The sky islands of the Madrean Archipelago are a globally recognized center of biocultural diversity that sprawls north to south across the US-Mexico Borderlands. There are 55 sky island mountain ranges and desert grassland seas that are thought to contain more than 3,000 plants, over half of all species of birds found in North America, thousands of species of invertebrates, 104 mammals, including the only known wild jaguar in the US and the only ocelot in Arizona, nearly 100 reptiles, and 25 native amphibians. Tucked within this magnificent and valuable landscape, the majority of US citizens exist with household and per capita incomes much lower than both state and national levels. As with the majority of the world’s poor, people living in similar rural areas depend on ecosystems and related biodiversity for subsistence, security, and income.

Our vision:

• Restore hydrologic and biologic processes throughout whole watersheds, from the top of the mountains to the basins below
• Maintain the unique biocultural diversity found in the Madrean Archipelago by working across borders, jurisdictions, and public and private boundaries
• Build resilient natural and human communities based on restoration economies
• Address social inequities and improve quality of life in the Borderlands

The Sky Island Restoration Cooperative (SIRC) is a bi-national community-based collaboration of government and non-governmental organizations, private landowners, ranchers, students, volunteers, scientists, and restoration practitioners. Our hope is that by combining our energy and knowledge we can improve restoration activities, outcomes, and awareness across the Madrean Archipelago and nurture an understanding of the importance of biodiversity for human well-being. Identifying restoration research and resource needs, the SIRC is a vehicle for information sharing, training, and project implementation. Our cooperative builds bridges across institutional, administrative, and cultural boundaries to create effective regional restoration strategies.
In FY15, the Sky Island Restoration Cooperative (SIRC) included involvement and/or direct work from these organizations:

- Arizona Department of Environmental Quality (ADEQ)
- Arizona Game and Fish Department (AZGFD)
- Arizona Geological Survey (AZGS)
- Bat Conservation International (BCI)
- Borderlands Restoration, L3C (BR)
- Cuenca Los Ojos (CLO)
- Hummingbird Monitoring Network (HMN)
- Natural Resources Conservation Service (NRCS)
- Sky Island Alliance (SIA)
- US Bureau of Land Management (BLM)
- US Bureau of Reclamation (BOR)
- US Fish and Wildlife Service (FWS)
- US Forest Service, Coronado National Forest (USFS)
- US Geological Survey (USGS)
- US National Park Service (NPS)

New SIRC partners in 2015:
- Gila Watershed Partnership (GWP)
- Institute for Applied Ecology (IAE)
- Tucson Audubon Society (TAS)
- Wildlands Network (WN)

Other organizations involved with SIRC:
- American Conservation Experience (ACE)
- Arizona Conservation Corps (AZCC)
- Brophy Family Foundation
- Cienega Watershed Partnership
- Comisión Nacional de Áreas Naturales Protegidas (CONANP)
- Comisión Nacional Forestal (CONAFOR)
- Desert Botanical Garden (DBG)
- Desert Landscape Conservation Cooperative (DLCC)
- Department of Corrections, Douglas Prison (DOC)
- Deep Dirt Farm, LLC
- DOI Resilient Landscapes Program
- Douglas High School
- Eco Ideas, LLC
- Freeport McMoran, Inc.
- Friends of Brown Canyon Ranch
- Friends of Madera Canyon
- Friends of Saguaro National Park
- Instituto Tecnológico Superior de Cananea (ITSC)
- Society for Ecological Restoration, Southwest Chapter
- Southern Arizona Buffelgrass Coordination Center (SABCC)
- Monarch Watch
- National Fish and Wildlife Foundation (NFWF)
- Native Seeds/SEARCH (NS/S)
- Naturalia A.C.
- The Nature Conservancy (TNC)
- Partners for Fish and Wildlife
- Patagonia Area Resource Alliance (PARA)
- Patagonia Regional Community Foundation
- Patagonia Union High School
- Pima County
- Seibert Ecological Restoration, LLC
- Springs Stewardship Institute (SSI)
- Southwest Monarch Study (SMS)
- University of Arizona
- Windsong Peace and Leadership Center

Contact: SIRC@skyislandalliance.org
mandates for species and ecosystem recovery. It is also our collective response to the climate crisis and the need for increasing the resilience of both human and natural communities.

With the increasing variability of climate in years to come, living in the Madrean Archipelago will require us to more tightly weave landscapes, communities, and nations together in ways that are more resilient. SIRC celebrates our relationships and different modes of knowing which deserve a particular form of shared cultivation; they emerge both socially and ecologically through SIRC efforts, into what the botanist and writer Robin Kimmerer describes in her book *Braiding Sweetgrass* as “a polyculture of complementary knowledges.” These relationships require us to listen and learn from colleagues and community members. SIRC has people going out of their way to collaborate in a spirit of cooperation, shared stewardship, and desire to communicate.

We are pushing boundaries to become more nimble, flexible, and build the capacity to respond quickly. Our collective work is rooted in our relationships and based on our shared desire for effective restoration on the ground, with an openness to alternatives and an eye toward adaptation. Each partner at all levels can find the opportunity to improve their capacity and skill sets and coordinate with others doing similar work. This allows us to attend to the mandates and needs of our particular physical space, whether forest district, refuge, park, working ranch, or schoolyard garden; each of us working within boundaries but willing to work across those boundaries when needs and opportunities arise.
Restoration Implementation
SIRC partners implemented a wide variety of restoration projects, eleven of which are highlighted in the Resource Briefings section following this Summary. In FY15, we substantially increased our ability to implement integrated, cost effective, community based projects using locally sourced plant materials and crews; generating local jobs, volunteer opportunities, and educational programs.

This year’s projects all contained integrated objectives for multiple resource benefits, and were designed to include planting of native species and wildlife habitat enhancements. Themes of this year’s projects include invasive species treatments, wildlife corridors, and restoration of: aquatic/riparian areas, post-fire watersheds, grasslands, and pollinator food chains.

Partners implemented treatments on three highly invasive plant species: buffelgrass, vinca, and tamarisk. Projects included effectiveness monitoring and restoration of native plant communities following treatments. Aquatic and riparian enhancement and restoration was conducted at two of Arizona’s popular riparian areas–Aravaipa Creek and Madera Canyon. Sensitive aquatic habitats in the Chiricahua and Huachuca Mountains were part of our contribution to the recovery of the Chiricahua leopard frog and increases water availability for multiple bat species.

Partners at Las Cienegas National Conservation Area to restore native grasslands is resulting in substantial increases in local American pronghorn (Antilocapra americana) populations and supports ongoing reintroduction of black-tailed prairie dogs (Cynomys ludovicianus). Other partners enhanced habitat to facilitate safe wildlife passage at a critical point along Oracle road which had previously divided the Santa Catalina-Tortolita Mountains Wildlife Linkage in half.

Increased frequency and severity of wildfires triggered our efforts to implement watershed restoration...
restoration treatments to build ecosystem resiliency and monitored their effectiveness in post-fire landscapes in the Chiricahua Mountains and at Gila Cliff Dwellings National Monument. These projects highlight the implementation of low cost/low tech erosion control structures (ECS) and several of the Research/Monitoring Briefings in this year’s report present results on their effectiveness here and at other locations.

SIRC has identified restoration of nectar and milkweed plant species as a high priority to support dwindling populations of birds, bats and invertebrate species like the Monarch butterfly. The Sky Island region has been identified as having exceptionally high diversity of many of these taxa, which means the region is providing crucial habitat and migration corridors for pollinators. Pollinator Food Chain Restoration is a common aspect linking many of our restoration implementations, including successes at several national parks.

Research and Monitoring

SIRC partners have expanded monitoring their efforts to assess progress and success rates over time. The Botany Blitz in the Chiricahua Mountains near Rucker Canyon included hydrology and vegetation measurements to support nearby watershed restoration structure installation. Scientists are working together to determine and document vegetation response to watershed restoration techniques, develop monitoring protocols, and determine baseline conditions and early effects of restoration. Multiple partners worked to develop new information on springs in the Sky Islands using a combination of expert and citizen science field surveys to collect information in areas of interest and priority for managers.

Partners are evaluating the extent to which the western Yellow-billed Cuckoo (wYBCU) (*Coccyzus americanus*) uses various drainages to assess the correlation with breeding usage. Wildlife cameras are being used in association with erosion and fire mitigation projects to study animal movement and develop standard protocols for comparison between sites and establish conservation and monitoring priorities for mammals.

Researchers in the SIRC are evaluating the impact of newly-installed gabions (rock-filled wire baskets) by quantifying the effectiveness of such structures for enhanced water infiltration and recharge using a combination of temperature sensing buttons, pressure transducers, and wildlife cameras at the Babocomari Ranch. Partners are also continuing long-term assessments of the hydrologic and geomorphological changes induced by stream channel and riparian restoration at two additional sites: Vaughn Canyon near Elgin and Silver Creek in the San Bernardino Valley. Preliminary results indicate site characteristics such as geologic substrate, watershed characteristics, and soil-hydraulic properties must be taken into account during restoration planning, monitoring, and assessment.
Plant Materials
SIRC partners have doubled their capacity in the last year and are setting up long-term systems to address the plant materials needs for large-scale restoration in the Madrean Archipelago. From seed collection, to cleaning and curation, to propagation, to getting plants delivered to restoration sites, locally adapted native plant materials are becoming more readily available. Extensive data collection in seed curation captures phenological and habitat characteristics, as well as extensive propagation data that has already improved production efficiencies. As more resources are available to support seed collection the regional capacity for restoration will continually increase. The release of the National Seed Strategy in FY15 provided a template for assessing needs and promoting better integration of the regional seed supply chain.

Looking ahead to FY16, more milkweeds and agaves are being propagated, along with more trees, grasses, and pollinator plants. Seed collection will continue to expand along with our collective knowledge base. Infrastructure expansion at the MAPP Center will continue through the winter of 2016, building additional greenhouses that have been donated by the Desert Botanical Garden (DBG) and the National Park Service (NPS).

Education and Outreach
Education and outreach took many different forms through SIRC-led work, from work on public forests to private ranches, and in local high schools and small Sky Island communities anxious for training opportunities and potential employment. In a typical example, Patagonia and Douglas youth were trained in hydrology, erosion, native plant propagation and ecological restoration. At the same time, the interns were compensated for their time and introduced to a wide range of natural resource professionals. This approach is empowering the youth to become leaders in regional-scale restoration work. Sky Island Alliance, USFS, NPS, Borderlands Restoration and numerous private landowners, parents and teachers contributed to dynamic programming to accomplish on-the-ground restoration work in the field, and the social capacity and will to sustain the work. People are being offered restoration options for working in place, and they’re taking them.

In another example, NPS interpretive staff at Gila Cliff Dwellings National Monument were exposed to broad, multi-component restoration work that included plant material collection, grow-out, and return to the site, along with simultaneous fire fuels reduction work and erosion control. This positions NPS interpreters to have the opportunity to share this complex and integrated approach with visitors to the site. The restoration methods and how they are shared and translated for practitioners, scientists, and the public—both broadly and deeply—are indicative of the spirit behind the SIRC approach to restoration practice and theory. We believe it will continue to be highly effective at addressing the unknowns we face regarding the potential for climate change and other threats to shared resources and values.
Building a Restoration Economy
An enduring question in the work we do is how to make it self-sustaining and economically viable. One of the central themes in our work is bridging the gap between investments made in restoration and quantifying the value gained through more resilient ecosystem services. Investment in restoration can contribute in meaningful ways to sustainable economic development in rural and often marginalized communities.

Through our collective efforts we hope to continue shaping an ethic of care and shared stewardship in the borderlands, one that respects cultural differences and the “polyculture of complimentary knowledges.” We are hoping to shape an economy that celebrates our “right to lead a dignified life,” in the words of Pope Francis. Leading a dignified life can be as simple as having the capacity to care for special places, whether national parks or other public lands or simply by planting milkweeds in our gardens to sustain pollinator food chains, knowing that others in the regional “neighborhood” are doing the same.

In 2015, the paper *Estimating the Size and Impact of the Ecological Restoration Economy* illustrated that restoration contributes billions of dollars annually to the US economy. The paper by BenDor et al. suggested that a “coherent restoration sector...increases the quality of public environmental goods.” In communities across the region investment in the restoration of watersheds can develop jobs with sustainable incomes, stabilizing communities and the ecosystems in which they are integrated. We are working to create jobs and provide opportunities for further education and training, enabling individuals and organizations to diversify and better adapt to our complex regional natural resource challenges. Our vision is to create economic opportunities through investment in landscape-scale restoration.

Fiscal Year 2016, a look ahead
SIRC partners are increasing their capacity for restoration implementation, research and monitoring, plant materials, partnerships, and education. We encourage additional stakeholder investment in all aspects of regional watershed restoration. We see it as a viable strategy for creating sustainable jobs in local communities and promoting education and training as a path toward a regional restoration economy.

In 2016, SIRC partners will:
• Research groundwater recharge potential and how ecological restoration can be an economic driver
• Encourage public and private investment in regional ecosystem services in the form of watershed restoration
• Increase involvement in Mexico and on private and tribal lands in the US
• Broaden the scale of restoration and embrace a watershed and landscape approach
• Monitor restoration treatments for effectiveness and revise management based on lessons learned
• Communicate what is learned with the goal of strengthening and extending the restoration network taking shape in the region
• Work toward an integration of agricultural and ecological restoration efforts
Financials

In FY15, the SIRC combined contributions are estimated at $2,874,603 for the projects detailed in this annual report. This support came from numerous sources listed below. We estimate that more than $1.7 million came from governmental sources, and more than $1.1 million was contributed from a variety of private and non-governmental organizations. It is difficult to place a value on our volunteers and their commitment to our resources, they are essential to community-based engagement. Not all volunteer contributions were quantified, those that were tracked are valued at more than $191,000. These figures reflect actual time and money invested in restoration in FY15. They do not quantify the significant value of ecosystem services provided to our communities in the form of water quality and quantity, flood control and watershed stability, pollinator diversity, species recovery, quality of life, beauty, recreation opportunities, and a range of other ecosystem values that support game and non-game wildlife.

Amphibian and Reptile Conservancy
Arizona Game and Fish Department
Biophilia Foundation
Borderlands Restoration, L3C
Commission for Environmental Cooperation
Cuenca Los Ojos
Deep Dirt Farm Institute, LLC
Desert Botanical Garden
Desert Landscape Conservation Cooperative
Eco Ideas, LLC
Friends of Brown Canyon Ranch
Hummingbird Monitoring Network
Institute for Applied Ecology
National Fish and Wildlife Foundation
Partners for Fish and Wildlife Program, USFWS
Patagonia Area Community Foundation
Patagonia Area Resource Alliance
Seibert Ecological Restoration, LLC
Sky Island Alliance
Sonoran Joint Venture
Southern Arizona Buffelgrass Coordination Center
The Nature Conservancy
Tucson Audubon Society
University of Arizona
US Bureau of Land Management
US Bureau of Reclamation
US Department of Interior, Resilient Landscapes Program
US Fish and Wildlife Service
US Forest Service, Coronado National Forest
US Forest Service, Region Three
US Geological Survey, Land Change Science Program
US National Park Service
US National Park Service, Desert Research Learning Center
US National Park Service, SW Exotic Plant Management Team
Walton Family Foundation
Wilburforce Foundation
Wildlands Network
Wildlife Conservation Society, Climate Adaptation Fund
Wildlife Corridors, LLC
Windsong Peace and Leadership Center

Acknowledgements

Special thanks are due to Eco Ideas LLC, Seibert Ecological Restoration LLC, and the National Park Service’s Southwest Exotic Plant Management Team (SWEPMT) for the editorial, layout, and publication support provided to produce this report.
These 29 resource briefs are designed to provide specific information on the work done by partners in the Sky Island Restoration Cooperative (SIRC) during fiscal year 2015. The work is an effort to communicate about restoration activities across the Madrean Archipelago in a systematic way.

