Society for Ecological Restoration
Texas & Southwest Chapters

Joint Conference

Ecological Restoration in the Southwest

Conference Abstracts

Keynote Address by:

Brandon Bestelmeyer, Ph.D.
Research Ecologist
USDA Agricultural Research Service, Jornada Experimental Range
Co-PI, Jornada Basin Long-Term
Ecological Research Site
New Mexico State University
Las Cruces, NM

October 17-19, 2014
Sul Ross State University
Alpine, Texas

Gratitude

Many individuals played a role in the organization of this conference. From its inception, both the TXSER and SER-SW Board of Directors have had a hand in developing ideas and pulling together the many pieces of the conference, great and small. We owe you all many, many thanks!

We would especially like to thank our sponsors whose support has enabled us to bring together individuals and organizations involved in ecological restoration across the southwest region of the United States. Your contributions have allowed us to share regional expertise, experience and ideas and to enhance collaboration across our broad geographical area.

With much appreciation and a heart-felt thank you to all!

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Pronghorn – ($1,000+) Field Trips & Keynote/Plenary Speakers
Mountain Short-Horned Lizard – ($500) Southwest Chili Dinner
Rio Grande Darter – ($250) Conference Breaks
Big Bend Cave Amphipod – ($100) Chapter Business Meetings
Terlingua Brickellbush – ($50) Student Awards

Keynote Speaker: Dr. Brandon Bestelmeyer, Research Ecologist, USDA Agricultural Research Service, Jornada Experimental Range, Co-PI, Jornada Basin Long-Term Ecological Reseach Site, New Mexico State University, Las Cruces, NM

Contact: bbestelm@ad.nmsu.edu

Dryland Restoration in the Anthropocene

Brandon Bestelmeyer is a research ecologist with the USDA Agricultural Research Service, Jornada Experimental Range and a co-PI of the Jornada Basin Long-Term Ecological Research site at New Mexico State University in Las Cruces, New Mexico. His work focuses on understanding and managing long-term change in ecosystems, mostly in drylands for which he has had a lifelong attraction.

Bestelmeyer's research interests include the mechanisms causing alternative states and ecosystem resilience, the effects of landscape heterogeneity on state change and restoration success, and how biodiversity responds to state changes and restoration actions. Current projects emphasize collaborations with governmental and non-governmental organizations to use ecological science in rangeland decision-making.

Ongoing projects occur in the southwestern U.S. with the Bureau of Land Management and the Malpai Borderlands Group, the Mongolian government, and agricultural agencies in Argentina. Bestelmeyer obtained an M.S. in Zoology and a Ph.D. in Ecology at Colorado State University and Bachelor's degrees in Biological Sciences and Applied Ecology at University of California, Irvine.

In his keynote address, Bestelmeyer will describe his work in dryland ecosystems from the Southwest United States to Argentina and Mongolia. He will challenge conference participants to consider restoration through the lenses of land potential, nonequilibrium and alternative states, and different ecosystem functions and services.

Plenary Speaker: Carianne Funicelli Campbell, RESTORE Program Manager, Sky Island Alliance, Tucson, AZ
Contact: carianne@skyislandalliance.org

Bi-National Restoration in the Sky Islands

Carianne Campbell is the RESTORE Program Manager for the Sky Island Alliance (SIA), a conservation organization dedicated to the protection and restoration of the rich natural heritage of native species and habitats in the Sky Island region of the southwestern United States and northwestern Mexico. A cornerstone of SIA's conservation successes lie in the on-the-ground work of the RESTORE Program, which works cooperatively with government agencies, private landowners, and a corps of capable volunteers on both sides of the US-MX international border to increase ecosystem resilience to the stresses of land management and climate change.

Campbell joined the SIA team in the spring of 2013, and brings many years of experience in restoration from throughout the southwest desert region. Campbell specializes in using vegetation ecology field methods to develop and monitor restoration projects; designing and implementing invasive species management plans; and applying novel low-tech approaches to achieve restoration objectives. For most of the past decade, she has been involved in the leadership of the Arizona Native Plant Society, serving on the state board as Conservation Chair and as the President of the vibrant and energetic Tucson Chapter. Campbell also serves on the City of Tucson Landscape Advisory Committee as the Wildlife Habitat Representative.

Campbell received her B.A. in Botany from Prescott College in 1998, and has co-authored papers on saguaro demography and conservation of amphibians in urban Tucson. She can often be found lying on the ground looking at flowers.

Plenary Speaker: Louis Harveson, Director, Borderlands Research Institute for Natural Resource Management and Professor of Wildlife Management, Department of Natural Resource Management, Sul Ross State University, Alpine, TX
Contact: harveson@sulross.edu

Rewilding West Texas: The Importance of Public-Private Partnerships

Louis Harveson is Founder and Director of the Borderlands Research Institute for Natural Resource Management and holds the Dan Allen Hughes, Jr., Endowed Directorship. Since 1998, Harveson has served as a faculty member at Sul Ross State University in Alpine, Texas where his research program has focused on the ecology and management of large mammals, upland gamebirds, and predators. Harveson's research efforts have focused on the borderlands of Texas-Mexico including Gulf Coast Prairies, South Texas Brush Country, and the Trans-Pecos Mountains and Basins. An underlying theme to Harveson's research has been on the conservation of natural resources on private lands.

Harveson received a B.S. in Wildlife Management from Texas Tech University, his M.S. in Range and Wildlife Management from Texas A&M University-Kingsville where he worked with northern bobwhites, and received his Ph.D. in Wildlife Science from the Joint Ph.D. program at Texas A&M University-Kingsville and College Station where he studied mountain lions in south Texas.

Harveson serves on numerous regional and statewide conservation committees and presently serves as Second Vice-President of Programs for the Texas Wildlife Association. Harveson is a Certified Wildlife Biologist and an active member of The Wildlife Society at the national, state, and university level.

Presentation Abstracts

[*in alphabetical order by presenter's last name*]

Ackerman, Judy and Mike Gaglio. Authors: [1]Ackerman, J., Cutler, S., [2]Gaglio, M., Mendez, C., Moses, J., Reneaud Field, J., Teschner, T. and White, P.
[1]Franklin Mountains Wilderness Coalition, El Paso, TX
[2]The Frontera Land Alliance, El Paso, TX
Contact: jpackerman53@gmail.com, Mike@hd-env.com

Castner Range; Can it be Conserved?

