Conservation Ranching: This term describes most modern operations because long-term productivity depends on keeping soil in place, maintaining grass cover, and retaining water in the system. This map shows a few examples, among the many in the Sentinel area, of places that are being actively improved through water retention structures, grassland restoration, wildlife accommodations, and regular monitoring of resource conditions, frequently with the help of partners. Many properties have permanent protection as ranch land through conservation easements.

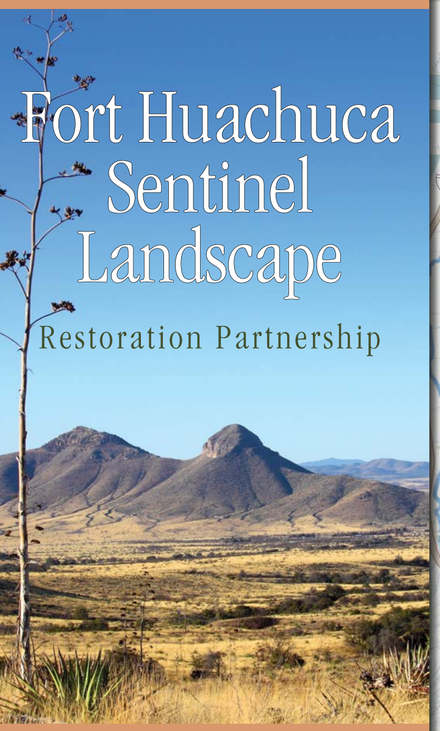
Fire: For centuries, sky island grasslands, woodlands, and forests burned every 5 to 20 years. Frequent fire kept areas open and grassy. This arrangement tamed fire behavior–understory burned but trees survived or resprouted. A century of very little fire led to over-dense woods, and managers now work to reverse that trend via thinning and prescribed fire projects.

Grasslands: Southeastern Arizona's grasslands are productive and rich ecosystems. Drought, lack of fire, invasive species, and overgrazing have degraded some grasslands, but modern management helps these areas heal. Erosion control holds soil, shrub removal and fire reduce woody species, creative grazing prevents over-utilization, and attention to weeds slows their spread.

Research: The Sentinel Landscape hosts three research sites that dedicate 50,000 acres to learning about the area's natural resources. Researchers from all over the world work at these sites, which also have value as climate monitoring stations and open space. Scientists also study grasslands, wildlife, water, fire, and livestock production practices (and much more) on other Sentinel private and public lands, including Fort Huachuca.

Water: Keeping precious water available for people, natural ecosystems, and livestock is key to the health of the Sentinel Landscape. People are conserving water in developed areas, and many partnerships monitor and maintain water in streams, springs, and the aquifer. Ranchers are providing water for wildlife as they ensure supplies for livestock. Other projects improve watersheds to slow runoff and allow local infiltration of storm water.

Wildlife: Loss of habitat has reduced wildlife numbers all over the world. The Sentinel Landscape contains large patches of habitat for important species. Keeping the patches connected helps all kinds of animals, including pollinators, have enough space to feed and breed. Preserving wetlands and removing invasive species have increased numbers of rare aquatic species. Agreements between wildlife groups and landowners aid coexistence of wildlife, humans, and livestock.



Fort Huachuca Sentinel Landscape

Restoration Partnership

The Sentinel Landscape Restoration Partnership exists to facilitate cooperative projects that improve water quality and quantity, range and forest conditions, wildlife habitat, the status of rare species, and other vital features of the working and natural lands within the Landscape and nearby ecologically connected areas. This map highlights efforts that meet these goals as well as help preserve open spaces for the testing and training missions of Fort Huachuca. The descriptions below outline restoration challenges that these projects are meeting. Mapped projects are just a sampling among many others taking place.

Map Key

Private Lands: Non-urban parcels vary from small-acreage residential holdings to large ranches, including some with land under permanent conservation status.

Public Lands: USDA Forest Service and Bureau of Land Management (BLM) balance resource protection and activities such as recreation, grazing, mining, and energy development on lands that belong to the citizens of the U.S.

State Trust Lands: These lands are held in trust for beneficiaries, chiefly K-12 education. The Arizona State Land Department serves as agent and fiduciary. Trust land is not public land; it is sold and leased under principles of highest and best use. Undeveloped State Lands serve as open space and wildlife habitat.

Urban

Wildlife Corridors: Projects protect wildlife travel routes between mountain ranges.