This report is a fully interactive digital file. The table of contents on the following pages is hyperlinked to individual briefs; simply click on the title. It is optimized for iBooks or pdf viewer. The SIRC banner at the top of each brief will bring you back to the table of contents.
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- Watershed Restoration in the Chiricahua Mountains
- Renovation of Critical Frog Habitat at House Pond, Brown Canyon
- Madera Canyon Bridge Replacement Restoration
- Aravaipa Creek Riparian Forest Restoration for Pollinators
- Native Vegetation Screening at the Oracle Road Wildlife Overpass
- Post-Fire and Drought at Gila Cliff Dwellings National Monument
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The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

Southern Arizona Resilient Landscape Collaborative
NPS, USFS, Southern Arizona Buffelgrass Coordination Center

Abstract
Saguaro National Park (SNP) is one of ten recipients of the Department of Interior Resilient Landscape Program (RLP) awards, to which Congress provided $10 million in FY2015. This program was established within the wildland fire management program to address broad, land-health outcomes by conducting collaborative treatments across landscapes that improve the integrity and resilience of ecosystems. The Southern Arizona Collaborative (Collaborative) was formed in response to the RLP, however, it largely existed already as a result of the on-going, cooperative buffelgrass management efforts in the region.

Keywords
wildfire, buffelgrass, invasive plant management, resiliency

Project Background
The Collaborative aligns fully with the primary national goals of the National Cohesive Wildland Fire Management Strategy, including ensuring landscape resiliency to fire-related disturbances. The work plan relies upon the collective knowledge, experience, and past successes of all collaborators working towards maintaining a fire resilient landscape. Ensuring resilient landscapes and fire-adapted communities depends on the implementation of a broad-based, collaborative, and cohesive strategy to better address the mounting challenges of escalating fire behavior, increased risk to people and native plant and animal communities, greater home and property losses, and increased threats to communities.

Project Activities and Outcomes
RLP funds are being used to protect native plant and animal communities from displacement by buffelgrass, an aggressive invasive plant species; maintain a more natural fire regime; and help prevent large, intense wildfires from converting a biologically rich, fire-sensitive habitat into a near-monoculture and highly flammable grasslands. The project will help prevent damage to private property, utility corridors, and the area’s tourism based economy. In addition, our efforts will aid managers of fire-adapted and fire-dependent ecosystems at high elevations in managing wildfires to benefit those ecosystems, and to maintain their ecological integrity and resilience. RLP funds were used to supplement NPS and USFS allocations to treat additional acres of buffelgrass. SNP treated a total of 2103 acres, (219 acres with RLP) and USFS treated a total of 500 acres (225 acres with...
Receiving funds in future years (FY2016 through FY2020) will depend on achieving demonstrable results each year. In the following years, potential partners in the Collaborative could include the BLM, USFWS, Pima County, USGS, and the Tohono O’odham Nation. In addition to buffelgrass control, aerial surveys for mapping buffelgrass and effectiveness monitoring activities are proposed.

**Funding**

The Collaborative received $150,750 of RLP funding in FY15, and each partner is required to provide matching funds and in-kind support. SNP received $33,000 and provided $396,000 of matching funds, USFS received $110,750 and provided a $149,000 match, and SABCC received $7,000 and provided a $13,000 match. Other partners within the Collaborative contributed an additional $100,000 of matching funds. Total project value was $808,750.

**Stakeholder Involvement**

USFS and the Southern Arizona Buffelgrass Coordination Center (SABCC) partnered with SNP to complete ground and aerial control of buffelgrass, urban buffelgrass fire synthesis, and outreach to private land owners within the Collaborative landscape boundary.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

Seep/Spring Habitat Enhancement for Frogs and Bats
Sky Island Alliance, USFS, Arizona Game and Fish Department, Borderlands Restoration

Abstract
Efforts to create habitat for Chiricahua leopard frogs (CLF) (*Lithobates chiricahuensis*) and bats in the Chiricahua Mountains in FY15 have featured a lighter approach thanks to lessons learned from last year’s project at Ash Spring. As a result, Sky Island Alliance (SIA) was able to limit ground disturbance at Hermitage Seep and preserve important wet meadow habitat and achieve desired habitat benefits.

Keywords
Chiricahua leopard frogs, wetlands, habitat creation, bats, wildlife ramps

Project Background
The Chiricahua Mountains are a large, relatively wet high elevation range that connects the diverse Sierra Madre with the vast Gila Wilderness and are, therefore, perfectly positioned for importance to a huge diversity of plants and animals. Increasing scarcity of mid- and high-elevation water sources has prompted project partners to create new open-water habitats for bats and the threatened CLF in this important mountain range.

Project Activities and Outcomes
In FY14, new habitat was created for CLF and bats at Ash Spring as part of a collaborative wetlands restoration workshop. During construction, partners decided to reduce the number of ponds from nine to three in order to preserve wet meadow habitat. Following discussions with partners, this scaled-down approach was taken a step farther at Hermitage Seep, where SIA proposed to create open water habitat using hand tools in the existing wet meadow. During Botany Blitz 2014, an extensive and healthy population of whorled milkweed (*Asclepias subverticillata*), a known larval host for monarch butterflies (*Danaus plexippus*), was identified onsite, underscoring the importance of preserving the wet meadow habitat.

The USFS utilized a Department of Corrections crew to replace the cattle-exclusion fence at Hermitage Seep during the spring of 2015, and in the process significantly expanded the protected area within the exclosure. In addition, fire crews...
were employed to prune and/or remove several trees growing near open water so that bats would have adequate flight path to access water. SIA staff and volunteers then installed 55 pollinator plants of 10 different native species (grown by Borderlands Restoration) and excavated the existing drainage ditch to create long, narrow ponds. Native sedges that were removed were directly transplanted to an area newly enclosed by the fence that had been trampled by cattle. In addition, wildlife ramps were installed at the adjacent livestock tank to make that open water accessible to CLF.

Work at Ash Spring also continued in FY15 - the Borderlands Earth Care Youth Institute returned to Ash Spring in June to remove an invasive plant, horehound (Marrubium vulgare), and to make a plan for a supplemental spring 2016 planting to increase pollinator resources on the site. The plants will be grown from seeds collected from similar elevations in the Chiricahua Mountains. In addition, SIA volunteers continue to monitor conditions at Ash Spring under our Adopt-a-Spring Program. These habitat creation projects allow Arizona Game and Fish Department to release new CLF populations and contribute to the recovery of the species, and these two projects embody the flexible and responsive nature in which SIRC partners are collaborating to continually improve outcomes. In FY16, partners plan to implement another project at Camp Rucker to create habitat for CLF, bats and pollinators.

Stakeholder Involvement
USFS, Borderlands Restoration, Bat Conservation International, and AZGFD provided technical assistance. SIA was able to participate in the habitat creation projects with funding from USFS and the Wildlife Conservation Society through its Climate Adaptation Fund; support to establish the Climate Adaptation Fund was provided by a grant to the Wildlife Conservation Society from the Doris Duke Charitable Foundation.

Funding
USFS provided $4,550 of staff time and DOC crew supervision and funded $4,600 for SIA staff time and materials for a total of $9,150. SIA provided an additional $5,500 of staff time, $9,090 in volunteer time, and $1,684 in volunteer travel expenses for a total contribution of $16,274. Total project value was approximately $25,424.
Watershed Restoration in the Chiricahua Mountains

Sky Island Alliance, USFS, Cuenca Los Ojos, Borderlands Restoration, USGS, GeoSystems Analysis, Inc.

Abstract
Partners have undertaken a watershed restoration project in burned (Tex Canyon) and unburned (Bar Boot Allotment) watersheds in the southern Chiricahua Mountains that will inform future ecological restoration in arid lands. Treatments included installation of loose rock erosion control structures in drainages to increase ecosystem resilience to climate change. Partners are monitoring the effects that these structures have on soil moisture and vegetation response. The Coronado National Forest is planning to use results of this project to increase the scope and scale of this type of watershed restoration in the Douglas Ranger District.

Keywords
watershed restoration, low-tech, soil moisture, erosion control, youth engagement

Project Background
Water resources are becoming increasingly scarce in the arid Sky Island Region of southern Arizona. Severe fires followed by intense monsoon precipitation alter streams, springs and entire watersheds in rapid and sometimes catastrophic ways. Burned areas that receive no rehabilitative treatment experience destructive erosion due to lack of ecosystem recovery; wildlife and pollinator corridors may suffer as a result. In January 2015, stakeholders conducted site visits in the southern Chiricahua Mountains to identify project watersheds that could inform future restoration work in arid landscapes. Tex Canyon and the Bar Boot grazing allotments were chosen as the two project sites. Environmental compliance was completed by the Douglas Ranger District during
the spring of 2015, in time for summer fieldwork. In 2011 the 220,000+ acre Horseshoe Two Fire devastated the Chiricahuas, including portions of Tex Canyon, located in the southeastern portion of the range. The ground cover lost as a result meant that existing soils could easily be eroded if actions were not taken to stabilize the watershed.

The Bar Boot allotment on the southwestern flank of the range is largely-unburned land and in the headwaters of Leslie Creek. The Leslie Canyon National Wildlife Refuge was established in 1988 to protect two of the eight native fish species of the much larger Río Yaqui watershed. Cuenca Los Ojos has been conducting similar watershed restoration on the private portion of Bar Boot Ranch for many years.

**Project Activities and Outcomes**
During summer 2015, 585 rock structures were installed in Tex Canyon, highly leveraged by USFS funding to hire an 8-10 person Department of Corrections (DOC) crew for 30 days of work, including funds to train the crew and supervise the work.

At Bar Boot, 123 structures were installed during the same work period, the first 46 of which were built by a 7-person paid crew of youth interns sponsored by the USFS and managed through partner Borderlands Restoration. The Borderlands Earth Care Youth (BECY) Institute crew members from Douglas High School learned about careers in natural resources and valuable restoration techniques. The remaining 77 structures were built by the aforementioned DOC crew after they had finished Tex Canyon work earlier than expected.

The monitoring component at these sites includes USGS long and short-term vegetation study plots as well as eight separate hydrology data stations (4 in each project area) where flow and inundation sensors are employed. SIA provided supplemental crew training and supervision of both DOC and BECY Institute crews as well as the mapping of the structures; we plan to return in 2016 with volunteers to strengthen certain structures and install native pollinator plants.

**Stakeholder Involvement**
The Coronado National Forest provided funding and resources for the work crews. USGS designed vegetation monitoring protocols and conducted data collection. GeoSystems Analysis, Inc. staff installed the soil moisture monitoring stations and designed protocols for data collection. Borderlands Restoration trained and supervised work crews and SIA provided technical assistance via funding from the Wildlife Conservation Society through its Climate Adaptation Fund. Private landowners Valer and Joe Austin and their Cuenca Los Ojos Foundation provided access, lodging, and additional expertise in watershed restoration.

**Funding**
USFS provided $30,000 in staff time, and provided funding for the BECY and DOC crews for labor. Sky Island Alliance provided $96,376 using WCS funding. Total value was approximately $126,376.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

Renovation of Critical Frog Habitat at House Pond, Brown Canyon

USFS, Sky Island Alliance, AZ Game and Fish Department, Friends of Brown Canyon Ranch, Borderlands Earth Care Youth Institute – Douglas, Wetland Restoration and Training LLC, Amphibian and Reptile Conservancy, FWS

Abstract
There are two ponds at Brown Canyon Ranch – House and Wild Duck Ponds, and both have been designated as Critical Habitat for the Chiricahua leopard frog (CLF) (*Lithobates chiricahuensis*) by the US Fish and Wildlife Service. The CLF has consistently been observed at the Ranch despite unreliable flow from a spring fed pipeline. Over time, the liner in House Pond has degraded resulting in leaks and air pockets that reduced the quality of habitat for the CLF and other species.

During the summer of 2014 the non-native southern leopard frog (*Lithobates spenocephalus*) was discovered in House Pond and Wild Duck Pond, further degrading this important aquatic habitat. Efforts to remove the invasive adult frogs were implemented immediately. The water was turned off to allow House Pond to dry, and kill any remaining non-native frogs and their tadpoles. While House Pond was dry, several partners worked together to replace the liner and improve native species habitat near the ponds, including habitat improvements for the recently listed as threatened Northern Mexican gartersnake (NMGS) (*Thamnophis eques megalops*).

Keywords
Chiricahua leopard frog, aquatic habitat, pond reconstruction

Project Background
House Pond is located within the Brown Canyon Ranch, an historic property located just south of Sierra Vista, AZ. The property was built over a century ago by a local pioneer family and includes their ranch house, storeroom, corrals, water system and two ponds. The ranch was acquired by USFS in 1998 and has since served as a local tourist attraction interpreting early ranching operations of the area, water source for wildlife, and Critical Habitat for the CLF. Friends of Brown Canyon Ranch (FBCR) are local volunteers that help the USFS maintain the buildings and interpret the significance of the site for visitors.

While the discovery of the southern leopard frog was unfortunate, it did afford the opportunity for a number of partners to work together to replace the House Pond liner, and improve the habitat for a number of aquatic and terrestrial species.

BECY Crew works to improve pond drainage before liner installation / USFS
Project Activities and Outcomes
The old pond liner was removed and a trackhoe was used to reshape the basin and prepare the bed for a new liner, installed in three layers. A protective layer of geotextile fabric was spread across the re-contoured basin. A second layer of fish-safe polyvinyl chloride (PVC) was placed on top of the geotextile fabric to seal the basin. A third layer of protective geotextile fabric was stretched across the PVC layer. The layers were pinned to the ground around the perimeter of the pond to keep them in place and prevent air pocket development. All three layers of fabric were stretched and placed in the basin by hand. The trackhoe then placed 6-8 inches of soil over the liner to provide a substrate for aquatic species recolonization of the pond.

Plant materials removed during construction were salvaged and replanted around the site. Additionally, approximately 200 native plants that provide habitat for a variety of butterfly, bird and invertebrate species were planted at the site. These plants also improved habitat for the threatened NMGS.

Stakeholder Involvement
USFS provided partial funding for the project, and completed all of the necessary clearances and consultations. Wetland Restoration and Training (WRT) provided pond design and oversight of equipment operation, and pond reconstruction and lining. Sky Island Alliance (SIA) selected suitable plant materials for the site and supervised planting. FBCR and AZGFD provided additional labor. Over 25 people were present during two days to provide the labor that was required for the pond reconstruction and planting, including local SIA volunteers, Borderlands Earth Care Youth Institute (Douglas) interns, USFS fire crews, FBCR volunteers, and Arizona Game and Fish Department staff.