The Frontera Land Alliance, Franklin Mountains Wilderness Coalition and Franklin Mountains State Park (FMSP), (4C's), through a collaborative approach are working to conserve Castner Range (Castner), El Paso, Texas. The conservation of Castner will result in: a safeguard of natural and cultural features, improve wildlife habitat and connectivity, address the health of our regional watershed and contribute to the local economy. Conservation of Castner will be achieved through stakeholder participation, local, regional and federal partnerships and public support.

1. Castner Range Conservation Conveyance Report, 2011. The document includes background information and a path to achieve the conservation of Castner. The report states the ideal method to conserve the 7,081 acres is a conservation conveyance. 4C's are investigating other possibilities that may allow access only to trails which was done at Dolly Sods Wilderness. The El Paso City Council, El Paso County and Texas Congress all passed resolutions supporting the preservation of Castner.
2. Castner Range Land Use Plan, 2013, provides various plans that may be implemented at Castner if FMSP managed the area for wildlife and/or general public.
3. Local communications expert, Jackson Polk, produced a DVD called Conserve Castner Range in English and Spanish. The DVD shares the background, history, current state of Castner.

The presentation will discuss the objective of Castner to be part of the FMSP and the methods available to accomplish this goal. Castner has the ability to provide benefits to Veterans, impact the local quality of life, and the economy through private and public partnerships.

Alexander, Heather.
Authors: [1]Alexander, H., [2]Moczygemba, J., and [1,2]Dick, K.
[1]University of Texas, Brownsville
[2]U.S. Fish and Wildlife, Laguna Atascosa National Wildlife Refuge, Los Fresnos, TX
Contact: heather.alexander@utb.edu

Coastal Thornscrub Forest Restoration in South Texas: Effectiveness of Different Management Techniques

Coastal thornscrub forests occur throughout south Texas and provide critical habitat for numerous fauna, including the Federally-endangered ocelot and a variety of migratory songbirds. However, <1% of original thornscrub remains due to conversion for agriculture and urbanization. One approach currently underway to restore thornscrub habitat around core ocelot populations in south Texas is the planting of native seedlings and subsequent control of competing invasive grasses through herbicide application. Over the last five years, ~ 150,000 seedlings have been hand-planted across 150 acres in the Laguna Atascosa National Wildlife Refuge (LANWR), location of one of two remaining breeding populations of ocelots in the U.S. Despite the importance of these restoration efforts, the effectiveness of this approach and feasibility of alternative strategies have yet to be established. In March 2011, a pilot study was initiated at LANWR to assess the effects of various management strategies (fire, invasive grass herbicide, acetic acid, and seedling shelter tubes) on thornscrub seedling growth and survival. For two years post-treatment, we quantified seedling growth characteristics (basal diameter, height), invasive grass cover, and browse intensity. We found that seedlings growing in shelter tubes tend to be taller with smaller basal diameters and contain less browse than those that were unprotected. This project will fill this knowledge gap by determining the empirical relationships between thornscrub seedlings and their abiotic and biotic environments and using these relationships to predict seedling success under different management strategies.

Allcorn, Robert A.
Authors: Allcorn, Robert A. and Warnock, B. J.
Borderlands Research Institue, Sul Ross State University, Alpine, TX
Contact: robertallcorn@gmail.com

Small Mammal Response to Wildfire on the Marfa Grasslands, Texas

In April of 2011, the largest grassland fire in recorded Texas history roared across the landscape between the cities of Marfa and Ft. Davis. The fire, named the Rockhouse Fire, burned for 34 straight days and covered 314,444 acres. The effects on the landscape were dramatic and were compounded by a severe drought that afflicted the region from October 2010 to May 2012. With this fire came the opportunity to monitor the natural successional process that would be taking place on the Marfa grasslands. Small mammals are a crucial element in the full restoration of any landscape since their presence, or absence, has a profound impact on both flora and fauna communities. As part of our efforts to observe the natural restoration process in the Marfa grasslands, we monitored small mammals through a mark-recapture study. Our monitoring efforts have noted obvious differences in small mammal populations. Both population size and composition have changed noticeably from the beginning of the study in the Summer of 2011 to its completion in August of 2014. These changes suggest a healthier ecosystem and are indicative of the restoration process occurring on the landscape.

Balin, Lois.
Texas Parks and Wildlife Department, El Paso, TX
Contact: lois.balin@tpwd.texas.gov

Evaluating Burrowing Owl Nest Site Selection in Far West Texas

Urbanization of the desert southwest is rapidly encroaching habitat for burrowing owls. The Rio Bosque Wetlands Park in El Paso, Texas provides suitable habitat needed for burrowing owls (*Athene cunicularia*). Prior to 2004, owls occupied three natural burrows on the site. In 2004, TPWD and partners initiated a study to determine burrowing owl nest site selection, and to examine whether artificial den sites could aid in burrowing owl restoration. From 2004-2007, nine artificial nest sites where installed using a preliminary den design. From 2007-2010, nine artificial nest sites and three natural nest burrows were active. Some nest sites became unusable or were destroyed by predators, erosion, or soil plugging and blocking the nest boxes. TPWD began installing burrows of various designs and construction materials during 2011 and 2012. Faults were assessed in the remodeled nest sites and nest sites were renovated again in 2013 with a newer design. Sites were remodeled with improved erosion control, additional satellite nests, infrared cameras installed into two newly constructed nest sites, and two trail cameras installed at the remaining two natural burrows. In the 2004 nesting season nine, of the ten nest sites were occupied by owls. Eight sites produced clutches of 7-9 eggs with numerous successful fledglings. One site was occupied by an owl pair that did not breed and a new site was occupied by a single owl. We present lessons learned in creating artificial den sites for burrowing owls, recommendations for artificial nest designs, and the preliminary results of our camera monitoring project.