Arizona Trail: The first 115 miles of the magnificent trail that crosses the entire state illustrates the Sentinel Landscape's recreational riches. There are hundreds more miles of hiking trails plus places for hunting, biking, birdwatching and other activities.

Buffalo Soldier Electronic Testing Range Boundary

Major Streams

Restricted Air Space: Maintained by Fort Huachuca in support of manned and unmanned aviation operations.

Miles

0 5 10

N

Map Area

Organizations working on Sentinel Landscape restoration who welcome volunteers

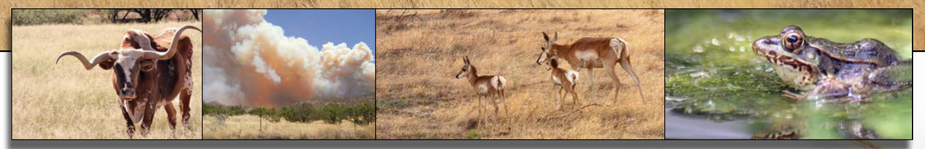
Appleton-Whittell Research Ranch researchranch.audubon.org
Arizona Antelope Foundation azantelope.org
Cienega Watershed Partnership cienega.org
Coronado National Memorial nps.gov/coro
Borderlands Restoration borderlandsrestoration.org
Sky Island Alliance skyislandalliance.org
The Nature Conservancy nature.org

Other partners

Arizona Game and Fish Department
Arizona Department of Environmental Quality
Arizona Department of Forestry and Fire Management
Arizona State Parks
Arizona Land and Water Trust
Bureau of Land Management
Cascabel Conservation Association
Cochise County
Coronado National Forest
Fort Huachuca
Fry Fire District
Hereford Natural Resource Conservation District
Huachuca Gould's Chapter/NWTF
Natural Resources Conservation Service
Santa Cruz Natural Resource Conservation District
Santa Rita Experimental Range
UA-Cochise County Cooperative Extension
US Fish & Wildlife Service
US Geological Survey
Walnut Gulch Experimental Watershed

Muleshoe Ranch Prescribed Fire
Muleshoe Ranch Preserve
Hot Springs Wildlife Corridor
Teran Watershed Enhancement
Gould's Turkey
Allen Flat Habitat Restoration
Gould's Turkey
Davidson Canyon Wildlife Corridor
Dragoon Fuels Project
Cochise Stronghold
Stronghold Firewise
Las Cienegas National Conservation Area
Prairie Dog Reintroduction
Las Cienegas Grassland Restoration
Greaterville Frogs
Antelope-friendly Fencing
FROG Project
Simpson Spring Restoration
Kartchner Caverns State Park
McGrew Spring Stewardship
Sands Grassland Restoration
Walnut Gulch Experimental Watershed
San Pedro Riparian National Conservation Area
Madera Canyon
Vera Earl Ranch
Rose Tree Ranch
Brookline Ranch
Babacomari Ranch
Babacomari Erosion Control
Antelope-friendly Fencing
Gould's Turkey
Patagonia Wildlife Corridor
Babacomari-Research Ranch Firewise
San Pedro Beaver Reintroduction
Appleton-Whittell Research Ranch
Sierra Vista EOP
Backyard Erosion Control
Tamarisk Removal
47 Ranch
Whitewater Draw Wildlife Area
Patagonia-Sonoita Creek Preserve
Native Plant Nursery
Coalmine Spring
Patagonia Firewise
Patagonia Lake State Park
San Pedro House
Fort Huachuca Prescribed Fire
Brown Canyon Wetlands
San Pedro Prescribed Fire
Banning Creek Firewise
Scotia Canyon Restoration
Ramsey Canyon Preserve
Ramsey Canyon Firewise
Parker Lake
Gould's Turkey
Riparian Pasture Restoration
Palominas Recharge
Horseshoe Draw
San Jose Ranch
San Rafael State Natural Area
Border Savanna Project
Coronado National Memorial
Agaves and Bats
St. David Upland Restoration
Little Joe Restoration

UNITED STATES / MEXICO BORDER



Fort Huachuca Sentinel Landscape Restoration Partnership

Conserving grasslands and forests that provide habitat, water, livelihoods, and recreation in Cochise, Pima, and Santa Cruz counties, Arizona

For decades, people have worked together to protect precious natural and cultural features of southeastern Arizona's sky island region. In 2015, the Sentinel Landscape Restoration Partnership came together with an added twist—preserving the electromagnetically quiet area for the U.S. Army's Fort Huachuca Buffalo Soldier Electronic Test Range.