Funding
USFS provided $16,000 for pond materials, contractor, SIA staff time, and plant materials. USFS also contributed approximately $4,000 in staff time. SIA contributed $9,700 of staff and volunteer time, and volunteer labor. The Amphibian and Reptile Conservancy contributed $10,000 for pond materials and design. FBCR provided $540 of volunteer time. AZGFD contributed approximately $2,000 of staff time. FWS provided $400 in staff time. Total project value was approximately $42,640.
Madera Canyon Bridge Replacement Restoration

Sky Island Alliance, USFS, Borderlands Restoration, Friends of Madera Canyon

Abstract
Replacement of two bridges at the popular Madera Canyon Trailhead resulted in the disturbance of approximately one acre of the Coronado National Forest (CNF), including two stream crossings. Project partners were unsatisfied with the original revegetation plan that called for minimal effort, and collaborated to design, install, and maintain a more comprehensive restoration that would protect the creek and be an amenity for wildlife, visitors, and residents.

Keywords
pollinator plants, erosion control, ecotourism

Project Background
Madera Canyon is a world-renowned birding hotspot and one of the most popular areas of the CNF, with about 300,000 visitors per year. People flock to the canyon each year to see tropical species such as the elegant trogon. In FY 15, the CNF embarked on the replacement of two narrow bridges in the canyon to improve safety and traffic flow. The construction plans for the road and bridge project originally required only seeding as the revegetation treatment. The CNF was able to redirect a portion of the construction budget to work with area residents, business owners, and conservation organizations to develop a more comprehensive restoration approach in this highly visible and environmentally-sensitive location.

Project Activities and Outcomes
Borderlands Restoration (BR) conducted extensive site protection through carefully-designed rock erosion control structures to address the high erosion potential on the site and to protect the creek. Friends of Madera Canyon and Sky Island Alliance (SIA) worked together to develop a site-specific suite of native plants that would assist in site stabilization efforts and enhance resources.
for native pollinators onsite. BR supplied many of the plants that have been installed, grown from locally collected seeds and cuttings. Installation was carefully timed to take advantage of monsoon precipitation, and began with the application of organic composted mulch and a hydroseed mix of 13 native grass and wildflower species. Plants were installed using dryland techniques (without irrigation) - with water harvesting berms and the use of DriWater irrigation supplement. Nearly 30 volunteers joined the partners for National Public Lands Day in September to continue the restoration effort. Almost 200 plants native plants of 26 species were installed in FY 15.

Germination from the hydroseed mix was very successful, and container plant survival has been over 90 percent. SIA is organizing ongoing maintenance of the site with weekly volunteer trips to the canyon that include an opportunity for participants to spend time hiking and birding with staff; the CNF is supplying water.

Although the construction of the new bridges was inconvenient for area visitors, residents, and business owners while it was ongoing, the restoration is likely to have a positive effect on visitor experiences once the new plants become established. Many of the businesses in the area, including the adjacent Chuparosa Inn, are rooted in ecotourism, and this project will reward visitors with increased opportunities to observe birds, butterflies, and other pollinators in action. In addition, plant materials and mulch were purchased from five different local vendors, and a local firm was chosen to conduct the hydroseeding operation.

**Stakeholder Involvement**

Area business owners were actively involved in the planning, design, and implementation of this project. The project team was able to respond directly to requests, particularly about plant selection and placement, contributing greatly to the project success. Project design was closely coordinated with the Friends of Madera Canyon to ensure ecologically and culturally appropriate choices were made.

**Funding**

USFS provided $28,300 in funding to SIA. SIA volunteers contributed more than $6,500 in labor and travel costs. Total project value was approximately $34,800.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

Aravaipa Creek Riparian Forest Restoration for Pollinators

Sky Island Alliance, USFWS Partners for Wildlife, The Nature Conservancy, BLM

Abstract
The non-native plant vinca (*Vinca major*, also known as periwinkle) has infested the riparian forest floor and crowded out a diversity of native plant species at many areas in southern Arizona. Ongoing work along the main stem of Aravaipa Creek aims to eradicate it and re-introduce native ground cover in its place that will enhance wildlife habitat, especially that habitat which supports native pollinators.

Keywords
riparian restoration, non-native species, invasive species, Aravaipa Creek, vinca, volunteers

Project Background
Aravaipa Creek, located at the north end of the Galiuro Mountains, just 50 miles northeast of Tucson, hosts seven species of native fish, two of which are federally-protected, and hundreds of other wildlife species. Managed by The Nature Conservancy (TNC) (as the Aravaipa Canyon Preserve) and the BLM (as the Aravaipa Canyon Wilderness), this lush canyon has proven to be an attractive work site for SIA volunteer field projects over the years. During the course of ongoing collaborative watershed restoration projects, SIA has become increasingly concerned about the extensive infestation of vinca in the canyon and its impacts on the quality of habitat for a variety of species. Vinca is an ornamental invasive - its attractive purple flowers and evergreen leaves and potential to control erosion made it popular with homesteaders in the canyon, and flood events have allowed this vigorous re-sprouter to spread extensively in the canyon. Vinca does not appear to have any wildlife value, is toxic to livestock, and forms a thick, impenetrable mat that diminishes infiltration to the roots of native riparian trees.

Manual removal of vinca from southern Arizona riparian areas has proven successful at other locations on a smaller scale - such as TNC’s Ramsey Canyon Preserve. SIA has begun mapping vinca across 580 acres of potentially infested habitat within the Aravaipa Canyon Preserve, and initiated a pilot project in FY 15 to test the feasibility of using volunteers to systematically remove it from the canyon and to restore native plants for wildlife and pollinators.
Project Activities and Outcomes
SIA staff, interns and volunteers began manual removal of vinca in January 2015. Through this pilot project, we found that once initially cleared, sites had to be re-visited to remove vigorous re-sprouts at least two more times before they are ready to be planted with native species. In addition, we identified preferred tools for the task and optimal timing of activities. During FY15, four volunteer weekends were conducted, with 57 volunteers contributing 1,253 hours of work. With this effort, approximately one solid acre of vinca was cleared (with repeated removal of re-sprouts) and we installed 170 appropriate native, including vines, grasses, shrubs and wildflowers of 23 different species.

TNC is able to follow our work with spot treatment of herbicide. Manual removal of this plant is clearly labor intensive, but in this environmentally-sensitive location, this combination of approaches ensures that herbicide use is reduced to the minimum amount necessary to control this plant. Recommendations for future work that have resulted from this pilot project to decrease per-acre treatment cost and increase efficacy include:
- Follow-up with spot treatments of aquatic-safe herbicide to control re-sprouts and eradicate populations in unsafe locations;
- Focus manual removal in spring, summer, and fall, when soils are moister and digging is easier;
- Useful tools include picks, shovels, and sodforks; having a variety of tools on-hand reduces volunteer fatigue; and,
- Consider using paid crews to conduct initial removal efforts; volunteers are better suited to the follow-up removal and planting activities.

Stakeholder Involvement
SIA recruited and managed volunteers, many of whom are active recreationists in the Aravaipa Canyon Wilderness. BLM and TNC staff and interns provided technical expertise, logistical support (including lodging for volunteers and disposal of removed vinca), and supplies.

Funding
Funding for the pilot project was provided by the USFWS Partners for Wildlife Program, $20,000. SIA volunteers contributed $28,200 in labor and more than $4,000 in travel expenses. TNC Aravaipa Canyon Preserve provided lodging for a contribution of $1,500. Total project value was approximately $53,700.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

Native Vegetation Screening at the Oracle Road Wildlife Overpass

Sky Island Alliance, Tucson Audubon Society, Coalition for Sonoran Desert Protection, Pima County, Santa Catalina Catholic Church

Abstract
The first wildlife overpass in Pima County is under construction across Oracle Road in northwestern Tucson as part of road construction project to widen Oracle Road. Santa Catalina Catholic Church is located immediately south of the wildlife bridge. To mitigate the disturbance to wildlife using the bridge that would occur due to vehicular headlights shining on the linkage corridor by parishioners in the evenings, Tucson Audubon Society (TAS), Sky Island Alliance (SIA), and the Coalition for Sonoran Desert Protection (CSDP) partnered with the Church to install a native-plant vegetation screen.

Keywords
wildlife corridor, wildlife linkages, re-vegetation

ADOT combined all of the available scientific information about this wildlife linkage with actual roadkill data from the AZGFD and SIA. The wildlife underpass is located in an existing wash area and the wildlife bridge takes advantage of an existing hill on the east side of the road. This reduces the cost of both crossings significantly, since much less earth has to be removed and/or moved during construction. The land on either side of both crossings is owned by Catalina State Park, Pima County, and the Arizona State Land Department. This ensures that there will continue to be protected open space for wildlife to move through on either side of the crossing structures.

Increasing amounts of research document the deleterious effects of artificial lights after dark on

Project Background
In 2006, the Arizona Game and Fish Department (AZGFD) and Arizona Department of Transportation (ADOT) completed a statewide Wildlife Linkages Assessment. This report studied all of Arizona’s main wildlife linkages and prioritized those that are most threatened by new roads and development. The Santa Catalina-Tortolita Mountains Wildlife Linkage, which Oracle Road cuts in half, was identified as one of the most threatened wildlife linkages in all of Arizona.
The existing traffic flow at the Church involved both incoming and outgoing traffic using a driveway that bordered the wildlife linkage to the north. Exiting traffic late at night would shine their headlights directly north into the overpass feeder zone where minimal vegetation existed on Church property. The Church agreed to realign their flow pattern by adding an exit to the south, thereby reducing the amount of lights shining to the north after dark. Further, they removed the northernmost lane of the driveway and contracted SIA, TAS, and CSDP to install a vegetative screen of native plants that would block the early evening traffic lights and well as occasional late-night lights.

**Stakeholder Involvement**

Irrigation design/installation and mulching was guided by TAS. SIA purchased plants and rock, created the planting plan, and coordinated the volunteer effort. SIA and TAS jointly salvaged plants, and implemented the project. CSDP helped provide volunteers and outreach about the project and was instrumental in working with the Church and Pima County to establish the right of way and mitigation requirements. This project is the first time that these three conservation organizations have collaborated in an on-the-ground project.

**Funding**

Approximately $27,500 was provided by Pima County. SIA volunteers provided $4,500 in labor. Total project value was approximately $32,000.

**Project Activities and Outcomes**

TAS and SIA, along with many volunteers, jointly installed an irrigation system to establish native plants in the re-vegetation strip. Over 175 native trees, shrubs, and perennials were planted, and nearly 100 cacti and grasses salvaged from the new driveway exit area were transplanted. The areas between the plants were covered with a loose layer of riprap to create wetter microclimates for the establishment of native seeds. The gaps between the riprap were covered with wood mulch to increase moisture retention, decrease irrigation needs, and increase aesthetic value. Both rock and wood mulch help to control erosion and dust in the newly replanted area. SIA will provide the Church with landscape maintenance guidelines that acknowledge the difference between the manicured landscape on the rest of grounds, and the native species buffer adjacent to the wildlife overpass.
Post-Fire and Drought at Gila Cliff Dwellings National Monument

NPS, Sky Island Alliance, Borderlands Restoration

Abstract
The Miller Fire (2011) at Gila Cliff Dwellings National Monument (NPS) severely burned through a dense and steep riparian area closely associated with the Monument’s Contact Station and the primary trail used by visitors. Over the subsequent three years, drought compromised one particularly vulnerable slope immediately above the trail preventing vegetation recovery and threatening to cause extensive erosion. A micro-burst storm then hit the same area, snapping off more than 75% of the site’s small- and large-diameter trees in May 2015 increasing fuel loads for future fires, which would further compromise site resiliency. NPS, Sky Island Alliance (SIA) and Borderlands Restoration (BR) collaborated on a restoration plan for the site that included collection and grow-out of site-specific native plant material for re-planting, volunteer training and local involvement, downed-wood removal and translation into erosion control structures and firewood for USFS campsites, and on-site interpretation for visitors.

Keywords
post-fire restoration, drought response, public interpretation, collaborative restoration, native plants for pollinators

Project Background
SIA, NPS and BR agreed to identify their strengths and potential contributions toward an integrated restoration effort on a severely threatened ecological site. NPS offered its significant administrative and interpretive infrastructure including: logistics, site support and interpretation, oversight and tools. SIA provided staff expertise in complex restoration planning and execution, and used the opportunity to mobilize its New Mexico volunteer base for much needed help on the site and to set the stage for future efforts in the region. BR contributed its experience through the application of BLM’s Seeds of Success protocol in seed collection, curation and plant grow-out at BR’s nursery in Patagonia, AZ. BR also provided project management and restoration technical assistance.

Project Activities and Outcomes
Three site visits and extensive research and communication among collaborators led to the creation of a comprehensive and integrated draft restoration plan. Careful mapping of access points, footpaths for workers, coordinated seed and cuttings collection of native plants important to local pollinators, fuel load...
assessment and reduction planning, and erosion control installations of downed wood were all synchronized to maximize efficiency and effectiveness at this remote site.

Plant material collection began in 2014 for the project, and more than 3,600 native grass plugs were planted in a large volunteer effort in the summer 2015. Invasive species were removed, and seed balls containing pollinator species were cast throughout the site. Collection of native plant materials and installation will continue into FY16. With the assistance of an American Conservation Experience crew supported by NPS, further seed collection and down-wood cutting and translation into erosion control structures is planned for early FY16, in preparation for potentially high rainfall amounts over the coming winter. Timely rainfall soon after planting contributed to the first steps in restoration recovery, and NPS reported that plant survival rates may be as high as 75%. It is the hope of all collaborators that this project becomes a model for site-specific responsiveness to unique conditions by identifying and utilizing the strengths and capacities of multiple skilled partners.

**Stakeholder Involvement**

This project was initiated and funded by the NPS through the SW Exotic Plant Management Team and the Desert Southwest Cooperative Ecosystem Studies Unit. SIA recruited local volunteers for the fieldwork and provided additional funding through a grant with the Wildlife Conservation Society’s Climate Adaptation Fund. BR provided plant materials and specific expertise on erosion issues and fire ecology. NPS has been pleased with the effectiveness and the collaborative nature of the work, and has pledged an addition of $20k+ for the project in FY16. These funds are marked especially for continued plant materials collection, grow-out, and return to the site to support pollinators and provide further interpretive opportunities to the public, as well as research that will contribute to effective projects.

**Funding**

NPS provided $10,000 for the project. SIA provided $1,600 from a Wildlife Conservation Society grant, and volunteer time/travel contributions of $7,125. The total value of the project was $18,725.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

Restoration of Sonoita Plains Pronghorn and Black-tailed Prairie Dog

Arizona Game and Fish Department, Arizona Antelope Foundation, BLM, National Fish and Wildlife Foundation

Abstract
Much of the native grasslands of southeastern Arizona have been invaded by non-native grasses and native shrubs, degrading the habitat quality for a suite of grassland obligate species. The black-tailed prairie dog and American pronghorn have been the focus of a number of restoration projects conducted by the Arizona Game and Fish Department (AZGFD), the Arizona Antelope Foundation (AAF), and the BLM at the Las Cienegas National Conservation Area (LCNCA). A significant portion of the funding for this work has been provided through National Fish and Wildlife Foundation (NFWF) grants. Both prairie dog and pronghorn populations continue to show impressive gains within the Sonoita Plains.

Keywords
grassland restoration, pronghorn, prairie dog, grasslands, LCNCA

Project Background
Native southeastern Arizona grasslands have experienced a dramatic conversion to non-native and shrub-invaded grasslands over the past century or so. This conversion has led to a decline in native grassland wildlife populations. Collaborative work between partners such as BLM, AZGFD, and AAF in recent years has focused on restoration of mesquite-invaded grasslands, reintroduction of prairie dogs, translocation of pronghorn, and improvements to pronghorn connectivity.