Banta, Joshua A.
Authors: [1]Banta, J.A., [1]Sain, M., [2]Marshall, N., [3]Walters, A., [4]Ford, D., [5]Heffentragger, K., [1]Placyk, J., [1]Ford, N., [1]Williams, M., [1]Williams, L., and [6]Small, R.

[1]Department of Biology, University of Texas at Tyler, Tyler, TX
[2]Department of Biological Sciences, University of Toledo, Toledo, OH
[3]Department of Biology, Miami University of Ohio, Miami, OH
[4]Halff Associates, Inc., Dallas, TX
[5]Titanium Environmental Services, Longview, TX
[6]Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, TN
Contact: jbanta@uttyler.edu

An Integrative Approach to Conservation Biology

Conservation biology seeks to understand how to protect species and their habitats from destruction, as well as how to restore species to areas suitable for their persistence and survival. To understand how to conserve species, we need to identify areas where the species does live and extrapolate to other areas where we predict the species could live if it became established there. But we also need to think about what taxa we should be conserving. Many species were first described long before the advent of modern molecular methods that can reveal gene flow, paraphyly, and cryptic speciation. Thus sometimes the entities needing protection do not correspond to the entities we think we need to protect. To put all these pieces of the puzzle together and come up with rational conservation plans, we need to integrate modern genetic methods along with landscape genetics approaches. This talk will outline the general strategy with examples.

Crawford, Priscilla and Angelina Stancampiano.
Authors: Crawford, P., Treat, B., and Stancampiano, A.
Oklahoma Biological Survey, University of Oklahoma, Norman, OK
Contact: prill@ou.edu

Productivity of Interior Least Terns in Central Oklahoma: Past Habitat Dynamics, Current Pressures, and Future Management Considerations

The interior least tern (LETE) establishes nesting colonies on the unvegetated sandbars and banks of the braided prairie rivers of the central and south-central U.S. Since 2007, we have monitored and protected LETE breeding sites along a 25-mile reach of the Canadian River in central Oklahoma. Nesting colonies in this region are small, with the number of breeding pairs ranging from 1 to 17, with a median of 7. Nest success varied from year to year and from site to site, with flooding, predation, weather, and human disturbance all affecting fledgling production. We compared our data to data collected during a previous 8-year period beginning in 1992. Number of breeding pairs and reproductive success has dropped significantly since 1992. We analyzed historic aerial imagery to evaluate the change in available nesting habitat. Images from previous decades illustrate the dynamic river riparian zone. While flooding may reduce fledgling rates to near 0 in one year, the long-term benefit of vegetation removal can be seen for several years. In the absence of scouring floods, LETE may be forced to utilize less optimal habitat, thus increasing the loss of nests and flightless young to predation, minor flooding, and human activity. Protection from human disturbance and vegetation removal from overgrown sandbars will be the most helpful management techniques for this area. Although the number of nesting terns in our region has always been relatively small, the disturbing downtrend of this population should be considered in future discussions of the LETE's endangered species status.

Edwards, Mary Carol
Texas Coastal Watershed Program, Texas Sea Grant/Texas A&M AgriLife Extension, Houston, TX
Contact: mcedwards@tamu.edu

What Can Restoration Science Do For Green Infrastructure?

Stormwater management projects in urban and suburban areas increasingly utilize principles of Green Infrastructure, Least Impact Development (LID), and Best Management Practices (BMPs). Such practices as vegetated buffers, vegetated swales, and stormwater wetlands mimic functions of natural areas in order to cleanse, slow or infiltrate stormwater runoff. The side benefits of habitat and park space are often capitalized as well. Even though these are created, not restored, landscapes, restoration and conservation scientists can influence the success of these projects.

How can restoration scientists contribute? Urban planners, landscape architects, municipal staff, and civil engineers need access to ecological knowledge when planning sites. Establishing soil health, developing plant communities, managing succession and opportunistic species are critical aspects of successful green infrastructure projects, and require different approaches than a traditional landscape. Restoration and conservation specialists can offer techniques, local sourcing, access to genetic diversity and seed stocks, reference sites, volunteer bases, and research, all of which contribute to developing regional bodies of knowledge on the use of green infrastructure.

Fierro-Cabo, Alejandro.
Authors: Aguilar, G. and Fierro-Cabo, A.
Department of Biological Sciences, University ot Texas at Brownsville
Contact: alejandro.fierro@utb.edu

Key Plant-Animal Interactions in the Natural Propagation of Sabal Palm (*Sabal mexicana*) and the Restoration of Palm Forests in Texas

Only two small remnants of the once abundant sabal palm (*Sabal mexicana*) forest are found today in the US; they are located in the vicinity of Brownsville, Texas. Understanding the propagation ecology of this native plant species is needed in order to conduct a potentially effective restoration effort. Interactions with various animal species appear to play a critical role. A peculiar interaction between the palm and the opportunistic coyote (*Canis latrans*) includes the dispersal and easier germination benefits, but possibly also a much needed protection from an intense seed predation. A series of germination tests, camera trap surveys and seed predation experiments were conducted in order to explore the interactions between palms, seed predators and coyotes. Results show that seed predation by beetles, rodents or raccoons, can reach 100% within a few days. A strong edge effect appears to determine the dominant predator type (beetle or mammal). Seeds collected from coyote scats have an improved and faster germination. Seeds in scats were also effectively protected from seed beetle (*Caryobruchis gleditseae*) oviposition, and consumption from seed destroying mammals. Results suggest the interaction of the palm with its seed disperser/protector balances the effect of seed predators and may promote seedling recruitment through congregated germination and seedling establishment.