This "working landscape" hosts world-class biodiversity and offers recreation opportunities for residents and visitors. The diverse partnerships dedicated to maintaining these riches are made up of landowners, concerned citizens, scientists, and staff of local, state, and federal governments.

Sky Island Grasslands and Forest

On the Fort Huachuca Sentinel Landscape, grassland "seas" sit at 3500-5000 ft elevation, and mountain "islands" rise from valleys to over 9000 ft. Grass reigns supreme here. A field guide to the grasses of Las Cienegas National Conservation Area describes 45 native species in that area alone.

Oak trees join grasses in the foothills, then going up, pines join the oaks. Firs and pines inhabit the tops of the Huachuca and Santa Rita mountains.

This guide shows how people are taking care of these sky island grasslands and forests. It highlights partnerships that conserve water and improve wildlife habitat and rangeland for livestock.

The result is a beautiful place where people can both make a living and play. Many of the organizations represented on this map offer opportunities for volunteers—check their websites.

Early Residents

Humans have inhabited the Sentinel area for millennia. Mammoth hunters lived along the San Pedro River 13,000 years ago, and evidence of farming dates back a thousand years or more. Around 500 years ago, Apaches gained a foothold in the Southwest and were able to limit settlements of other tribes, the Spanish, Mexicans, and westward-moving Americans until after the Civil War.

Fort Huachuca

In 1877, the army added Camp Huachuca to the line of Southwestern outposts directed to end the threat from the fierce and resourceful Apache raiders. Fort Huachuca's (renamed in 1882) officers and men spent more than a year pursuing Apache leader Geronimo. His 1886 surrender marked the end of an era.

Fort Huachuca is the one Arizona post from the 1880s that remains active today. It was home to all-black troops from the post-Civil-War time of the Buffalo Soldiers until desegregation in the late 1940s. Ranks swelled to 25,000 during World War II when Huachuca's varied and rugged terrain prepared soldiers for action in Europe and the Pacific.

Fort Huachuca began its modern electronic testing mission in 1954. The army needed a place free from the interference of radio, television, and airport transmissions. The Sentinel Landscape preserves the same kind of testing plus restricted air space for flying missions. Fort Huachuca's 21st-century configuration has made it southern Arizona's largest employer. As it carries out its defense duties, it also works with partners to fulfill its obligation to be a steward of the region's natural resources.

Conservation Ranching

47 Ranch: On the 47 Ranch in the Mule Mountains, attention to ranching is inseparable from a long view towards sustaining livestock and wildlife. Conservation easements guarantee long-term status as ranch land, and 2500 retention structures improve water capture and infiltration. Native biodiversity highlights include five species of oaks, mule and white-tailed deer, three species of quail, and 50 different grasses.

Babacomari Ranch: Within the boundaries of an extensive 1832 Mexican Land Grant, current management (since 1935) actively maintains grasslands using grazing rest, prescribed fire, and treatments for invasive brush. The ranch, key open space near Fort Huachuca, includes over 3000 acres of conservation easements. The Babacomari supports projects with partners to improve habitat for antelope and other wildlife, control erosion, and monitor water in the major San Pedro tributary that gives it its name.

Brookline Ranch: Protecting and improving condition of the Babocomari River riparian corridor are priorities on the Brookline Ranch. The operation includes deliberate range rest and pasture rotation to sustain grazing lands. Treatments on over 4000 acres of shrub land have restored grasses and brought a long-dry spring back to life. The ranch has long been a partner in local wet-dry mapping of the San Pedro River and its major tributaries.

Rose Tree Ranch: "Grass farming" is the foremost goal on the Rose Tree, where monitoring tracks range condition. Increasing the numbers of pastures and watering sites helps even out cattle grazing across the ranch and promotes growth of native grasses. Selective breeding for high-value qualities makes a smaller herd feasible. Permanent water, antelope-friendly fencing, and escape ramps in water tanks benefit the non-cattle ranch residents. Reducing grazing access to a riparian corridor maintains plant cover for antelope fawning.

San Jose Ranch: Grassland restoration to reduce soil erosion and benefit livestock is top priority for this 1896 homestead, still run by the original family. Wildlife corridors wind between areas where mechanical and chemical treatments eliminate encroaching shrubs. The San Jose Ranch now includes the adjacent Flying H; over 4000 acres of both are protected as open, working land by conservation easements. The ranch is the site of a San Pedro River recharge project that also prevents downstream floods.