After a 48-year absence from Arizona, black-tailed prairie dogs (Cynomys ludovicianus) were reintroduced by AZGFD beginning in 2008, the goal being reestablishment of the species to its historic range while improving overall grassland health and wildlife diversity.

Since 2008, 381 black-tailed prairie dogs have been released on four sites at LCNCA. A total of 700 acres at LCNCA will be restored to allow expansion for the prairie dog. To date, 329 acres have been completed at the Cieneguita colony. Within two weeks of mesquite removal, prairie dogs were digging new burrows and establishing themselves in the newly available space.

American pronghorn (Antilocapra americana) in the Sonoita Plains have experienced a significant decline since 2009. The 2011 surveys detected only 81 pronghorn. Reasons for the decline include an aging population, no fawn production, and travel corridor barriers (i.e., fences, roads, and shrubs). The AAF was awarded a series of NFWF grants...
grants totaling $515,000 for the period 2012-2017. Under these grants, fence modifications, water development, invasive brush removal, a prescribed burn, and landowner/agency partnerships have provided unencumbered travel corridors for pronghorn and other wildlife species.

Project Activities and Outcomes
Prairie dog pups numbered only six in 2009 with minimal increases for the next two years. Supplemental feeding during the breeding season has resulted in dramatic reproductive success, with the greatest number of pups ever (234) born in 2015. Between January and October 2015, 32 volunteers, primarily University of Arizona (UA) students, contributed 333 volunteer hours, playing a major role in prairie dog trapping, data collection, and feeding.

Close coordination between AZGFD, AAF, and Arizona Department of Transportation (ADOT) set the stage for a fence modification project along several stretches of SR 83. In April, AZGFD staff joined 42 volunteers from AAF, Arizona Mule Deer Foundation, Audubon Research Ranch, and Fort Huachuca to modify 2.6 miles of existing highway ROW fence. This section encompassed documented pronghorn crossing zones and is expected to significantly improve pronghorn and motorist safety. The second phase of the SR 83 project (removal of 71 mesquite trees in the ROW) was completed in October by AZGFD and ADOT personnel and 18 AAF volunteers.

Stakeholder Involvement
BLM provided project review, access, and coordination. They also are completing all the grassland restoration work for the prairie dog expansion areas including mesquite removal, grass rehabilitation, and prescribed burns. AZGFD provided biological expertise, funding, coordination, volunteer management, and prairie dog and pronghorn surveys. AAF provided expertise, volunteers, funding, coordination, and fencing materials and equipment. ADOT provided approval for fence and mesquite modifications within their ROW.

Funding
An NFWF grant provided funding for work along SR 83 ROW. Additional NFWF funding of $85,000 and BLM funding of $67,100 was used for grassland restoration at Cieneguita. UA volunteers provided almost $1000 of labor. Additional in-kind, staff time and volunteer contributions were not quantified, but were provided by ADOT, Arizona Mule Deer Foundation, Audubon Research Ranch and Fort Huachuca. Total project value was $153,100.
Riparian Restoration on the Upper Gila River in Arizona

Gila Watershed Partnership, National Fish and Wildlife Foundation, Freeport McMoran Inc., FWS

Abstract
The Gila Watershed Partnership of Arizona (GWP) initiated a public-private project to restore native riparian ecosystems on the Upper Gila River in Arizona. The Upper Gila Riparian Restoration project is a proactive effort to re-establish native habitat for threatened and endangered migratory bird species, prior to colonization of the area by the tamarisk leaf beetle (TLB). There is limited time before the arrival of the TLB, and it is unlikely that native vegetative communities will re-establish on sites where tamarisk will be defoliated, therefore, active restoration techniques are being implemented. It is our hope that these lessons learned will provide a model for other riparian restoration projects in the southwest to minimize negative impacts to sensitive species, and promote cost effective treatments by capitalizing on evolutionary adaptations and minimizing re-treatment efforts.

Keywords
invasive species, tamarisk, riparian restoration, endangered species

Project Background
The Upper Gila River is one of the most productive breeding sites for the federally listed Southwestern willow flycatcher (SWFL) in all of Arizona, and is critically important to the recovery of the species. However, the invasive tamarisk tree has established monocultures of tamarisk forests throughout the riparian corridor. USDA targeted these invasive trees in the early 2000s as a species that could be reduced using biocontrol methods, specifically the TLB. The beetle was released in 2001 in Moab, UT, and in 2009 in the Big Bend region of TX. The beetle has spread further and faster than anticipated. One of the unintended consequences of the TLB release is the degradation of SWFL critical habitat. While tamarisk is not native, the SWFL and other wildlife species have adapted to it. Tamarisk provides excellent cover from predation for SWFL due to its dense structure. The TLB is expected to arrive in our area in the spring 2017, threatening the prolific nesting grounds for SWFL on the Upper Gila River.

Project Activities and Outcomes
To address the arrival of the TLB, the GWP has created a restoration framework to select riparian sites with the highest potential for restoration. In
February, 2015, we received permits from Arizona Department of Environmental Quality (ADEQ), Arizona State Historic Preservation Office (SHPO), U.S Army Corps of Engineers (USACE), and U.S. Fish & Wildlife Service (USFWS) to use mechanical and chemical methods to control tamarisk infestations on 54 acres of critical habitat, and to re-establish native riparian vegetative communities on treatment areas.

Due to the dense nature of the tamarisk thickets on the Gila, GWP invested in a mid-sized excavator and mulching head attachment to mulch the woody tamarisk material in place. This mastication method is then followed by a low-cut stump and herbicide application. We applied a 12% triclopyr mix to the cut stump with flip-top bottles to reduce our drift and more accurately target the tamarisk stump. Permit conditions required we stop mechanical treatments by April 15th, in order to avoid harassing migratory birds as they return to the Upper Gila to establish nesting territories. Within our ten-week work window, we treated approximately 20 acres across three properties between the towns of Pima and Geronimo, AZ. Over the summer, we introduced native plant materials that were propagated at the GWP Native Plant Nursery as a means to establish native plant communities that may help suppress tamarisk re-infestation and secondary weed establishment. Mechanical treatments resumed October 5, 2015.

**Stakeholder Involvement:**
The GWP, Arizona Conservation Corps, and Boulder Creek Construction & Excavation led the on-the-ground restoration activities, with planning support from Stillwater Sciences and Westland Resources. Eastern Arizona College and the BLM have generously supported the GWP Native Plant Nursery operations, and our permitting partners at ADEQ, SHPO, USACE, and USFWS were most helpful throughout the planning process.

**Funding**
Work was funded through a Walton Family Foundation grant of $177,713, a Freeport McMoran Inc. contribution of $111,000 and $23,083 from FWS. Total project value was $311,796.

**Excavator with mulching head, masticating material on-site / GWP**

**Recruitment of native Coyote willow five months after treatment / GWP**

**Sky Island Restoration Cooperative**

**Riparian Restoration on the Upper Gila**
Editor: Shawn Stone
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

Pollinator Food Chain Restoration in the Madrean Archipelago

NPS, UA Southwest Center, BLM, USFS, Borderlands Restoration, USGS, Sky Island Alliance, Hummingbird Monitoring Network, Tucson Audubon Society, Institute for Applied Ecology

Abstract
Climate change is already impacting southwestern US aridland ecosystems, with potentially profound consequences for pollinators. The Madrean Archipelago is an especially biologically diverse ecoregion of the United States, supporting upwards of 500 known species of bees, hundreds of butterfly species and with 15 regularly occurring species, the highest diversity of hummingbirds found in North America, along with over 3,000 species of plants.

Research and restoration efforts in the region are now considering the impact of “phenological mismatches,” or the mismatch of flowers flowering and insects pollinating and feeding at the same time. Changes in phenology are driven in part by climate change which is projected to bring warmer and drier winter conditions. The regional food chain restoration for pollinators seeks to connect hydrological restoration, the restoration of soil and its communities, and the restoration of vegetation communities to ultimately form floristically diverse and resilient nectar landscapes.

Keywords
food chain restoration, phenological change, climate change, nectar landscapes, agriculture

Project Background
There is growing concern over the potential for collapse in pollinator-plant mutualisms, with climate change cited as one of the most significant reasons for phenological mismatch in aridland ecosystems. With over 75% of all food for human consumption being the direct result of pollination, the stakes for conservation of pollinators and plants are extremely high.

Regional food-chain restoration is underway across large areas of the Madrean Archipelago. It comes in the form of active restoration efforts at NPS units to support agave and bat mutualisms by growing and planting agave across the region.
to support their nectar corridors. It also comes through expanded seed collection and greater interagency coordination, which leads to greater capacity for plant propagation and seed production, and results in better research to support restoration practitioners, scientists, and land managers.

Project Activities and Outcomes
In FY15, National Park Service (NPS) worked with the Sky Island Alliance and Borderlands Restoration to fund the planning, design, and construction of pollinator gardens at two park units in the Madrean Archipelago: Saguaro National Park and Tumacácori National Historical Park. Building on ongoing efforts at Chiricahua National Monument and Coronado National Memorial to support monarch butterflies and lesser long-nosed bats by planting milkweed and agave, these new projects sought to connect the different threads of pollinator food chain restoration already happening throughout the region.

Regional efforts in FY15 included the US Forest Service (USFS) releasing a categorical exclusion to support pollinator plantings and seeding across the Coronado NF, USGS efforts to quantify infiltration and monitor for the most successful hydrological restoration techniques, and SIA creating and restoring wetlands and other habitats with a range of native species beneficial for pollinators.

In the Madrean Archipelago, food chain restoration is being done on multiple scales and by looking at different aspects of the problem simultaneously, and by many organizations. It spans from how best to restore hydrological systems, to collecting and growing the necessary plant material and seed, to improving restoration success and plant community establishment, to restoring human food systems that create economic opportunity in ways that restore pollinator health.

Stakeholder Involvement
Pollinator recovery is going to require an all-hands-on-deck approach with climate change as the variable. With recent attention focused around the iconic monarch butterfly, there is a window of opportunity to engage the broadest range of stakeholders and deepen support for the mutualisms between plants and pollinators, people and pollinators, and people and landscapes. In the Madrean Archipelago, we’re working to preserve the natural biological wealth of the region by building an economy that is restorative of communities, both human and natural.

Funding
NPS contributed $20,000, while SIA volunteers added $1,763 for an insect and butterfly bioblitz at Tumacácori NHP on September 30th. Results can be found at the iNaturalist site: https://www.inaturalist.org/projects/plants-of-tumacacori-national-historical-park Total project value $21,763.

Pollinator habitat, Deep Dirt Farm Institute / S Buckley

Sky Island Restoration Cooperative
Pollinator Food Chain Restoration
Editor: Steve Buckley, David Seibert
Botany and Monitoring Blitz 2015 in the Chiricahua Mountains

Sky Island Alliance, USFS, NPS, USGS, GeoSystems Analysis

Abstract
Sky Island Alliance (SIA) conducts an annual “Botany Blitz” at different locations each year to augment on-the-ground conservation and restoration work with detailed botanical inventory conducted by professional botanists. In FY15, botanists visited sites near Rucker Canyon and expanded the scope of data collection to include hydrology and vegetation measurements to support the watershed restoration structure installation at Tex Canyon and Barboot Allotment.

Keywords
botany, vegetation, monitoring

Project Background
Restoration and conservation projects in the Sky Islands are improved when they are informed by accurate and current botanical information that is collected before, during, and after on-the-ground efforts to improve habitat for native wildlife and plants. Baseline botanical data informs management decisions -- including documenting the presence of ecologically problematic invasive species, rare/focal species, and general biodiversity. In addition, these data sets may add to the body of knowledge about how ecosystems are shifting with climate change.

In 2015, SIA initiated an annual effort to gather botanical data at sites where restoration and conservation activities are occurring or are planned to occur. Regional botanical experts are invited to participate in a weekend-long effort to collect data at targeted sites. The information is then used to develop climate-appropriate planting palettes and restoration plans and to document project effects.

Project Activities and Outcomes
SIA assembled a team of professional volunteers in August to visit several sites in Rucker Canyon, where restoration work is ongoing and/or planned. Participants included: Carianne Campbell, Samantha Hammer, Christopher Morris (SIA); Angela Barclay, Salek Shafiqullah, Reuben Gay, and Rebekah Karsch (USFS); Natalie Wilson (USGS); Matt Grabau and Lindsey Bunting (GeoSystems Analysis, Inc.); Steve Buckley and Marcus Jernigan (NPS); Sue Carnahan (UA Herbarium); Walter Fertig (ASU Herbarium); Max Licher (NAU Herbarium); and Caleb Weaver and Perrin McNeils (Borderlands Restoration).

Sites visited included:
• Hermitage Seep: This mid-elevation seep and wet meadow is the site of on-going habitat enhancement for Chiricahua leopard frogs, bats, and pollinators, and was one of the sites visited during the FY 14 Botany Blitz. The botany crew added approximately 50 species to the...
previous plant list for this location, highlighting the importance of repeated inventory and monitoring efforts when possible.

- Camp Rucker: Another habitat creation/enhancement project is scheduled at this location for FY16, and the botany crew was able to map areas of high-quality pollinator habitat for inclusion in the restoration planning, as well as areas of invasives to prioritize for removal.
- Tex Canyon and Barboot Allotment: Extensive installation of restoration structures occurred this summer. Botanical information from these watersheds will be used to inform the possible augmentation with pollinator plants in FY16. Work here was expanded to include the installation of soil moisture monitoring stations by GeoSystems Analysis and long- and short-term vegetation monitoring plots by USGS.

Plant lists are not yet final but will be shared among all involved botanists for verification. This project adds to the botanical knowledge in the southwestern portion of the Chiricahua Mountains, and voucher specimens were collected for regional herbaria. Soil moisture monitoring of areas immediately adjacent to restoration structures and in untreated drainages will occur through at least October 2016, and results will be presented in a final report to the Wildlife Conservation Society. USGS will combine the data from vegetation plots with data from other sites in the region to develop a large-scale characterization of vegetation response to watershed restoration structures.

**Stakeholder Involvement**

This monitoring effort is part of a larger watershed restoration effort involving many stakeholders (see other related restoration briefs), including the adjacent landowner of Barboot Ranch. Botanists from across the region have academic and professional interests in documenting the diversity of plants at these sites, and this event creates a unique opportunity for networking and collaboration.

**Funding**

USFS provided lodging, logistical support, and staff time as an in-kind contribution. SIA used USFS and Wildlife Conservation Society Climate Adaptation Fund sources to provide $5,000 in staff time, and contributed $10,000 in volunteer time and travel. NPS provided in-kind travel support of $200. Total project value was $15,200.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

Western Yellow-billed Cuckoos: Guides for future restoration

USFS, Tucson Audubon Society

Abstract
This study evaluated the extent to which the western Yellow-billed Cuckoo (wYBCU) (*Coccyzus americanus*) uses mid-elevation oak drainages in the Sky Island Region of southeastern Arizona during the breeding season, habitat that is traditionally considered atypical and outside proposed Critical Habitat. Biological and geophysical characteristics of each drainage surveyed were evaluated to assess what components correlate to breeding usage by wYBCU with the goal of guiding future habitat restoration efforts and prioritizing conservation locations in the Sky Island Region.