Fierro-Cabo, Alejandro.
Authors: [1]Fierro-Cabo, A., [2]Marquez, M. A., and [1]Cintra- Buenrostro, C.
[1] University of Texas at Brownsville
[2] Florida A&M University
Contact: alejandro.fierro@utb.edu

Effective Indicators of Ecosystem Functional Recovery in Estuaries Linked to Lower Laguna Madre, Texas

With increasing environmental concerns in estuaries, effective means to assess and monitor their ecosystem status and trends are needed. In this study, two estuaries in the process of restoration, and one reference system were evaluated to assess their ecosystem status through the examination of key ecosystem processes such as leaf litter decomposition and concurrent nitrogen dynamics. The estuaries are located at the southern end of the Lower Laguna Madre in Texas. Black mangrove (*Avicennia germinans*) leaves were used as the decomposition substrate because it is endogenous to these systems. Metrics derived from leaf litter decomposition and N dynamics did discriminate among sites with different known ecosystem status. Metrics from mass loss (decay constants, half-lives or mean residence times) are reliable functional indicators, however, metrics from N dynamics (Nmax, immobilization time and release rates) are more accurate indicators of functional recovery, pointing at a more conservative nutrient cycling in recovering and less degraded sites. While these processes are linked by the activity of the decomposer community, they can be used separately as functional indicators. Nonetheless, when evaluated simultaneously, they can provide a more accurate and reliable way to assess ecosystem function of estuarine systems.

Garrison, Taylor O.

Authors: [1]Garrison, Taylor O., [1]Harveson, Louis A., [1]O'Shaughnessy, Ryan and [2]Gray, Shawn S.
[1]Borderlands Research Institute for Natural Resource Management, Sul Ross State University, Alpine, TX
[2]Texas Parks and Wildlife Department, Alpine, TX
Contact: Tgar3881@sulross.edu

Pronghorn Restoration in Trans-Pecos, TX: Where Are We Now?

Pronghorn (*Antilocapra americana*) are an important ecological and intrinsic species found across most of western North America. A unique ungulate only found in North America, pronghorn are indicative of grassland ecosystem health and provide recreational, economic, and aesthetic value for society. Once thought to number >30 million in the 1880s, today pronghorn populations are approximated to be around 1 million throughout North America. Past livestock practices, agricultural development, urbanization, and over-hunting were key components that led to the near extirpation of pronghorn. Populations in Texas have suffered a similar reduction since the early 1900s. Distribution once extended across the western two-thirds of the state near the 97th meridian, but now only reside in the Trans-Pecos, Panhandle, and portions of the Edwards Plateau. Restoration efforts, primarily through translocation practices, were first implemented in the late 1930s. Since that time, >6,500 pronghorn have been translocated in Texas to help restore historic ranges and supplement declining populations. In the mid-1980s however, there were as many as 17,000 pronghorn in the Trans-Pecos. Today their numbers only total 3,000 for the area, an imminent problem continuing to be resolved. Current restoration efforts have proven successful to increase pronghorn distribution and abundance. Pronghorn were translocated from the Panhandle in 2011, 2013, and 2014 to the Trans-Pecos. These translocations are a part of a study to identify aspects of movements and survival of translocated pronghorn as well as translocation success. Without this research, proper management, landowner cooperation, and restoration efforts, pronghorn population levels in Texas would not be where they are today.

Grabau, Matthew.
Authors: Grabau, M. R., Milczarek, M. A., and Hovland, L.
GeoSystems Analysis, Inc., Tucson, AZ
Contact: matt@gsanalysis.com

Irrigation to Establish and Maintain Riparian Plant Assemblages along Regulated Rivers

River regulation infrastructure has been installed on rivers worldwide to provide flood control, diversions for agricultural and municipal water use, and hydroelectric power generation. River regulation results in degradation of ecosystems dependent on natural flows. Many programs are underway to re-create at least a portion of the historic vegetation along regulated rivers. “Restoration” in these novel ecosystems must overcome many challenges. Passive regeneration is limited or absent due to the lack of overbank flooding. Once established, native trees are susceptible to floodplain desertification, salinization, and wildfires. Revegetation can be achieved by active planting or seeding, which must be supported by irrigation if groundwater depth is excessive.

The authors have completed two pilot projects at irrigated riparian restoration sites on the lower Colorado River to determine baseline soil and groundwater conditions, conduct in-situ irrigation monitoring, and support irrigation optimization. Between 2010 and 2013, soil and groundwater salinity was monitored at three sites, and a salinity model was used to estimate the amount of irrigation required to sufficiently leach salts. Required irrigation rates varied based on soil texture, depth to groundwater, and groundwater flow rates. Irrigation distribution and soil moisture were also monitored using automated data acquisition systems at a 74-acre site. Data showed irrigation was sufficient to support plant water needs, but did not provide saturated soils for extended periods between irrigation events as needed for riparian obligate birds. Irrigation efficiency and soil moisture data were used to provide recommendations for optimizing water application and improving habitat quality.

Hoge, Brad.
University of Houston - Downtown, Houston, TX
Contact: hogeb@uhd.edu

Edge Effects on Diatom Community Succession Trajectory within a Mitigation Wetland

A long-range ecological survey was recently completed to study diatom community succession trajectory in the Greens Bayou Wetland Mitigation Bank (GBWMB) in Harris County Texas. The objective of the study was to determine whether changes could be observed in diatom community structure over time and what this could tell us about the rate of succession and the amount of time needed for the climax community to be established. An overall trend in succession trajectory toward the climax community at the GBWMB was observed, but disturbances such as Hurricane Ike and recent drought have also produced distinct signals. Water entering the GBWMB comes primarily from overflow of nearby bayous and storm water run-off from both urban and forested areas within the larger Trinity River watershed. Changes in land use in the surrounding area, such as home construction that diverted one of the key bayous that contribute water to the bank, occurred throughout the length of the study. Storms were also shown to bring diatom species from estuaries south of the mitigation bank. What long-term impact these events have on the GBWMB are unclear from the observed trends. A survey of diatom communities in lakes, streams, and estuaries along the upper Texas Gulf coast is underway which will allow us to model the edge effects of each of these communities on the GBWMB. These models will contribute to our understanding of succession trajectory in the GBWMB, and provide insights into the impacts of land use changes on mitigation wetland projects in general.