Vera Earl Ranch: The Vera Earl operation combines livestock production with stewardship of the Sonoita grasslands and resident wildlife through a variety of partnerships. Antelope and grassland birds benefit from removal of encroaching mesquite on 2400 acres. Paired water projects support cattle and create habitat for threatened leopard frogs, and a conservation easement maintains key acreage as ranch land into the future.

Fire

Dragoon Fuels Project: The Coronado National Forest and local partners are returning fire to the Dragoon Mountains to open up overgrown chaparral and oak-pine woodlands. Thinning and trimming pretreatments allow safer prescribed burning. In addition to benefiting vegetation and wildlife, the fuels project improves safety near developed areas.

Firewise Communities: Babacomari-Research Ranch, Banning Creek, Cochise Stronghold, Patagonia, and **Ramsey Canyon partnerships** are groups of neighbors who have made their communities safer in the face of wildfires. They work with local fire departments and Arizona Department of Forestry and Fire Management to plan for wildfire and reduce fuels that prevent safely protecting structures. Certification comes with meeting National Fire Protection Association standards. Efforts in the Research Ranch-Babacomari and Ramsey Canyon communities help keep unwanted fires away from Fort Huachuca.

Fort Huachuca Prescribed Fire: Fort Huachuca works with the Coronado National Forest to conduct prescribed fires that reduce woody vegetation and make ecosystems more fire-tolerant. Thousands of acres of grassland and oak savanna have been treated at regular intervals since the 1980s. The burn program also allows for safe execution of Army training activities and protects developments.

Muleshoe Ranch Prescribed Fire: Since the mid-1990s, BLM, The Nature Conservancy, Coronado National Forest, and private landowners have burned tens of thousands of acres on the Muleshoe. Burns renew grasslands and improve bighorn sheep habitat. Arizona Department of Water Resources has supported this work because healthy grasslands hold soil and keep streams clear and able to support native fish.

San Pedro Prescribed Fire: To restore native sacaton grasslands, BLM has conducted prescribed burns on 4000 acres of the San Pedro Riparian Conservation Area. Regular fire reduces fuel loads and helps fireproof expanses of this giant bunchgrass. The fire program also works to prevent loss of the riparian corridor as a result of human-caused wildfires.

Grasslands

Border Savanna Project: The Coronado National Forest is opening up oak savanna and restoring it to a healthy, grassy condition. This thinning treatment produces commercially marketable firewood and also allows for safer management of fires along this stretch of the international border.

Coalmine Spring: The Arizona Game and Fish Commission has protected 4405 acres of grassland, including four separate springs that are home to the endangered Gila topminnow. The property is part of a wildlife habitat linkage connecting the Patagonia, Santa Rita, and Tumacacori Mountains and adds value to the string of high-biodiversity conservation areas along nearby Sonoita Creek.

Las Cienegas Grassland Restoration: BLM conducts shrub treatments and prescribed fires to preserve the high diversity grasslands that form the Cienega Creek headwaters and provide beautiful open space for recreation. A long-standing group of partners, including local youth and the grazing allotment holder on the historic Empire Ranch, comes together to monitor range condition.

Native Plant Nursery: BLM, Gila Watershed Partnership, and Borderlands Restoration have set up native plant nurseries in Patagonia and Safford (NE of map area) to collect and grow grasses and other material for restoration. The initiative researches best horticultural and restoration practices and makes resulting data available to others doing similar work.

St. David Upland Restoration: BLM has installed small erosion control structures and seeded with native grasses above the wetlands of the St. David Cienega. Building up the soil allows grasses to germinate and grow in areas dominated by gullying and shrubs. Keeping soil on the uplands also protects cienega habitat for rare plants and birds. BLM has carried out similar work nearby above Contention.

Sands Grassland Restoration: The Sands Ranch and Arizona Department of Environmental Quality have teamed up to remove brush and install new waterlines that better distribute cattle throughout pasture areas. This work helps restore 2000 acres of grasslands where both wildlife and cattle will benefit. Other partners include Arizona Game and Fish, Borderlands Restoration, and UA Cooperative Extension.

San Rafael State Natural Area: Arizona State Parks oversees the 3500-acre border portion of this rich grassland valley that also forms the headwaters of the Santa Cruz River, home to rare aquatic species. Though not open to the public, spectacular views of this area are attainable on public roads and trails. An 1825 Mexican land grant, this historic valley has been cattle country since that time.