Keywords
western Yellow-billed Cuckoo, restoration strategy, habitat characteristics, Madrean pine-oak woodland

Project Background
In October 2014, the wYBCU was listed as Threatened under the Endangered Species Act, primarily due to habitat loss. In the American west, cuckoos have traditionally been tightly associated with riparian gallery forests, dominated by cottonwoods and willows, nestled in wide mesquite belts. Less than 5% of this habitat remains. The population in Arizona has recently been estimated at 170-250 pairs, the highest concentration in the U.S., making this region an important stronghold for cuckoos.

Birders and scientists regularly report wYBCU in mid-elevation drainages in the Madrean pine-oak woodland ecoregion in southeastern Arizona, and have documented active nesting. However, prior to this effort, no systematic surveys had been done to quantify the numbers of wYBCU present in these drainages, nor the usage of this habitat for breeding.

Project Activities and Outcomes
For this study, the Coronado National Forest (CNF) contracted the Tucson Audubon Society (TAS) to conduct surveys for wYBCU in 40 Madrean pine-oak drainages on the CNF consisting of five drainages in each of the following eight Sky Island Ranges: the Huachuca, Chiricahua, Whetstone, Santa Catalina, Santa Rita, and Patagonia Mountains, the Atascosa
Highlands, and the Canelo Hills. Surveys involved two components: breeding call-back surveys and habitat assessment surveys in each of the drainages at occupied and at unoccupied areas. Drainages were surveyed biweekly, four times each for a total of 160 surveys in July and August 2015. To accomplish such a survey effort, TAS mobilized a volunteer force to assist staff logging over 950 volunteer hours on the study as well as TAS staff and River Pathways interns, TAS also surveyed additional areas outside the CNF around the town of Patagonia and in the Santa Catalina Mountains. TAS collected preliminary prey-base information at the survey locations, and analyzed the vegetation and geophysical characteristics of the habitat assessment surveys to begin to guide restoration and conservation efforts for this habitat. Additional avian species were recorded in each drainage. The breeding behavior and habitat requirements of wYBCU are poorly understood due to their cryptic nature, and guidance for best management practices for habitat restoration is still needed.

The surveys documented at least 19 breeding territories and 24 occupied territories for a total of 43 territories, and seven of the eight Sky Islands surveyed had evidence of breeding habitat. Further, wider drainages with less steeply sloped hillsides or canyon walls were more likely to be occupied, as well as drainages exhibiting vegetation requiring higher levels of moisture availability. These results demonstrate that the Madrean pine-oak woodlands provide valuable breeding habitat for wYBCU in southeastern Arizona.

**Stakeholder Involvement**

CNF and TAS staff jointly determined drainages to survey and developed the habitat assessment protocol. TAS staff, River Pathways interns, and volunteers performed the call-back surveys and habitat assessments. TAS staff and River Pathways interns compiled the survey data, and TAS staff performed preliminary analysis of the habitat assessments.

**Funding**

USFS provided $40,000 to TAS for surveys along with $3,000 in staff time. TAS volunteers contributed $25,578 in labor and travel. TAS contributed in-kind staff time valued at $2,300 and equipment valued at $2,050. Total project value was approximately $72,928.
Sky Island Springs: Expanding Knowledge, Informing Management

Sky Island Alliance, Springs Stewardship Institute, Desert Landscape Conservation Cooperative, USFS

Abstract
There are approximately 1,300 springs in the Arizona portion of the Sky Island Region. Springs are keystone ecosystems and are known to be biodiversity hotspots, however, they are poorly documented and suffer from extensive human modification. Conservation of springs is hindered by a lack of baseline information, increasingly limited resources for land management agencies to conduct field work, and a lack of coordination across jurisdictions and disciplines. Sky Island Alliance (SIA) worked with multiple partners to develop new information on the location, management context, and biological, hydrological, and ecological characteristics of springs. A combination of expert and citizen science field surveys was employed to collect this information in areas of interest and priority for managers. Data were applied to management through climate change adaptation planning.

Keywords
spring ecosystem inventories, springs inventory database, climate change adaptation, monitoring

Project Background
The need for spring ecosystem inventory and restoration was raised at regional adaptation workshops SIA developed with numerous partners and convened in 2010 and 2011. Practitioners including federal, tribal, state and local land and resource managers, researchers, private landowners and organizations, identified lack of data on the ecological condition, management status, and restoration needs of the majority of springs as a serious obstacle to conservation. Strategies identified to reduce the vulnerability of springs to climate change include: inventory springs in priority watersheds to gather basic information on condition, species presence and management status; coordinate data sharing across jurisdictions to understand springs in a regional context; and prioritize springs for restoration and protection. SIA initiated the springs inventory project in 2011 by convening a diverse group of partners, including many Sky Island Restoration Cooperative (SIRC) partners, with interests in spring stewardship,
research, and restoration. We worked with partners to identify priority study areas in which to complete field work to collect new information. Since the start of the project we have surveyed over 150 springs in the region. In 2014 the partner group chose the Santa Cruz River Basin as our current study site. In order to develop information on regional characteristics, threats, and integrity of springs we used a geospatially-stratified random sampling design to identify a subset of 50 springs for inventory. Inventory protocols, developed by the Springs Stewardship Institute, were modified in collaboration with managing agencies to ensure collection of data pertinent to management decisions and to make protocols accessible to volunteers.

**Project Activities and Outcomes**

In FY 2015 we collected field data on 39 springs in the Santa Cruz Basin and an additional 12 springs in Aravaipa Canyon, the Dragoons, and the Chiricahuas. Inventories were conducted using crews of formally trained volunteers led by SIA staff and SIRC partner personnel (chiefly biologists and hydrologists). Volunteers contributed nearly 1,000 hours to spring surveys. The following data was collected: spring locality, spring classification, georeferencing, a scaled map documenting geomorphology and diversity of microhabitats, photographs, solar radiation, flora and fauna (with attention to presence of sensitive and invasive organisms), flow, and water quality (pH, conductivity, and temperature). At each spring visited, crews also performed Spring Ecosystem Assessment Protocols (SEAP) to document ecological condition, risks, and restoration potential. We also continued our Adopt-A-Spring pilot monitoring program at five spring sites and added a new site at Saguaro National Park. Citizen scientist volunteers contributed nearly 500 hours to survey these springs five times per year using an abbreviated spring assessment protocol.

Newly collected and previously existing information from cooperating agencies is now available online through the Springs and Springs-Dependent Species Online Database (springsdata.org). The database is a central repository for data that transcends jurisdictional boundaries and is providing landscape level context for management decisions. This was not previously possible due to data being stored by individual agencies in different formats.

**Stakeholder Involvement**

Project partners have been involved throughout development and implementation of the project including: USGS, USFWS, BLM Safford Field Office, NPS (Saguaro National Park and Sonoran Desert Network), Pima County, University of Arizona Water Resources Research Center, AZGFD, Desert Botanic Garden, The Nature Conservancy, Arizona Native Plant Society, Bat Conservation International, and Pima Association of Governments.

**Funding**

SIA provided $90,400 in grant funding awarded them by the Desert Landscape Conservation Cooperative, along with volunteer time valued at $31,400. Total project value was approximately $121,800.
Abstract
We are evaluating the impact of newly-installed gabions (rock-filled wire baskets) by quantifying the effectiveness of such structures for enhanced infiltration and recharge using a combination of temperature sensing buttons, pressure transducers, and wildlife cameras. This is part of a larger study to investigate the most cost efficient way to recharge the Sierra Vista sub-basin aquifer using low-technology rainwater harvesting at the Babocomari Ranch, property of the Brophy family.

Keywords
restoration, infiltration, gabions, recharge, riparian health, erosion, monitoring

Project Background
In water-scarce regions prone to flash-flooding, simple rock structures (such as gabions) can be used to slow runoff and erosion in ephemeral stream channels, increasing infiltration and recharge and improving riparian ecological health. However, few quantitative studies assess the effectiveness of this strategy. In the spring and early summer of 2015, five gabions were installed in Vaughn Canyon, a tributary of the Babocomari River, by Borderlands Restoration with support from the Walton Family Foundation (WFF).

Project Activities and Outcomes
For this study, we instrumented channel reaches upstream and downstream of one of the gabions with wildlife cameras, pressure transducers, and surface and subsurface temperature sensors. We will infer vertical water flux through the subsurface using daily surface and subsurface temperature fluctuations and analytical solutions of heat transport in soil (specifically, the VFLUX toolbox for MATLAB). These methods use the extent to which daily temperature fluctuations are dampened and delayed with depth (because water transmits temperature changes more quickly than dry soil).
Novel to this study, repeat camera imagery will be used to estimate ponded area through time. This information will be used to convert temperature-sensor derived infiltration flux to total flow, with and without the gabion’s influence. Additionally, we expect to be able to monitor changes in infiltration flux through time, which will advance our understanding of the impacts of fine-sediment deposition upstream of the gabion. As of September 2015, two significant flows have been recorded by both the cameras and the temperature sensors, one on August 20th and one on August 26th (see photos). Due to successful collaborations, consent of the landowning family, and the importance of the USGS contribution, continued WFF funding to continue the research through 2017 is likely.

**Funding**

USGS provided $22,000 for equipment and staff time. The University of Arizona provided $13,500 for equipment, travel, and staff time through the Dept. of Hydrology and Water Resources, and an NFS CHN grant. Borderlands Restoration installed the gabions and administered the project using $125,000 of Walton Family Foundation funding, and $15,000 of in-kind services. Total project value was approximately $175,500 in FY15.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

Monitoring Vegetation Response to Watershed Restoration

USGS, USFS, BLM, USFWS, Sky Island Alliance, Borderlands Restoration, Cuenca los Ojos, and Stream Dynamics

Abstract
USGS scientists are working with partners to determine and document vegetation response to watershed restoration techniques at five project sites in the Sky Island region. Vegetation monitoring protocols are being developed to compare responses at erosion control structures and nearby control sites. Data from FY15 and early FY16 will be used to determine baseline conditions at restoration sites and determine early effects of restoration. This research is part of the USGS Aridland Water Harvesting Project, supported by the Land Change Science Program.

Keywords
restoration, monitoring, vegetation response, ecology, erosion control structures

Project Background
Watershed restoration techniques – gabions, check dams, cross vanes and one-rock dams – have been implemented by land managers seeking to conserve ecological and cultural values, but the relative effectiveness of these techniques is still unknown. Vegetation metrics – vegetation abundance, species composition and species diversity – are used as a proxy for assessing changes in water availability resulting from successful restoration. To quantify short-term effects on vegetation the area within 4 m of the restoration structures and within the channel was divided into zones based on proximity to structure. Within these zones nested frequency plots, canopy cover estimation and photo points were implemented to assess abundance, composition and diversity. Long-term monitoring plots were established using point-line intercept in three different height strata (field, sub-canopy and canopy); this will capture changes in vegetation structure in addition to changes in abundance. Long-term monitoring plots also include subplots to assess changes in species composition and diversity.

Project Activities and Outcomes
Twenty-five long term vegetation monitoring plots were established at four different project sites: eight at Vaughn Canyon, seven at Wildcat Canyon, seven at BarBoots Ranch, and three at Tex Canyon. Eighteen short term macroplots were established with a total of 244 nested frequency plots at four

USGS scientists Laura Norman and Natalie Wilson at a gabion in Vaughn Canyon / USGS
different project sites: four at Vaughn Canyon, six at Wildcat Canyon, six at BarBoot Ranch, and two at Deep Dirt Farm.

Preliminary, qualitative results indicate vegetation growth at and within rock structures. Non-native species (*Sorghum halepense*, *Eragrostis ciliaris*, *Eragrostis curvula*) are a large proportion of herbaceous vegetation growth at restoration sites. Native species (*Anisacanthus thurberi*, *Cyperus* sp.) are also part of the vegetation response at restoration sites. Species, native and non-native, that were not previously observed at project sites were possibly introduced by restoration activities. At other sites, native and non-native species were present in nearby areas of the watershed and are colonizing the new habitat provided by the restoration structures. At Vaughn Canyon non-native *S. halepense* and native *Cyperus* sp. were not previously observed and are now present at the gabions. At Deep Dirt Farm non-native *S. halepense* and native *A. thurberi* are present in other areas of the watershed and are also present at the gabion.

In FY16, quantitative analysis of short term vegetation response data and long term vegetation baseline data will be completed. Terrestrial LiDAR and aerial photogrammetry data will be compared to vegetation data to assess the effectiveness of these technologies in monitoring vegetation response. Short term vegetation plots will continued to be sampled in FY16 to capture local responses at restoration structure sites. Long term vegetation plots are expected to capture landscape level response throughout the system over a period of decades.

**Stakeholder Involvement**

USGS, with assistance from the NPS, Sky Island Alliance (SIA), and USFWS, is developing the vegetation monitoring protocols. USGS is coordinating field work and receives assistance from SIA, Borderlands Restoration (BR), USFS, BLM and NPS. The restoration projects were completed by Cuenca los Ojos, SIA, BR, USFS, and Stream Dynamics.

**Funding**

USGS has spent $35,000 to date working on this project. Many organizations have provided substantial amounts of people-hours to the project: BLM provided $3,000, SIA provided $2,500, USFS provided $1,000, BR provided $400, USFWS provided $200, and Deep Dirt Farm provided $200. Total project value was approximately $42,300.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

Hydrologic and Geomorphological Assessment of Restoration

USGS, BLM, Stream Dynamics, Borderlands Restoration, Univ. of Arizona

Abstract
The USGS and its partners are carrying out assessments of the hydrologic and geomorphological changes induced by stream-channel and riparian restoration at two sites: Vaughn Canyon near Elgin and Silver Creek in the San Bernardino Valley. Preliminary results indicate that site characteristics such as geologic substrate, watershed characteristics, and soil-hydraulic properties must be taken into account during restoration planning, monitoring, and assessment.

Keywords
Infiltration, geomorphology, geophysics, isotope geochemistry, restoration, monitoring, water and soil detention structures

Project Background
A number of methods have become available that allow for monitoring and assessment at multiple scales of the hydrologic and geomorphologic changes induced by restoration structures. Measurements of streamflow, soil-moisture, and infiltration are used in conjunction with models to estimate local impacts to the water budget and the response of channel morphology.

Project Activities and Outcomes
We report on results from a multidisciplinary, multi-scale approach to assess the interaction of restoration methods with land management and natural processes at two sites in southeast Arizona (Silver Creek in the San Bernardino Valley, and Vaughn Canyon near Elgin). Local-scale techniques include high-resolution topographic surveys from RTK GPS and terrestrial- LiDAR and drone-based photogrammetry structure from motion (SfM) data to assess geomorphologic changes. The USGS is combining repeat photography, in-channel water stage, and subsurface temperature variation to assess streamflow, and infiltration rates and volumes.

We are also using electrical resistance tomography and electromagnetic induction (EMI) to determine subsurface structure and spatiotemporal water-content variability and isotopic analysis of bed sediments to assess changes in carbon and nitrogen cycling and storage. Electromagnetic Induction (EMI) can give information on soils, geology, moisture, and salt content as well as information on change in electrical conductivity. This is a simple and inexpensive way to document that there are water content changes at depth and to give an approximate depth of percolation.
Stream-gaging, and rainfall-runoff and hydraulic modeling are being used to evaluate hydrologic and geomorphologic changes occurring at both local and landscape scales. Preliminary results indicate that methods to support restoration planning, monitoring, and assessment must be tailored not only to the scale, information needs, and scope of the individual project, but also to landscape characteristics, including geologic substrate, watershed characteristics, and soil-hydraulic properties.