Houston, Taylor.
Authors: [1]Houston, T., [1]Houston, D. and [1,2]Fushille, P.
[1]7eco10, Dripping Springs, TX
[2]Travis County, TX
Contact: taylor.houston@7eco10.com

Don't Be a Vector: Practical Biosecurity Standard Operating Procedures to Prevent the Spread of Invasive Species

Vehicles, equipment, clothing, and gear can be pathways for invasive species introductions. As we execute management activities, monitoring surveys, and restoration plans in damaged and degraded wildlands, conservation professionals can act as vectors for introductions to and from other locations. Further, restoration activities typically occur when a site is more susceptible to species invasions. Therefore, we must recognize that good intentions of building ecological resiliency must also include due diligence to remove as many species as possible from introduction pathways. The first part of this paper provides an overview of the invasion process, vector (or pathway) analysis, the Hazard Analysis Critical Control Point (HACCP) planning tool, and common sense best management practices adapted for upland southwestern sites. Project owners and their consultants can use these tools to better protect lands and incorporate protocols into statements of work for contractors. The second part of this paper provides checklists for specific vehicles and equipment typically used on rangelands. With the simple application of pressurized water and air, potentially invasive species can be removed from introduction pathways prior to arrival to a target site.

Jackson, Chris
Authors: [1]Jackson, Chris D., [2]Powell, A. Michael, and [1]Warnock, Bonnie J.
[1]Department of Natural Resource Management, Sul Ross State University, Alpine, TX
[2]Department of Biology, Sul Ross State University, Alpine, TX
Contact: cjackson2@sulross.edu

The Relocation of a Population of *Plateilema palmeri* (A. Gray) Cockrell (Asteraceae), in Brewster County, Texas.

Plateilema palmeri (A. Gray) Cockrell is a little understood and infrequently documented species of the Composite family. This species has not been observed in the USA since 1929, when two specimens were collected by Henry T. Fletcher in central Brewster County, Texas. Within the past 85 years, few locations have been documented in the states of Coahuila and Nuevo León, Mexico, yet the presence of *P. palmeri* has remained undocumented in Brewster County since Fletcher's find. On 12 August 2014, Sul Ross State University graduate student Chris Jackson, relocated a small group of individuals growing within an long-term grassland restoration site, approximately 40 miles south of Alpine, Texas. Identification of the specimen was verified by Dr. A. Michael Powell, Distinguished Professor Emeritus and Director of the Sul Ross State University Herbarium. On a following field outing to the relocation site, flowering buds were collected by Dr. A. Michael and Shirley Powell to determine the chromosome number. Analysis revealed an identical chromosome number to the population in Mexico, **2*n* = 13 II**. Continuing field studies by Mr. Jackson, Dr. A. Michael and Shirley Powell, and Dr. Bonnie J. Warnock have documented several additional groups throughout similar habitats within these desert grasslands. Voucher specimens have been deposited at the Sul Ross State University Herbarium in Alpine, Texas. Mr. Jackson is currently proposing a biological study of *P. palmeri* to meet the requirements of his Master's thesis.

Janke, Thomas S.
Authors: [1]Janke, T. S., [1]Harveson, L. A., and [2]Hernández, F.
[1]Borderlands Research Institute, Sul Ross State University, Alpine, TX
[2]Texas Parks and Wildlife Department, Alpine, TX
Contact: tjanke@sulross.edu

An Overview of Texas Bighorn Restoration Efforts

In the late 1800s, there were believed to be 1,500 desert bighorn roaming throughout 16 mountain ranges in the Trans-Pecos region of Texas. By the early 1960s, the last of the native bighorn were believed to be extirpated from the state. Starting in 1957, restoration efforts began with the capture and transport of desert bighorn from Arizona back into Texas. Throughout the next 40 years, a total of 146 desert bighorn were captured from Nevada, Arizona, Utah, and Mexico and released in Texas brood facilities. Populations grew within the enclosures and excess individuals were liberated to the open mountain ranges. In the last 4 years, 246 bighorn have been captured from free-ranging bighorn populations in Texas and released into 3 uninhabited mountain ranges. Recent milestones in Texas bighorn restoration efforts include: releasing bighorn in a state park for the first time; translocating the 500th bighorn born and raised in Texas; and the release of the 700th bighorn into Texas since 1957. In less than 60 years, with the help of numerous individuals and organizations, bighorn have been restored to 7 of their 16 historic mountain ranges and recent population estimates put their numbers at approximately 1,200 individuals.

Karklins, Ingrid.
Authors: [1]Karklins, I., [2]Moore, G. W., and [3]Kruse, D. A.
Ecosystem Science and Management, Texas A&M University
[1]Candidate, Bachelors of Science in Ecological Restoration
[2]Associate Professor
[3]Curator, S. M. Herbarium
Contact: ingrid.karklins@gmail.com

Post-Fire Response of Understory Bryophytes in Association with Vascular Plants in the Lost Pines Ecosystem of Central Texas

Bryophytes, which are usually early-responders to disturbance, have generally not been included in post-fire vascular plant research and may be an important element in the fire-recovery process. This study expands the work of past studies of forest succession after fire by combining vascular and non-vascular community fire-response interactions in a comprehensive evaluation of understory response to the Bastrop Fires of 2011. Approximately two years after the fire, I quantified herbaceous and non-vascular plant cover in both heavily burned and unburned riparian and upland areas in two adjacent watersheds of the unique Bastrop Lost Pines Ecosystem to identify recognizable post-fire plant assemblage patterns. I also measured soil moisture and estimated ground cover percentages of litter, bare ground and rock. Results demonstrate clear differentiation in species presence. Vascular plant species diversity and abundance was higher in burned areas while bryophyte presence in burned areas was primarily restricted to a limited number of early disturbance species. In unburned areas, bryophyte diversity was high while vascular plant diversity and abundance was low. Burned areas had low bryophyte diversity but were dominated by both vascular and non-vascular species commonly associated with disturbance. A significant finding is that soil moisture was higher in burned areas than unburned areas. Litter cover was not found to inhibit groundcover species regeneration, however litter composition and thickness may have an influence. Results of this study offer inferences into interactions between bryophytes and vascular plants and the role these interactions play in ecosystem recovery processes.