Research

Appleton-Whittell Research Ranch: On the Research Ranch, the National Audubon Society and partners maintain a native grassland ecosystem on private and public lands. Chief methods are controlling erosion, eliminating non-native species, and reintroducing fire. Efforts here also preserve research "reference" areas where natural processes prevail and sites can be compared with areas with more direct human management. Access is limited to protect research projects and sensitive wildlife habitat, but find opportunities for the public to visit the ranch on the Research Ranch website.

Santa Rita Experimental Range: The Santa Rita Experimental Range (SRER) was initially a USDA facility (1902), was transferred to the State of Arizona for management by the University of Arizona (1988), and was recently included as one of 20 core sites in the National Ecological Observatory Network. SRER is the oldest continuously studied rangeland in the world. Research covers range management, vegetation change, and eco-hydrology. Long-term databases include repeat photography starting 1902, precipitation since 1922, and vegetation transects beginning 1953.

Walnut Gulch Experimental Watershed: USDA-Agricultural Research Service established the Walnut Gulch Experimental Watershed (WGEW) near Tombstone in 1953 to learn how rainfall affects runoff, groundwater recharge, and movement of material in an arid environment. Research results have been used locally and all over the world to guide erosion control, flood forecasting, and water supply management. WGEW is operated by the USDA-ARS Southwest Watershed Research Center.

Water

Babacomari Erosion Control: Borderlands Restoration and partners install structures to keep soil and moisture on the land in critically eroding sacaton grass bottomlands on the Babacomari Ranch. The group has helped stabilize burned areas after wildfires and works closely with USGS scientists to place structures and monitor how well they work.

Backyard Erosion Control: A site at the University of Arizona in Sierra Vista shows the public how to create water retention and erosion control structures in backyards. The UA-Borderlands Restoration partnership is also demonstrating this practice at four homesites in Cochise County.

Cochise Recharge Network: Cochise County, Hereford NRCD, City of Bisbee, City of Sierra Vista, and The Nature Conservancy have come together as the **Cochise Conservation and Recharge Network**. **The Palominas Recharge** and **Horseshoe Draw** projects capture surface storm water, and the **Sierra Vista Environmental Operations Park** releases treated effluent to recharge groundwater that feeds the San Pedro River.

McGrew Spring Stewardship: Sky Island Alliance is working with Arizona State Parks to conduct seasonal monitoring at this spring at Kartchner Caverns State Park. Citizen scientists visit the spring five times per year to measure water quantity and quality and record observations on plants and animals. Resulting information guides future restoration projects and is deposited into an online database.

Simpson Spring Project: The Coronado National Forest and Arizona Game and Fish Department are reworking this Whetstone Mountain spring. New fencing surrounds the opened up spring to keep out cattle, and five new, dispersed troughs receive spring waters that will supply both wildlife and livestock.

Teran Watershed Enhancement: Multiple partners installed 5000 small water-retaining structures and other improvements on private and state lands. The Arizona Department of Water Resources helped the Redington NRCD, NRCS, and others hire locals to do work that prevents soil erosion, disperses cattle, and improves water quality. UA Cooperative Extension continues to monitor project effects on upland vegetation and waterways.

Wildlife

Agaves and Bats: Agaves are in decline at Coronado National Memorial due to past grazing practices and present dominance of invasive Lehmann lovegrass. The National Park Service and local middle schoolers are working to restore these food plants for endangered lesser long-nosed bats, important regional pollinators. Students visit the park on field trips to collect seed, raise agaves in their classrooms, then return to the park to remove invasive species and plant their agaves.

Allen Flat Habitat Restoration: The Arizona Antelope Foundation and Arizona Game and Fish Department are working on state lands and with willing private landowners to restore historic grassland habitat for antelope. Techniques include both shrub removal and contour plowing followed by seeding. Partners are also placing waters and modifying fences to benefit antelope and mule deer.

Antelope-friendly Fencing: Pronghorn herds need connected expanses of intact grassland to thrive. The Arizona Antelope Foundation and partners are installing smooth bottom fence wires, removing mesquite, placing waters, and coordinating prescribed fires to support the Sentinel Landscape herd. Mesquite has been removed along Hwy 83; modified fence along Hwy 82 allows antelope to cross more easily.

Brown Canyon Wetlands: Coronado National Forest, Sky Island Alliance, and Borderlands Restoration repaired and planted around ponds at historic Brown Canyon Ranch that provide habitat for rare frogs and snakes, and drinking water for all kinds of bats. One pond has also been adapted for use as a fire-fighting dip site. A similar renovation is underway just south in Carr Canyon.