**Stakeholder Involvement**
USGS is coordinating field work with and receives financial assistance from the BLM. BLM also contributed personnel to carrying out geophysical and sUAS surveys at Silver Creek in the San Bernardino Watershed. USGS, with UA professors and students, has installed an infiltration monitoring system in Vaughn Canyon at Babocomari Ranch (discussed in a companion briefing on Vaughn Canyon). UA has also assisted in carrying out geophysical and RTK-GPS surveys. The restoration projects were completed by Borderlands Restoration, BLM, and Stream Dynamics.

**Funding**
BLM contributed $100,000 for the Silver Creek project and Walton Foundation (via Borderlands Restoration) contributed as well (funding amount was listed with Babocomari work elsewhere). USGS contributed $40K in-kind. Total project value was approximately $140,000.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

**Santa Catalina/Rincon Mountains Lowland Leopard Frog Working Group**

NPS, Pima County, AZGFD, TNC, Univ. of Arizona School of Natural Resources, Sky Island Alliance, FWS, USFS

**Abstract**
The lowland leopard frog (*Lithobates yavapaiensis*) is a sensitive amphibian that requires perennial water, which is increasingly rare in the desert Southwest. Numerous threats affect the species throughout its range, including invasive aquatic, novel diseases, and habitat loss, but it is not federally listed as threatened or endangered. Because it is elusive, rare, and occurs in remote areas, we lack basic knowledge of the population, distribution, and ecology of the lowland leopard frog in the Sky Island region.

The Greater Santa Catalina/Rincon Mountain Lowland Leopard Frog Working Group formed in 2013 with the major goals of understanding and monitoring the status of lowland leopard frogs, defining and answering important research questions, and exploring management options for this species. We are an informal group with limited funding that meets annually to report on current population and distribution results from monitoring efforts. In 2015 we began creation of a document on the current status of the species, including distribution maps. One of our goals is to have a more active presence in fire management and spring restoration efforts that may promote the conservation of this sensitive aquatic frog. In addition, some of the partners are working with landowners in the vicinity of Saguaro National Park to raise lowland leopard frogs for potential restoration, and in 2015 we created a new pond at the NPS Desert Research Learning Center.

**Keywords**
amphibians, springs, wetlands, leopard frogs, habitat, refugia, backyard ponds

**Project Background**
This project grew out of a long-term monitoring program for lowland leopard frogs at Saguaro National Park (SNP), initiated in 1996. More than 16 years of monitoring (Zylstra et al. 2015) demonstrate that the species undergoes dramatic population fluctuations related to water dynamics. In 2011, the NPS partnered with Pima County to expand inventories of frogs throughout the Santa Catalina and Rincon Mountains east of Tucson. Seeking basic information on this species, biologists from University of Arizona first interviewed local experts and did a comprehensive search for data. Subsequent field investigations
revealed several large, previously undocumented populations in remote canyons. However, some historic populations now appear to be extirpated; most notably, the species is no longer found in some larger southern and western drainages of the Santa Catalina Mountains, including Montrose and Sabino canyons.

With support from local high school students, NPS and partners constructed new refuge habitat at the NPS Desert Research Learning Center and introduced lowland leopard frogs obtained from stock from nearby backyard pond refugia. We are planning to introduce at least two species of endangered fish into the pond, as well as the Huachuca water umbel. In the past we have also conducted experimental restoration of leopard frog habitat in SNP. Working group tasks in 2016 will involve progress on a conservation strategy for the species in the project area. Key elements of this strategy will include a summary of known information, key research questions, and identification of funding sources.

 Stakeholder involvement
The partnership includes the National Park Service (SNP and Sonoran Desert Inventory and Monitoring Network), Pima County Office of Sustainability and Conservation, Arizona Game and Fish Department (Nongame Wildlife Branch), The Nature Conservancy, University of Arizona School of Natural Resources and the Environment, Sky Island Alliance, U.S. Fish and Wildlife Service (Ecological Services office), USFS (Coronado National Forest), Historic Notch Neighborhood, and others. Past funding has been provided by the Friends of Saguaro National Park, Cooperative Ecosystem Studies Unit at the University of Arizona, and National Fish and Wildlife Foundation.

A meeting was convened in April 2013 with experts and managers to discuss the results of the surveys, develop a monitoring strategy, and discuss conservation actions. One outcome was the formation of our informal group. Because there is no reliable source of funding for monitoring lowland leopard frogs in the project area, we felt that pooling resources and data was the most appropriate and effective short-term strategy.

Project Activities and Outcomes
Working group members have met three times since 2013, and annual surveys and reporting began in 2014. The 2015 annual meeting resulted in a consensus on the outline for a report on the current status of the lowland leopard frog in the project area, which includes the Santa Catalina and Rincon Mountains, west to the Santa Cruz River, east to the San Pedro River, and south to the vicinity of Interstate 10.

Funding
This project did not have a designed project fund source in 2015, but relies on contributed staff time by our partner organizations listed above (approximately $2,000 annually). Expert volunteers contributed $900 of time, and youth volunteers contributed more than $2,200. In-kind staff contributions and volunteer time add up to more than $5,000 in project value.
Cooperative Wildlife Monitoring in Borderland Parks and Reserves

NPS, CONANP, Sky Island Alliance, Sonoran Joint Venture

Abstract
Wildlife cameras are used in a large number of national parks in US and Mexico to study wildlife, but their potential to monitor mammal communities and set conservation priorities remains underutilized. This project leverages existing camera studies in 11 parks (8 in Mexico and 3 in the US) that share similar species and habitats. Together we created a standard protocol that allows comparisons between sites, provides support for all parks by sharing wildlife cameras and other resources, and helps establish conservation and monitoring priorities for large and medium-sized mammals.

Key Words
wildlife camera, wildlife conservation, sensitive mammal species

Project Background
The national parks and other reserves along the US-Mexico border in Sonora, Baja California, and the southwestern United States share and protect a rich biological diversity. However, wildlife habitat in along both sides of the border is under increasing threats related to climate change, human population growth, and the combination of illegal border and heightened border security activities. The common conservation threats and goals of sister parks on both side of border facilitate the coordination of monitoring projects to understand and address loss of biodiversity. The purpose of this project is to develop a strong international partnership, based on wildlife cameras, to monitor and protect our unique mammal diversity.

Wildlife conservation is a major concern of the “sister parks” near the US-Mexico border: Saguaro National Park, Chiricahua National Monument, and Coronado National Memorial in the US, and Sierra de San Pedro Mártir Parque Nacional, Parque Nacional Constitución 1857, Ajos-Bavispe National Forest Reserve & Wildlife Preserve in Mexico. These parks began collaborating on resource management projects more than 10 years ago, but the projects were interrupted.
due to travel restrictions. Recently, we renewed and improved our cooperative efforts in natural resource management. All parks share sensitive mammal species including large cats, black bears, and neotropical mammals such as javelina and coati, as well as conservation issues such as border issues, habitat loss, and climate change. Four of the parks are part of the Sky Island region of the southwestern US and Sonora, Mexico, an area with high endemism and conservation value.

Project Activities and Outcomes
In February of 2015 Sky Island Alliance and the NPS with the help of Sonoran Joint Venture hosted a meeting in Tucson, Arizona, which included workshops and visits to Saguaro National Park, Chiricahua National Monument and Coronado National Memorial. This meeting resulted in specific management recommendations with conservation priorities for mammals in each park unit and a detailed protocol that can be adopted by other parks and reserves.

The major goals of this project are to leverage existing camera studies in the six border parks to help establish conservation and monitoring priorities for large and medium-sized mammals, as well as to renew several long-existing sister park relationships. Through our partnership we created a standard protocol that will allow comparisons between sites, provide support for all parks by sharing wildlife cameras and other resources. In addition, this project provides a baseline of knowledge of mammals in all parks that will allow for comparison among sites.

Stakeholder Involvement
Project partners and participants who have been involved through the development and implementation of the project include Sonoran Joint Venture, NPS (Saguaro National Park, Chiricahua National Monument and Coronado National Memorial), CONANP (Parque Nacional Constitución de 1857, Reserva de la Biosfera Sierra la Laguna, Parque Nacional Sierra de San Pedro Mártir, Area de Protección de Flora y Fauna Sierra de Alamos-Río Cuchujaqui, Reserva Forestal Nacional y Refugio de Fauna Silvestre Ajos-Bavispe), Area de Protección de Flora y Fauna Bosque la Primavera located in the state of Jalisco and NCI México Reserva Monte Mojino located in southern Sonora.

Funding
NPS provided project funding that totaled $31,406.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

Wild Linkages Binational Partnership: Mexican Highway Two

Wildlands Network, Cuenca los Ojos, University of Arizona, Naturalia A.C., Northern Jaguar Project

Abstract
The Wild Linkages Binational Partnership has been organized in response to the recent proposition to expand Federal Highway 2, a Mexican highway in Northern Mexico that runs near the international border with the United States. Roads fragment habitats by establishing obstacles to animals’ movements. Many of the species in the region are of conservation concern to either or both countries. Some, such as jaguars, black bears and cougars, require large connected habitats for dispersal, other smaller species use this landscape for migrations or to establish home ranges with the resources they need to survive. The partnership is gathering together to exchange knowledge and leverage resources to take wildlife corridors into better consideration for the road expansion.

Keywords
habitat connectivity, fragmentation, road expansion, Highway 2

Project Background
Highway 2 has access to every Port of Entry into the United States along its span. Starting in 2010 the Secretariat for Communications and Transports (SCT- Secretaría de Comunicaciones y Transportes), Mexico’s federal transportation authority, has been increasing the infrastructure of Highway 2 in Sonora. The expansion threatens to fragment ecosystems that have been recognized as important for conservation and are under protection. The road splits the Los Ojos Voluntary Conservation Area certified by CONANP (Comisión Nacional de Áreas Naturales Protegidas) and the San Pedro Ramsar site. If expansion continues eastward it will also increase the divide in the Janos Biosphere Reserve. The new route near Ímuris threatens to destroy sensitive riparian habitat; impact a cienaga in the Cocóspera river Basin; and split the Voluntary Conservation Area Aribabi.

The highway lies between important conservation areas including, on the Mexican side: the Reserva Nacional Forestal y Refugio de Fauna Silvestre Ajos-Bavispe, and the Certified Voluntary Areas of Los Fresnos and La Mariquita; and on the U.S. side: the San Bernardino National Wildlife refuge, the
Coronado National Forest, the Coronado National Memorial, the San Pedro Riparian National Conservation Area, and the Las Cienegas National Conservation Area. The region forms part of the Mexican Wolf Reintroduction Area and is critically located along the Jaguar’s Northern Recovery Unit, where corridor-road intersections have been identified by the Wildlife Conservation Society - under contract by USFWS- as needing intervention to secure the species recovery. Vehicle traffic along highways causes collisions with wildlife, a process that if left to continue, can eventually lead to isolated populations that are more vulnerable to other impacts.

Project Activities and Outcomes
Road ecology specialists along with transport engineers have developed a range of alternatives to mitigate the fragmenting effects of roads on the landscape. The effectiveness of them has been assessed in several study sites and found to differ depending on the type of infrastructure, its design and the behavior of wildlife. The Ímuris-Cananea stretch already requires 7 wildlife crossings to be built, although the design and suitability of these are unknown to conservation partners. A preliminary assessment of the road and its surroundings indicates that several already existing culverts could be retrofitted to serve as wildlife underpasses – some of which already exist in Mexico- at relatively little expense. Additionally the region may be suitable to establish the country’s first wildlife overpass, both because its topography lends itself to it in a few places and because it is one of the few regions of Mexico with a full suite of large mammals (i.e. black, bear, jaguar, cougar, white tail deer, bighorn sheep, pronghorn, mule deer).

Stakeholder Involvement
Wild Linkages Binational Partnership is a cooperative effort coordinated by Wildlands Network’s Mexico Program and involving the following groups and Individuals: Center for Large Landscape Conservation, Conservation Science Partners, Cuenca Los Ojos, Defensa Ambiental del Noroeste, Friends of the Sonoran Desert, Naturalia, Northern Jaguar Project, Sierra Club-Grand Canyon Chapter, Sky Island Alliance, USFWS-Arizona Ecological Services Office, USGS-Western Geographic Science Center, Wild Cat Research and Conservation Center-UofA, Arizona State University, Reserva Ecológica El Edén, UofA. Our mission is to foster wildlife connectivity between the states of Sonora and Arizona.

Funding
Wildlands Network provided $9,155 in staff time, travel, and expenses.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

**The Madrean Archipelago Plant Propagation Center (MAPP)**

**Borderlands Restoration, BLM, NPS, USFS, FWS, Desert Botanical Garden, Native Seeds/SEARCH**

**Abstract**

Development of the Madrean Archipelago Plant Propagation (MAPP) Center continued in 2015. We produced upwards of 20,000 plants for a range of projects throughout the Madrean Archipelago. Deepening the official cooperation, the NPS and BLM formalized their involvement with the MAPP Center by providing funding for a federal lead to assist with organization and development of the facility. The MAPP Center is looking toward the future as the largest working seed bank for native plant seeds of the Madrean Archipelago. Public and private investment is presently being sought to develop additional acreage as an agricultural and restoration training center.

**Keywords**

plant materials, propagation, Madrean Archipelago, economic development, agriculture, job training

**Project Background**

Borderlands Restoration L3C (BR) manages a 3-acre complex of greenhouses on land leased from Native Seeds/SEARCH in Patagonia, Arizona. Since 2013, the MAPP Center has received funding from a range of federal sources, including the BLM, NPS, USFS, as well as numerous private sources. In 2015, the MAPP Center worked closely with these agencies to further develop plant propagation operations. Through an Interagency Agreement, the NPS and BLM worked to establish a more formal coordinating role through a shared botanist position that was funded to work with BR, BLM, and NPS to develop the MAPP Center.

The long-term funded work at the MAPP has three objectives, to: 1) grow native plant materials not currently available in commercial quantities; 2) reduce native plant and restoration costs by increasing availability of native plant material, improving recruitment success, increasing effectiveness of restoration efforts, and providing information on best restoration practices; and 3) connect local residents of all socioeconomic groups to the ecosystems where they reside.

**Project Activities and Outcomes**

In 2015, Native Seeds/SEARCH and BR formalized their lease arrangement to manage three acres at the north end of their farm in Patagonia. These three acres include greenhouses, shadehouses, and additional agricultural acreage that is being put into cover crops to begin production in early 2016. In FY15, the MAPP Center staff constructed an additional shadehouse and in FY16 will add

![Asclepias texana, or Texas Milkweed growing at the MAPP Center / NPS](image-url)
three new greenhouses, one donated by the NPS to support agave propagation, another from the FWS to support grass production, and a 25’x100’ greenhouse from the Desert Botanical Garden.

The MAPP Center has an active volunteer program that supports all its horticultural and seed curation activities. Monday afternoons at the seed lab, and Tuesday mornings at the greenhouse, volunteers are welcomed by BR, amounting to over 800 hours in FY15. They clean seed and help repot and transplant thousands of plants, with 560 hours alone helping with propagation. BR employs multiple horticulturalists, farm hands, interns, and seed collectors in the town of Patagonia.