Lightfoot, David.
Authors: Lightfoot, D., Stropki, C., Amato, V., and Russell, A.
SWCA Environmental Consultants, Albuquerque, NM
Contact: dlightfoot@swca.com

Forest Watershed Tree Thinning Restoration Effectiveness Monitoring in the Manzano Mountains of New Mexico

SWCA Environmental Consultants developed and implemented a forest thinning monitoring study to evaluate the effectiveness of forest thinning projects in the Manzano Mountains in New Mexico. The purpose of the forest thinning projects is to restore forest stands to more natural and sustainable tree densities, improving watershed health and surface water yield, and to reduce the potential for high severity wildfire. The principal goals of forest thinning monitoring are to evaluate the effectiveness of standard prescribed forest thinning on soils, hydrology, water yield and quality, vegetation, and wildlife. The experimental restoration effectiveness monitoring study is being conducted at two piñon/juniper and two ponderosa pine sites, in the same areas as actual thinning projects. The experimental monitoring study utilizes paired thinning treatment and adjacent non-treated control sites, on adjacent small watersheds, 3-5 acres in size. A variety of parameters are being measured, representing soil, hydrology, vegetation (both woody and herbaceous), and wildlife. The 8 study plots were measured from 2008-2010 for 3-years of baseline data, and forest thinning treatments were imposed during the winter of 2010/2011, with post-treatment measurements for three years in 2011-2013. The monitoring results are revealing that tree thinning treatments increase soil moisture, herbaceous vegetation cover, and water yield, but do not result in increased soil erosion. Little to no differences were found in rodent, bird and other wildlife abundance and composition.

Margo, Michael R.
USDA-NRCS, Marfa, TX
Contact: michael_margo@TX.usda.gov

Using Ecological Site Descriptions for Rangeland Restoration

An ecological site is a conceptual landscape division defined by recurring soil, landform, geological, and climate characteristics. A site produces distinctive kinds, amounts, and proportions of vegetation and responds similarly to management actions and natural disturbances. Ecological sites are the fundamental units for inventorying, monitoring, and managing rangelands. Ecological site descriptions (ESDs) are the document that applies the concepts to a particular piece of land in a management context. ESDs provide a repository of the best available information for landowners and managers, restoration ecologists, and others to develop plans and implement practices to achieve conservation goals. Most importantly, ESDs provide users with the range of possibilities within a site. This presentation will define the ecological site concept, outline steps involved in their development, and emphasize their values for rangeland management, specifically rangeland restoration.

McIntosh, Leah M.
Authors: McIntosh, Leah M. and Fierro-Cabo, Alejandro.
University of Texas at Brownsville
Contact: Leah.McIntosh112@utb.edu

Indicators of Ecosystem Development in Resaca Restoration Based on the Macroinvertebrate Community

Freshwater wetlands in the Lower Rio Grande Valley of Texas are locally known as resacas. Resacas are remnants of the Rio Grande River channel that were cut off by sedimentation and erosion of river banks. Many are maintained as permanent wetlands through intermittent water pumping from the river; and provide valuable habitat for fish, invertebrates, migratory birds and a diverse floral community in the semi-arid environment of South Texas. Three resacas in different stages of ecosystem development were studied, including one from day zero after re-flooding. The objective was to document the macroinvertebrate community to differentiate successional stages of the studied resacas. Results indicate that environmental factors (i.e. water, sediment) varied little between resacas, but there were significant differences in the biotic community among the sites studied. The most developed site exhibited the lowest diversity and richness, and the highest dominance. The intermediate site exhibited the greatest diversity and richness, and a low level of dominance. The new site fell between the other two, but was most similar to the intermediate site. Composition of the functional feeding groups does not follow expected trends within this community, but is still a useful metric for differentiating the study sites. Each of the sites was characterized by different invertebrate taxa. Similarities were primarily driven by tubificid worms within the new site, chironomidae within the intermediate site, and gastropods within the old site. Based on the results of this baseline study, the invertebrate community can be used to discriminate between successional stages of resacas.

Misztal, Louise.

Authors: [1]Misztal, Louise, [1]Campbell, C., [1]Morris, C., [2]Stevens, L., and [2]Ledbetter, J.
[1]Sky Island Alliance, Tucson, AZ
[2]Springs Stewardship Institute, Flagstaff, AZ
Contact: louise@skyislandalliance.org

Inventorying and Restoring Springs in the Sky Island Region: New Tools for Mangers

Springs are keystone ecosystems in the Sky Island Region, exert disproportionate influence on surrounding landscapes, and are known to be biodiversity hotspots. Although they are abundant in this arid region, they are poorly documented and suffer from extensive human modification. Lack of information on their location, management context, and biological, hydrological, and ecological characteristics hinders effective stewardship and restoration of springs. Furthermore, guidance on restoration options, techniques, compliance needs, conservation targets, and other considerations does not exist for springs in Arizona.

Over the past three years, Sky Island Alliance has been working to develop new information on the biological and management status of springs in the Sky Island Region. We employed a combination of expert and citizen science inventories and ecological assessments to collect data on spatial location, ecological threats, restoration potential, and the biological, hydrological and geomorphological status of springs. Data collected is now available online regionally and internationally through the Springs Inventory Database (springsdata.org). This database provides a landscape level context for making management decisions and is a tool to identify high priority restoration sites.

To address restoration for springs, Sky Island Alliance is working with the Spring Stewardship Institute to develop a restoration guidebook for springs in Arizona. The guidebook will draw on the Springs Inventory Database, local expertise, and case studies to provide decision support for practitioners seeking to restore springs ecosystems. We have conducted two workshops with managers and experts in order to develop the guidebook and will be conducting a third workshop in 2015.

Nokes, Jill.
Hill Country Land Trust, Fredericksburg, TX
Contact: jill@jillnokes.com

An Art and a Science: How Can Researchers Better Influence Landowner Stewardship Practices?

Landscape-scale restoration projects are difficult to achieve in a state like Texas, where over 95% of the property is privately owned. In the Edwards Plateau, various agencies, including Texas Agri-Life, the NRCS, TWA, and the Texas Forest Service, regularly offer a variety of seminars, workshops, and webinars on land management and related stewardship topics, yet it's hard to know to what degree this information actually influences the way people perform on the ground. There are also several cost-sharing programs available to landowners to assist with conservation projects. However, the guidance provided with these programs is often inconsistent, and follow up or monitoring is not included. The result is a pervasive "information fragmentation" that limits the potential of increasing the number of private properties linked together through best management practices, which in turn could provide a bigger benefit to watersheds, habitats, and range productivity. How can researchers, professionals, organizations, and experienced landowners reach across separate disciplines and obligations to collaborate on more effective ways to share information and track results of conservation projects on private land?