Davidson Canyon Wildlife Corridor: Pima County and Arizona Department of Transportation (ADOT) lands provide passage for wildlife under Interstate 10. Sky Island Alliance (SIA) documents wildlife use of Davidson Canyon between the Santa Rita Mountains and the Rincons to the north. SIA's findings are then used to make design recommendations to ADOT to improve safe passage of wildlife all over the state.

FROG Project: The Frog and Fish Recovery Group restored native frog and fish populations in the Cienega Creek watershed. For this and other projects, the Cienega Watershed Partnership received the Department of Interior's 2013 Partners in Conservation Award honoring exemplary collaborative conservation results.

Gould's Turkey: Hunted out by the 1920s, Gould's turkey from Mexico began a comeback in 1983 in the Huachuca Mountains thanks to reintroduction efforts of the Arizona Game and Fish Department, Mexican wildlife officials, National Wild Turkey Federation, Coronado National Forest, BLM, and private landowners. Since then Gould's populations have also been established (translocated from the Huachucas) elsewhere on the Sentinel Landscape (Santa Ritas plus Rincons and Galiuros) and beyond.

Greaterville Frogs: Threatened Chiricahua leopard frogs are alive and well at this site in the Santa Ritas thanks to efforts of the Arizona Game and Fish Department and Coronado National Forest. Many partnerships across the Sentinel Landscape exist to restore habitat for this frog and other native aquatic species that have declined due to drought, water diversions, exotic predators, and disease.

Hot Springs Wildlife Corridor: Cascabel Conservation Association and partners have established a wildlife corridor between the Galiuro Mountains and San Pedro River. A connected mixture of BLM land and private holdings with permanent conservation status provides passage for bears, mountain lions, bighorn sheep, and coatis. Voluntary grazing reductions and protection of perennial water increase the corridor's habitat value.

Little Joe Restoration: After BLM and partners dug out Little Joe Spring, it began flowing again and now hosts rare fish Gila topminnow and desert pupfish as well as the endangered plant Huachuca water umbel. Other springs isolated from the main channel of the San Pedro are habitat for rare aquatic plants and vertebrates.

Patagonia Wildlife Corridor: Borderlands Restoration of Patagonia and partners are protecting lands that link the Santa Rita Mountains with the Patagonias and Canelo Hills. Preserving travel routes for large mammals such as black bear and mountain lion is key to keeping population sizes healthy.

Prairie Dog Reintroduction: The Arizona Game and Fish Department and partners are working at Las Cienegas National Conservation Area (LCNCA) to re-establish the black-tailed prairie dog to its historic range. This species engineers its environment in ways that attract other species. At LCNCA, new prairie dog colonies provide habitat for burrowing owls who have recently arrived on their own.

Riparian Pasture Restoration: The Coronado National Forest is restoring riparian and aquatic habitat downstream of Parker Canyon Lake. This effort focuses on removal of invasive plants, primarily Johnson grass and tree of heaven. The native cottonwood-willow-lined stream is home to rare species including Northern Mexican gartersnake, Yellow-billed Cuckoo, and Gila topminnow.

San Pedro Beaver Reintroduction: Beavers were hunted out of the San Pedro by the late 19th century. Reintroduction began in 1999, and over time 15 individuals multiplied into a river-basin-wide population. Beaver dams help slow and spread flow, charging both the aquifer and river banks which keeps water available for vegetation and other wildlife along the river corridor.

Scotia Canyon Restoration: The Coronado National Forest and many partners, including Fort Huachuca, have for years been restoring the natural stream configuration and native species in Scotia Canyon. The project includes on-going removal of voracious non-native bullfrogs that hold down numbers of native amphibians. The rare plant Huachuca water umbel has thrived in this drainage since renovation began.

Tamarisk Removal: BLM has removed invasive tamarisk trees along 25 miles of the San Pedro River. Tamarisk thickets can push out the native cottonwood-willow forest and spread vigorously after fire. Removing this species that has little food value improves wildlife habitat along the riparian corridor used by almost 400 species of birds.

Funds for this project were provided by Arizona Department of Forestry and Fire Management – Partnership Projects. Major funding provided by the USDA Forest Service State and Private Forestry Program. Collaborators include the University of Arizona School of Natural Resources and the Environment. Arizona Department of Forestry and Fire Management is an equal opportunity provider.

College of Agriculture & Life Sciences School of Natural Resources & the Environment

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