Jr.

President

[ksb@esedona.net](mailto:ksb@esedona.net)

<wpumphrey@earthlink.net>