Jill Nokes and her family have received three grants from two agencies for conservation projects on their property in southwest Llano County. Her description of the experience of working with various agencies on these projects will launch a discussion that explores ways researchers can more directly influence landowners in the planning, design, and outcome of site specific conservation projects.

Norman, Laura M.
United States Geological Survey, Western Geographic Science Center, Tucson, AZ
Contact: lnorman@usgs.gov

Hydrologic Investigations of Rock Detention Structures

Rock Detention Structures (RDS), including loose-rock dams constructed across a drainage ditch or channel (check dams), and stationary groupings of rocks encased in wire mesh (gabions) are used to enhance soil and water conservation in riparian zones throughout the southwestern United States. Goals for installing these features are to detain rainwater-runoff, and in doing so increase infiltration and improve recharge, increase surface water and soil moisture for plants and animals, and reduce fluvial erosion, thereby stabilizing soil and preventing downstream transport. Working with partners, RDS are being installed and monitored for progress and success rates over time. Research includes field monitoring to document the hydrological impacts and identify sites for future installation. Satellite imagery is used to monitor changes in vegetation greenness over time. Geospatial watershed, erosion and hydrology models are being used (with Terrestrial LiDAR datasets) to model changes in surface flow, infiltration, and sediment build-up at new check dams and detention features. We have also modified a stream gaging mechanism to create hydrographs for calibrating models of various scenarios and long-term predictions. This presentation will describe some of my research to qualify and quantify how RDS can support stream restoration goals and discuss some preliminary results.

Peace, Annalisa.
Authors: [1]Roos, Marita and [2]Peace, Annalisa.
[1]UrbanBiology, LLC, Annapolis, MD
[2]Greater Edwards Aquifer Alliance, San Antonio, TX
Contact: annalisa@aquiferalliance.org

Edwards Aquifer Region of South-Central Texas: Unique Challenges and Solutions for LID Implementation

Watershed Stewardship for the Edwards Aquifer Region: A Low Impact Development Manual, *2014*, is a booklet targeting developers and planners who wish to implement development stewardship practices within the Edwards Aquifer region. The unique physical challenges and regulatory environments of the Edwards and Trinity Aquifers have slowed the development of LID practices, which have begun to take hold elsewhere in central Texas. The manual is a resource designed to promote the use of LID across this sensitive region, proposing a set of practical, LID-based applications that will treat stormwater at the source and maintain aquifer integrity at each developed site. Utilizing current scientific research, pertinent regulations and vegetation and water management practices, the manual outlines practices that restore sites and aid in aquifer recharge.

Reemts, Charlotte.
Authors: [1]Reemts, C. and [2]Poulos, H.
[1]The Nature Conservancy, Austin, TX
[2]Wesleyan University, Middletown, CT
Contact: creemts@tnc.org

Fuel Treatments Reduce Wildfire Severity in Sky Island Pine Woodlands

Sky islands are cool, moist mountains surrounded by a desert "sea". The sky islands in Texas have vegetation similar to the large mountain ranges to the north and south, but are mostly isolated from those ranges. Vegetation types include pinyon-juniper woodlands and ponderosa pine woodlands. In 2011 and 2012, three major wildfires burned across the Davis Mountains, including The Nature Conservancy's Davis Mountains Preserve. Prior to the wildfires, preserve staff had implemented fuel treatments (thinning and prescribed fire) in some parts of the preserve. We used pre- and post-wildfire monitoring data to show that all fuel treatments reduced wildfire severity (as measured by tree mortality). However, even in unburned areas, tree mortality was high, likely due to overcrowding, drought, insect outbreaks, and unusually long freezes. Continued management will be necessary to reduce tree density to pre-fire exclusion levels.

Ritzi, Chris.
Authors: [1]Ritzi, C. M., [1]Hilscher, A. M. and [2]DeLoach, J.
[1]Department of Biology, Geology, and Physical Sciences, Sul Ross State University, Alpine, TX
[2]Retired-USDA-ARS, Temple, TX
Contact: critzi@sulross.edu

Impact of Saltcedar Biological Control Along the Río Grande on Saltcedar and Athel.

The control of the exotic saltcedar (*Tamarix chinensis* and *T. ramosissima*) throughout the southwest is an area of concern for conservationists. In an attempt to control this plant by biological means, several species of tamarisk leaf beetle (*Diorhabda* spp.) have been approved for release in the United States by the USDA. Two species of leaf beetles have become established along the Río GrandeRiver in Texas, with one (*D. sublineata*, the tropical tamarisk beetle) dominating the biocontrol efforts in the region. While studies prior to release indicated that saltcedar was the primary preferred host for forage and reproduction, observations indicated that leaf beetles were capable of feeding and egg-laying on a sister taxa, the athel (*Tamarix aphylla*). Although athels are exotic, they are more widely accepted and are grown for shade and windbreaks. Beetles initially were released in various sites along the Río Grande in 2006, but active establishment did not occur until 2010. Since this time, defoliation has been observed across the region on both saltcedar and athel species. Beetle populations declined in number during the 2012 season, but defoliation of saltcedar remained consistent. After a disappearance of beetles during the early 2014 monitoring season, beetles have been observed to have returned to the study area and are renewing defoliation. Continued monitoring of saltcedar and athel is underway to determine dispersion and impact of the leaf beetles.

Shackelford, Colin.
Authors: Shackelford, C., Pawelek, K., Falk, A., Crumpler, J., and Smith, F.
Caesar Kleberg Wildlife Research Institute, Texas A&M University, Kingsville.
Contact: colin.shackelford@tamuk.edu

Evaluation and Development of Native Seed Sources for West Texas

The West Texas Native Plant Materials Initiative was organized under the *Texas Native Seeds* Project of the Caesar Kleberg Wildlife Research Institute at Texas A&M Kingsville in 2010 as a partnership with the Borderlands Research Institute at Sul Ross State University.