In FY15, the Southeast Arizona Group (SEAZ) of the NPS provided support to produce over 3,500 plants for Fertile Island experiments now being planted to take advantage of predicted El Niño precipitation. Looking ahead for FY16, there are an additional 35,000 plant units planted and being planted at the MAPP Center for NPS projects across seven national park units. The MAPP Center will receive funding through the NFWF Monarch Funds, as part of the Arizona Monarch Conservation Partnership in FY16. The MAPP Center will grow over a dozen different species of milkweed (Asclepias spp.) for seed production and as propagules. MAPP staff presented a bilingual and binational Milkweed Propagation workshop with NPS support and had horticulturalist Andrea Stanley present at the Intertribal Nursery Council conference in September.

**Stakeholder Involvement**

BLM and NPS have been the lead federal agencies working with Borderlands Restoration L3C to develop the MAPP Center. They work with BR because of their unique ability as a limited-profit company who can serve as both facility manager and raise private investment for further development of facilities. Private sector investment will be leveraged to apply for US Department of Commerce Economic Development and US Department of Agriculture grants to develop the MAPP Center as a hub for seed cleaning and storage, agricultural and restoration related research and training, along with agricultural production. Agriculture is a vital part of our effort to generate sustainable revenue that supports restorative economic activity in impoverished communities. Economic activity that is capable of providing a range of employment opportunities in both watershed and foodshed restoration. Working closely with a range of public, private, and non-profit partners, BR and the MAPP Center are putting restoration economics to work in the Sonoita Creek watershed and beyond.

**Funding**

BLM provided $40,000 for interagency MAPP Coordinator/Botanist and $94,305 in support for the MAPP Center through BR for operations. NPS SEAZ parks provided $15,000 and the SWEPMT provided $8,000 with an in-kind donation of an NPS greenhouse and horticultural support. The Desert Botanical Garden gave an in-kind donation of a greenhouse worth $50,000. The USFS provided $2,000 and BR volunteers provided an additional $12,600 in labor. Total value of the project was approximately $221,905.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

Seed Collection and Curation in the Madrean Archipelago

BLM, NPS, USFS, Borderlands Restoration, Sky Island Alliance, Institute for Applied Ecology, American Conservation Experience, AZ Conservation Corps

Abstract
Adequate seed collection requires trained eyes and hands to obtain a geographically and ecologically broad and genetically diverse sample of seed for use in restoration projects. This requires more hands not only for collection but more hands for curation of the seed. In FY15, the BLM and NPS made strides toward an integrated system of seed collection and curation for hundreds of small lots of seed and for national curation efforts like Seeds of Success (SOS) a program developed and administered by the BLM. Seed was collected all across the region by a range different groups from park staff, to volunteers, to individual botanists, to a three-person interagency botany crew, to larger conservation corps-type crews. Seed collection in the Madrean Archipelago is central to plant materials production and a fundamental component of any long-term restoration strategy.

Keywords
seed collection, plant materials, ex-situ native plant conservation, restoration strategy

Project Background
Seed collection in the Madrean Archipelago engages federal agencies, NGOs, and private companies. Seed collection across the region directly supports the development of the Madrean Archipelago Plant Propagation (MAPP) Center as the major seed bank conserving native plant seed in the region. Systematic seed collection is the beginning of a process that requires seed curation, whether contributing to national efforts like the SOS program, or for managing smaller lots of seed collected for specific localized projects. In FY15, the BLM worked closely with the NPS, SIA, the MAPP Center, and BR, to build an integrated system of collection and curation. The release of the 2015 National Seed Strategy provides an opportunity to further integrate agency efforts in the Madrean Archipelago and beyond.

Project Activities and Outcomes
Seed collection in FY15 in the Madrean Archipelago included at current count, more than 200 distinct collections of over 100 different species. Dozens of SOS collections have been made and have either been submitted or are being prepared for submission to the national collection. BLM utilized multiple Conservation Land Management (CLM) interns to collect seed in collaboration with the Gila Watershed Partnership. BR collected a range of species
throughout the borderlands region, while NPS made 79 collections of 34 different species in a pilot effort at the Southeast Arizona Group (SEAZ) in early FY15. The three parks of the SEAZ group include Chiricahua National Monument, Coronado National Memorial, and Fort Bowie National Historic Site.

The lessons learned from the fall collecting season in 2014, led to increased cooperation between the BLM, NPS, and USFS to pilot a botanical internship program that is managed by the Southwest Exotic Plant Management Team (SWEPMT). Three botany interns have been hired through the American Conservation Experience (ACE) program for a six month term that began in late FY15. The botany interns are presently averaging 10-15 collections per week, with well over 100 collections to date. Curation services have been provided by BR and the MAPP Center through an agreement between the NPS and Sky Island Alliance. Our hope is to quantify the costs of seed collection and seed curation to better set up crews in other regions.

Numerous volunteers have been engaged in the process of seed collection and curation, some working with BR at the MAPP Center seed lab, while others are in the field helping to locate and collect seed all across the region with NPS, SIA, and BR. In addition to the volunteers and botany interns, additional ACE and Arizona Conservation Corps crews have been hired by NPS to support collection at the SEAZ parks and at Gila Cliff Dwellings National Monument and numerous other regional parks.

**Stakeholder Involvement**

Seed collection in the Madrean Archipelago is a collaborative endeavor, receiving support from the federal land management agencies in the form of direct funding, housing support, and logistics. Non-profit groups like the Institute for Applied Ecology have provided financial resources to support collections on USFS land. BLM and NPS are working closely to build on the success of our interagency botanical crew to attract funding that can support skilled botanical research activities beyond just seed collection, including rare plant surveys and invasive species mapping.

**Funding**

BLM provided $53,000 to support Conservation Land Management Interns, and $7,200 in staff time and travel expenses. NPS provided $11,000 in staff time and travel expenses. The interagency botany crew was supported by $35,750 from BLM, $27,500 from NPS, and $24,000 from USFS. NPS funded the ACE and AZCC crews, providing $21,000. BR provided $5,700 in staff time and $700 in travel expenses. BR also provided $16,200 in volunteer labor for seed curation and collection. The Institute for Applied Ecology contributed $2,500 from a grant provided via Region Three of the USFS. Total value of this work was approximately $204,550.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

The Native Plant Nursery at Discovery Park
GWP, BLM, USFS, Borderlands Restoration, Eastern Arizona College, FWS

Abstract
Due to increased demand and limited supply of locally adapted plant materials in southeastern Arizona, the BLM, Eastern Arizona College (EAC), and the Gila Watershed Partnership (GWP) created the Native Plant Nursery (GWP Nursery) in Safford, AZ, in 2013. The nursery provides locally adapted plant materials to a multitude of public and private restoration practitioners including: the BLM, USFS, The Nature Conservancy (TNC), and the GWP’s Upper Gila Riparian Restoration Project. In FY15, the GWP Nursery produced over 30,000 plants for our customers. With continued interest in deep-planting restoration techniques, mechanized planting, and seed transfer zone applications, the nursery is primed to become a regional leader in locally adapted plant material production.

Keywords
plant materials, propagation, seed transfer zones

Project Background
The GWP Nursery is a 5-acre facility located on the Discovery Park Campus of EAC. The facility consists of a 3,000 sq ft greenhouse, 1,600 sq ft shade house, two acre coppicing field, a seed lab, and several acres of mother populations primarily used for seed collection and wildlife habitat. The facilities were constructed in 2013 with the assistance of GWP, EAC, BLM and the Arizona Conservation Corp (AZCC). Another 800 sq ft shade house was constructed in 2014 with BLM funding. Many of the plants are destined for GWP’s Upper Gila Riparian Restoration project, and additional plants are available for partners and the public. The nursery facilities are also used by EAC to provide ecological and horticultural educational programs.

The GWP Nursery provides customized services for our partners, including: 1) collecting detailed information on the sources of the plant materials utilized for plant propagation; 2) a variety of different container stock sizes customized to the specific needs of individual restoration projects; and 3) creating a hub for collaboration, community education, and career opportunities centered around ecological restoration.

NPN collaborated on expanding their plant materials collection program in consultation with Borderlands Restoration (BR) and the BLM in FY15. A seed lab was created in a building donated by EAC, and is equipped with a commercial narrowleaf milkweed (Asclepias angustifolia) growing at the GWP’s Native Plant Nursery in Safford / GWP
refrigerator, freezer, and seed cleaning supplies. Based on the BLM Seeds of Success protocols, the nursery began processing hundreds of plant material collections from throughout the region. GWP developed a digital seed collection app to more efficiently manage the seed collection data and plant population phenology provided by our seed collectors. We hope to make the data available to various academic and ecological restoration practitioners for further study and use. GWP, BR, TNC and the Deep Dirt Farm Institute partnered to host two seed collection workshops where community members were trained in sustainable seed collecting, plant propagation, and native grass production.

Project Activities and Outcomes
More than 30,000 plants were produced at the GWP Nursery in FY15. Approximately 2,000 trees, shrubs and grasses were planted to restore approximately eight acres treated as part of the Upper Gila Riparian Restoration Project. The nursery provided deep-rooted stock, as recommended by project designers, to help reduce the root depth to groundwater and capillary fringe.

Due to the prolonged drought in the Sky Islands, the City of Safford initiated water restrictions to help conserve water. In order to help the community adjust to these water conservation measures and to reduce the nursery’s municipal water consumption, we installed active and passive rainwater harvesting structures throughout our facilities. Two 2,825 gallon water harvesting tanks and several water catchment basins were installed to collect runoff and overflow. Two pollinator gardens utilizing passive rainwater harvesting techniques were planted near the nursery. The installations are used by the nursery as demonstration sites to showcase the benefits of water conservation, rainwater harvesting, mulch, and native plants.

Stakeholder Involvement
A full-time restoration horticulturist and two part-time nursery assistants were funded by the Walton Family Foundation and the BLM, and a part-time plant materials collection coordinator was funded by the BLM. EAC provided in-kind facility maintenance support. The AZCC and EAC provided crews and interns to help with major project installations. Over 750 hours of volunteer time were contributed to our nursery operations.

Funding
The Walton Family Foundation provided $34,000, BLM $31,000, USFS $2,500, and FWS $2,500. Volunteers contributed more than 750 hours of labor valued at $16,875. In-kind contributions from EAC have not been quantified. The nursery operations are valued at $86,875.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

Sharing Regional Restoration Strategies with the President and Congress

Arizona Department of Environmental Quality, USGS, Cuenca los Ojos, Borderlands Restoration

Abstract
The 16th Annual Good Neighbor Environmental Board Report for President and Congress focused on ecological restoration in the U.S.-Mexico Border Region. The latest report includes a case study on successful water harvesting and range restoration activities in Southern Arizona. Stakeholders may consider citing the report, its audience, and its recommendations when developing budgets requiring approval, or when applying for grants from private parties.

Keywords
international cooperation, water harvesting, grassland restoration, ecological restoration

Project Background
The Good Neighbor Environmental Board (GNEB or Board) is an independent federal advisory committee created by the Enterprise for the Americas Initiative Act of 1992. Its mission is to advise the President and Congress of the United States on good neighbor practices along the U.S. border with Mexico. Board membership include representatives from appropriate U.S Government agencies; the governments of Arizona, California, New Mexico, and Texas; and non-governmental entities. Each year, the board prepares an annual report reflecting consensus-based strategies and recommendations for addressing U.S.-Mexico border environmental issues. Contributions to the annual report are prepared and reviewed on a voluntary basis by the Board and its partners.

Project Activities and Outcomes
In 2014, the Board focused on ecological restoration within U.S.-Mexico binational watersheds. In response, the Arizona Department of Environmental Quality, USGS, Cuenca Los Ojos Foundation, and Borderlands Restoration collaborated on a case study entitled “Water Harvesting, Range Restoration and Local Economies”. The study highlights how a
A watershed-scale approach is necessary for ecological restoration. Given the scale, public-private partnerships are critical to the success of restoration activities.

Successful partnerships are contributing to the restoration of wildlife migratory corridors through privately funded water harvesting practices; securing the livelihoods of rural agricultural producers through range restoration practices; and supporting restoration economies where habitat restoration profits are reinvested in local capacity building and infrastructure. Successful partnerships between public, private, and non-profit stakeholders in Southern Arizona serve as models for realizing larger-scale ecological restoration activities within the U.S.-Mexico border region.

The case study was approved by the Board for inclusion in the 16th annual GNEB report. Stakeholders may consider citing the report, its recommendations, and its audience when developing ecological restoration budgets for approval, or when applying for grants from private parties.

More information on the GNEB is available at this link: [http://www2.epa.gov/faca/gneb](http://www2.epa.gov/faca/gneb). The 16th report can be downloaded through this link: [http://www2.epa.gov/faca/good-neighbor-environmental-board-gneb-reports-president-united-states](http://www2.epa.gov/faca/good-neighbor-environmental-board-gneb-reports-president-united-states).

### Funding
Contributions by project stakeholders were on a voluntary basis. No additional funding was used.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

Borderlands Earth Care Youth Institute (BECY)

Bar Boot Ranch/Cuenca los Ojos, Borderlands Restoration, Douglas High School, Patagonia Union High School, Sky Island Alliance, USFS, USGS, AZGFD

Abstract
Through a unique collaboration among Sky Island Alliance (SIA), USFS and Borderlands Restoration (BR), the Borderlands Earth Care Youth Institute took shape for its third straight summer in Patagonia, and for the first time in Douglas, AZ. High school students from each community were interviewed and hired to work and learn in local watersheds on projects including pond restoration, erosion control and moisture retention structures, invasive species removal, and native plant propagation.

Keywords
professional mentoring and outreach, youth training and job capacity building

Project Background
In Patagonia, AZ, throughout six weeks in June and July 2015 10 Patagonia Union High School students received an in-depth education in watershed, ecosystem, and food system restoration. SIA, the Douglas Ranger District of Coronado National Forest, and BR partnered to employ and educate a restoration work crew of seven Douglas High School students over the summer for work on the District. The students worked with SIA and BR to site, design and build 42 rainwater-harvesting rock structures on the Forest allotment managed by Bar Boot Ranch in the Chiricahua Mountains.

Project Activities and Objectives
Along with hydrological restoration on the Douglas Ranger District, youth received hands-on experience with SIA’s active ecological restoration projects, including wildlife pond installation at Brown Canyon, invasive species removal at Ash Spring, and planting projects at both sites. The youth also visited the private El Coronado Ranch property to learn from watersheds that have been undergoing restoration work for 25 years. In Patagonia, Caleb Weaver, Borderlands Restoration’s Ambassador to the Youth, raised funding to employ the youth crew to learn from various community restoration practitioners throughout the Upper Santa Cruz watershed. Sufficient funds were raised to hire Allegra Mount to serve as a co-facilitator with Caleb Weaver. The student interns in Patagonia visited 11 different sites, helping to support existing projects in some instances, while initiating projects in other areas. Four youth interns attended Advanced Leadership Training at Windsong Peace & Leadership Center, where they further developed their independent Community Restoration Projects, a graduation requirement for the 2015 BECY Institute.
In the Douglas BECY effort, multiple state and federal conservation and land management professionals representing the USFS, AZ Game and Fish Dept, USGS, local ranchers and others visited youth to discuss their day-to-day work and the paths that brought them to their occupations. It was particularly valuable to have relatable Douglas natives such as USFS range supervisor Joe Harris and Bar Boot Ranch Manager Kevin St. Clair share their experiences. The knowledge, passion, and commitment demonstrated by all the facilitators and visiting professionals translated into a strong crew culture and sense of purpose, and gave them the opportunity to envision themselves in similar professions in the future.

In Patagonia, the local high school immediately began implementing BECY programming and projects into its new Agricultural Science program and its new Ag instructor, Josh Moore. In addition to stakeholders noted above, FWS continues to support the youths’ development of a Watershed Living Laboratory on campus, and the Town of Patagonia is now prepared to act as fiscal sponsor for future grants involving youth job training and local capacity building as a contribution to the regional restoration economy.

**Funding**

Funds for BECY Douglas were provided by the USFS, and sponsored and facilitated by SIA ($38,000 total). Funds for BECY Patagonia emerged from six separate sources. The largest lump sum came from BLM, who put in $10,000 to fund youth under 25 years old to work on the land. Partners for Fish and Wildlife funded an outdoor classroom on the Patagonia Union High School campus with $7,500. Windsong Peace & Leadership Center and Me to We offered $6,580 in matching funds to send four of the BECY Institute youth Advanced Leadership Training. Two separate grants through the Patagonia Regional Community Foundation (PRCF) totaling $4,500, supported BECY Institute activities. Patagonia community members independently donated over $1,350 to the program. Total value of the BECY Patagonia and Douglas was approximately $67,930.
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**Youth Engaged Stewardship (YES!) at Las Cienegas NCA**

Cienega Watershed Partnership, BLM, YES! Partners, TNC, University of Arizona, USGS

**Abstract**

The Youth Engaged Stewardship (YES!) Program was designed by the YES! partners with the goals of training youth leaders and providing teens the opportunity to make a difference in the Cienega watershed through hands-on restoration projects. In 2015 YES! youth chose to make improvements at the Gardner Sacaton location at Las Cienegas National Conservation Area (LCNCA) by restoring sacaton grasslands and studying the effectiveness of different restoration techniques. YES! teens formed a board to design and implement the project, including developing a budget and planning work crews. YES! established two study areas and applied three different restoration techniques in July 2015.

**Keywords**

Youth engagement, sacaton restoration techniques, monitoring

**Project Background**

Youth engagement is a critical component in the future of southeastern Arizona landscapes. Since 2011, the Cienega Watershed Partnership (CWP) collaborated with YES! Partners (Empire High School, Ironwood Tree Experience (ITE), and Tucson BLM) to offer four field seasons of YES! at LCNCA. Students are recruited from Vail and Tucson High schools. Youth receive training in the ecology of grasslands and riparian areas, site assessment techniques, stakeholder issues, basic restoration issues and techniques, team leadership and communication, public lands management, and project design and implementation. The teens form a youth board, select at least one specific site to improve, and design and implement at least one restoration project. They make as many decisions as possible within parameters provided for NEPA, the Endangered Species Act, BLM-management goals and their own budget and timelines. The YES! teens decided to implement three different restoration techniques using a systematic design of treated and untreated plots. Participants implemented the treatments, established a monitoring program to determine most effective methods, and designed interpretation for visitors. Adult mentors, including scientists and public land managers, participated in every session.

**Project Activities and Outcomes**

In June 2015, the youth board visited the Gardner Sacaton location with The Nature Conservancy (TNC), Caldwell Design, BLM, University of Arizona (UA) scientists, and YES! Partners to
complete a site assessment. The youth board decided to establish two study areas; then worked with the BLM and Vera Earl Ranch to fence off one to exclude cattle. Sixteen sample plots were established within each study area. Each was mapped, staked and photographed with the help of USGS. Four untreated plots and 12 treated plots were randomly selected for each study area for a total of 32 sampling replications. Students organized work crews and implemented three different site preparation techniques: 1) planting alakali sacaton plants; 2) remove rocks and scarifying the soil to a depth of 3 or 4 inches; and, 3) aligning rocks into various structures ranging from circles to snake-like lines intended to hold water and soil. All plots were photographed to allow future comparisons and a grid was left in place to monitor results.

Plans are to continue monitoring the study areas with the help of the Advanced Placement students at Empire High School, future YES! interns, and other interested scientists. Rain and wind monitoring stations will provide further data and above average precipitation in 2015 will provide interesting results. Two YES! interns from the summer program are currently completing an interpretive display to describe the importance of sacaton communities and the specifics of the Gardner Sacaton restoration project for visitors.

Stakeholder Involvement
YES! Partners (CWP, ITE, BLM and Empire High School) were supported by many organizations and agencies to train and support the students including: USGS helped establish, map, and photograph the study area; TNC provided field assessment and restoration training; Univ. of Arizona provided education on the impacts of soil erosion; and the Vera Earl Ranch fenced a study plot and taught students about grazing. The BLM Safford Plant Materials Center provided 300 plants and DRI water to help plant establishment. Friends and family members also pitched in to provide volunteer labor.

Funding
Tucson BLM provided $12,000 for the YES! Program. YES! partners and volunteers provided $13,000 in-kind contributions of time and materials. YES! scientists and mentors time and mileage were contributed by their institutions. Total program value was approximately $25,000.
Seven Saturdays in Patagonia

Tucson Audubon Society, Hummingbird Monitoring Network, Borderlands Restoration, TNC, Patagonia Area Resource Alliance

Abstract
After the acquisition of the world famous birding backyard known as the Paton House, the Tucson Audubon Society (TAS) began a series of monthly, free educational lectures in 2015. Presentations were given by local non-profits on a variety of conservation topics of concern to southeastern Arizona and the residents of Patagonia, AZ. Additional presentations covered birds of conservation concern that are local specialties.

Keywords
conservation education, natural resource awareness, bird conservation

Project Background
The town of Patagonia is nestled in a critical wildlife linkage between two large areas of the Coronado National Forest - the Patagonia and Santa Rita Mountains. Sonoita Creek flows through the town and has seen severe anthropogenic changes since the area was settled. In 2014, TAS acquired the Paton House, now the Paton Center for Hummingbirds. The Paton Center is one of the primary ecotourism draws for the town, along with the adjacent Patagonia-Sonoita Creek Preserve of The Nature Conservancy (TNC). While birding there has been free and open to the public since the Paton's opened their yard in the 1970s, TAS aims to reach a wider audience with a broader conservation message. In order to provide greater access to information and birding opportunities, TAS hosted seven educational events. Each event began with a morning birding tour of a nearby birding hotspot, followed by a lecture, and culminating in lunch and occasionally a hands-on conservation activity.
These lectures engaged a varied audience on conservation and restoration topics and introduced people to the ongoing efforts of many Sky Island Restoration Cooperative organizations. Attendees came from Tucson, Patagonia, and numerous other towns throughout southeastern Arizona.

Each lecture was preceded by a guided bird and biodiversity hike leading 10 to 15 participants into differing natural areas around Patagonia. Emphasis for each hike was on educating participants about the local biota unique to each place, and to the area in general.

**Stakeholder Involvement**
Each participating organization presented one or more lectures. TAS hosted event, coordinated volunteers and presenters, and provided publicity for the lecture series.

**Funding**
TAS provided $6000 in staff time, travel expenses and volunteer contributions. HMN, TNC, PARA, and BR each provided $120 in staff time for a total of nearly $500. Approximately $6,500 was spent on the Seven Saturdays programs.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

USFS-SIRC Restoration Tour
USFS, NPS, USGS, Cuenca Los Ojos, Sky Island Alliance

Abstract
A number of Sky Island Restoration Cooperative (SIRC) partners hosted Kathryn Kennedy, Regional Botanist, and Wayne Robbie, Supervisory Soil Scientist from the USFS Southwestern Regional Office on a field tour in April, 2015. Our objectives were for them to meet with SIRC partners and demonstrate our grassroots approach to implementing cooperative ecosystem restoration projects, and build regional USFS support for our restoration activities in southern Arizona.

Keywords
outreach, plant materials, watershed restoration, spring restoration, pollinator food-chain restoration

Project Background
SIRC continues to outreach to various groups and agencies connected to the Madrean Archipelago in order to garner additional support for our ongoing restoration activities and our efforts to improve the availability of locally sourced plant materials. We were able to view SIRC field projects, and visit with a diverse group of restoration practitioners, scientists, and agency personnel to get an overview of the variety of projects SIRC partners are implementing.

Project Activities and Outcomes
Steve Buckley, an NPS botanist working for NPS, BLM, FWS, and USGS, on TES and rare plant surveys was along for the tour. We visited several TES/rare plant locations where we discussed opportunities for increased agency cooperation. Steve helps coordinate the Madrean Archipelago Plant Propagation (MAPP) Center in cooperation with Borderlands Restoration (BR), Native Seeds/SEARCH, and the BLM Safford field office. We visited the MAPP Center and discussed that SIRC partners strive to use locally collected and adapted,
Sky Island Restoration Cooperative

USFS–SIRC Restoration Tour
Editors: Michele Girard, Wayne Robbie, Steve Buckley

Sky Island Restoration Cooperative

chemical-free plant materials on our restoration projects, and to work on pollinator food-chain restoration across the region to help recover dwindling pollinator species populations. Staff and volunteers collect and process seeds, propagate local plant materials, and conduct field trials and greenhouse experiments on propagation methods.

Cuenca los Ojos (CLO) hosted the group at El Coronado Ranch where Dan Roe showed us low cost/low tech rock erosion control structures (ECS) installed to restore watersheds by trapping sediment and increasing infiltration. We visited with USGS scientists at one of their nearby research sites where they have documented a 29% increase in base flow on a treated vs. an untreated watershed. ECS also create additional mesic habitats suitable for pollinator restoration efforts.

Spring restoration is a high priority for SIRC partners and we met Carianne Campbell of Sky Island Alliance (SIA) and Abi King of Arizona Game and Fish Department (AZGFD) to observe ongoing restoration activities at Hermitage Spring. Hermitage Spring has been identified as a high priority for enhancement by the USFS, SIA, Bat Conservation International, AZGFD, and the Fish and Wildlife Service. A new exclosure fence was erected, two ponds were constructed by hand along the existing irrigation ditch to provide habitat for the endangered Chiricahua leopard frog (*Lithobates chiricahuensis*) and to provide water for bats, and a variety of native and nectar species were planted to enhance habitat diversity and create a habitat for pollinators. Work was accomplished by SIA and Douglas High School volunteers, and a Douglas Department of Corrections work crew. This small, low cost project achieved several high priority restoration goals and illustrates the efficiency and integration of SIRC partner projects. Additional discussions were held at nearby Camp Rucker where SIRC partners plan to conduct similar restoration activities in 2016.

Outcomes of the field tour include increased regional understanding of SIRC projects along with additional USFS funding and support for grants to help with rare plant inventories, an interagency botany crew, the MAPP center, and expanded seed collection.

**Stakeholder Involvement**

The tour was a great success and brought partners together from USFS, NPS, USGS, CLO, SIA, BR, AZGFD to share our success stories and discuss future projects. SIRC has developed a successful, multi-faceted restoration model that is community based, cost effective, long-term, and holistic. We collect seeds, propagate plants, restore watersheds, plant native species, enhance wildlife habitat, and monitor our results. SIRC provides an ecosystem restoration model based upon community involvement and partnerships that can be used on other forests and in other communities.

**Funding**

SIRC partners attended the tour with funding from their agency or organization. CLO provided lodging for the group for an in-kind contribution of $500.
The Sky Island Restoration Cooperative (SIRC) is a coalition of restoration practitioners, scientists, and land managers, working together to restore the ecological processes and systems of the Sky Islands in the Madrean Archipelago of the US-Mexico Borderlands.

Post-Fire Habitat Restoration with Inmate Crew

Tex Canyon Ranch, Bar Boot Ranch, Cuenca los Ojos, Borderlands Restoration, Sky Island Alliance, USFS, USGS, Arizona Department of Corrections

Abstract
Early in summer 2016 the U.S. Forest Service, Sky Island Alliance (SIA), and Borderlands Restoration (BR) entered into an agreement to supervise a 10-man inmate crew’s work to restore a severely burned area in the Chiricahua Mountains. The Horseshoe 2 Fire had created stand-replacing conditions and stripped areas of vegetation, making the oak woodland vulnerable to erosion and reducing ecological resilience.

Keywords
erosion control, pride, resilience, respect, trust

Background
Enter the inmates of the Forestry Crew at the Douglas, Arizona Department of Corrections prison. The Crew was ready to learn how to build erosion control structures, earn a little money, and get a lot of exercise outside “the yard” of the prison. The inmates are non-violent offenders who have earned the privilege of working in public. Multiple potential pitfalls, warnings about behavioral issues, and rules of conduct filled the crew leader training session; but once we entered the field together and pulled in the same direction for habitat health, a unique rapport took shape, along with respect and pride in the work at hand.

Activities and Outcomes
First we visited pre-built rock erosion control structures and talked about how they function in tandem with one another to stitch degraded watersheds back together. We then linked the work to a larger paired-watershed study coordinated by SIA and the USGS, comparing vegetation response to structures in burned vs. unburned areas. The inmates were told they would be considered employees, and treated as such while being held to high standards. With a few nods of approval from the group, we set off for the first work site.

Nicknames like Grumpy, Foreman John, Jarhead, and Bryan with a Y soon filled the air, along with plenty of expletives, competitive joking and critiques among the crew. They began comparing one another’s work and were quick to take credit for any functional structure and to mock those built by others; but there was more than rockwork and habitat resilience taking shape here. On a tour of one arroyo complex soon after the first rain event, Grumpy suddenly spoke up with surprise in
his voice: “At first I was like, What is this?! No way this is going to work. But then when I seen that stuff [moisture and organic material captured behind one of his intact structures], I tell ya, I stood a little taller.”

Pride had made its way into our work, and so had trust. At the end of each day the crew members would insist on filling the leader’s water jugs with theirs and offer their food remnants, intrigued that he was camping at the work site and doing what they could to set him up for the night. After a few weeks, structure spot-checks were greeted with strong insistence from the most outspoken of the crew: “Dude, you have got to go see what we built! You gotta check ‘em out!” They laughed, but they wanted to show what they had done, too. Bryan with a Y regularly insists that his work is so good it will surely make the cover of a hypothetical, future publication to be named Rock Wall Weekly.

One day immediately after major rains had ransacked the area, closing campgrounds and ripping roads, the men were anxious to gear up and check out their work. Shortly after we headed out, a great yell erupted from the burned forest ahead of me: “Woohoooo!! Take that [expletive]!! We built these!!” By the time I arrived the men were grinning and yelling excitedly, with one bent backward at the waist and laughing into the sky. “There’s two feet of sand under here! You can feel it!,” another said, bouncing up and down on the fresh earth.

Deeply incised arroyos that had been flushing moisture and nutrients out of the system were now stable sediment sponges, primed to support flora and fauna. The structures had held. Formerly disparate parts had been crafted into functional features of the landscape, and new ephemeral pools had formed in association with them. Little clouds of butterflies rose among fresh deer tracks in the soft, damp sediment; and different, yet inter-related features of the greater system continued to be built and cared for here, while we skipped around our work and laughed like giddy children at what we had built with our hands, together.

**Funding**

USFS provided funding to SIA and BR for supervision of the DOC crews at a cost of $7,750. USFS contributed approximately $4,150 in direct staff time to manage the DOC crew. Total project value was $11,900.