Our mission is to develop native ecotypic seed sources for restoration activities in the Trans Pecos, Chihuahuan Desert, western Edwards Plateau, and adjacent regions. At present, only one high quality, locally-adapted native seed source appropriate for use in these regions is commercially available. Our goal over the next decade is to develop 15+ regionally-adapted ecotypic seed sources for restoration work in West Texas.

Over 660 collections have been made from a target list of 38 grasses and 52 forbs across 37 counties in West Texas. These collections are the foundation for the evaluation and selection of ecotypic native plant materials for commercial scale production.

Presently three species are in the second year of evaluation at the Sierra la Rana Plant Material Evaluation and Research Facility just south of Alpine, TX, with an expected commercial seed release in fall 2015. Six additional species are in the first year of the two year evaluation process with an expected release date of late 2016.

A second evaluation site is being developed in Upton County just south of Odessa, TX. This facility will allow for multiple evaluations across different climate and soil environments. The Upton County site will be more representative of the climate and soils found on the western Edwards Plateau, the southern Rolling Plains, and the southern High Plains ecoregions of Texas. Infrastructure development is being completed with the first evaluation plantings expected in spring, 2015.

Shultz, Kristen and Ann Adams.
Authors: Lyons, K., Kwessi, E., Shultz, K., and Adams, A.
Integrated Research in Biomathematics (IRBM) Program, Trinity University, San Antonio, TX
Contact: kschultz@trinity.edu or aadams@trinity.edu

Modeling the Competitive Dynamics Between Native and Invasive Grasses Under Varying Light Conditions

The C_4 grass King Ranch bluestem (Bothriochloa ischaemum*;* hereafter referred to as KR) was originally planted throughout much of Texas to restore degraded rangeland; however, the species has since become an invasive pest for ranchers and private landowners. Widespread attempts have been made to reduce the species' abundance through application of herbicides, mechanical removal, and prescribed fire. Nonetheless, following removal, KR often returns and there is growing interesting in the use of native grassland species restoration as post-removal biocontrol. Competition theory suggests that species coexistence is enhanced through niche partitioning and that species with overlapping use for limiting resources will be in higher competition. Therefore, we hypothesize that species whose niches overlap with KR will be the most effective at controlling the species. Here we use niche theory to assess the mechanism of competition between KR and two native grass species at the seedling stage under low and high light conditions. We employ a two-way factorial growth chamber experiment with species composition and light condition as factors. KR bluestem and two native grasses used widely in rangeland restoration, sideoats grama (Bouteloua curtipendula) and little bluestem (Schizachyrium scoparium), were grown in competition from seed in 100:0, 50:50 or 0:100 ratios. Once germinated and established, the seedlings were exposed to one of two light conditions (300 or 1000 µmoles). Growth rate data were collected and applied to a modified version of Carroll et al.'s model published in Ecology in 2011. This model defines niche difference and relative fitness difference as a function of sensitivity, or the proportional reduction in growth rate due to interspecific competition. Our ultimate goal is to use this model to predict the future competitive dynamics between our focal native and invasive grasses under varying resource availability.

Stone, John.
Authors: Stone, J., and Ritzi, C.
Department of Biology, Sul Ross State University, Alpine, TX
Contact: jtstone.tamu@gmail.com

Utilizing Hunter Harvest for Disease Surveillance

Surveillance of wildlife diseases is an important problem that faces wildlife managers. Emerging diseases are frequently zoonotics emerging from wildlife reservoirs. These diseases can have impacts on human populations, livestock, agricultural interests, ecological processes and biodiversity. To be better prepared for these diseases when they emerge, proper surveillance protocols must be created and implemented. One concept of importance is the use of sentinel species in disease surveillance. Sentinel species are species that can be monitored for potential problems, and one group that has been studied as a possible sentinel species for disease surveillance are canines. Coyotes (*Canis latrans*) are ubiquitous in the United States, and their role as a mesocarnivore provides many opportunities for exposure to pathogens. In addition, coyotes are commonly hunted for depredation efforts and sport. This harvest is a largely unexploited resource for wildlife research. I have been successful in obtaining samples for a serologic survey of the Marfa Plateau by working with coyote hunting groups and believe that this type of resource could prove invaluable in studying diseases across the country. The information gained from harvest data can be used to better make management decisions and better manage our natural resources.

Stropki, Cody L.
Authors: [1]Stropki, Cody L. and [2]Kauffman, Aaron.
[1]SWCA Environmental Consultants, Albuquerque, NM
[2]Southwest Urban Hydrology, NM
Contact: cstropki@swca.com

Hillslope and Channel Restoration of Ox Canyon Following the 2007 Ojo Peak Wildfire

Ox Canyon is located on United States Forest Service Lands in the southern end of the Manzano Mountains in Central New Mexico. This drainage is a high elevation drainage (8,000 feet) defined by intermittent flow and numerous springs that provide year-round pools and riparian habitat. In November 2007 the Ojo Peak Fire burned approximately 7,000 acres of ponderosa pine and mixed conifer forest, including the upper watershed of Ox Canyon. This fire left steep, denuded hillslopes prone to severe erosion during high intensity summer thunderstorms. Following the fire the channel in Ox Canyon incised by as much as four feet after large precipitation events. Of particular concern was that the channel erosion might have dropped the water table in critical areas around springs, potentially leading to their desiccation and loss of riparian habitat. In an effort to stabilize approximately 1,000 feet of channel–below Forest Service Road 422–over 20 structures aimed at mitigating upland and channel erosion were installed in the fall of 2013 and followed up with the planting of native willow whips (*Salix sp.*) in the early spring of 2014. The project was collaboratively implemented by SWCA Environmental Consultants, Southwest Urban Hydrology, and Claunch-Pinto Soil and Water Conservation District.

Sun, Xiangmin.
Authors: Sun, X., Sheridan, R., and Popescu, S.
Department of Ecosystem Science and Management, Texas A&M University, College Station, TX
Contact: sunxm03@tamu.edu

Pine-Hardwood Classification with LiDAR-Derived Canopy Data and Multispectral Image for Mixed Forest in Huntsville, TX

Remote sensing has innovated and reshaped many traditional forestry investigation methods. Light detection and ranging (LiDAR) and high resolution imagery has been combined and utilized to extract many forest inventory data, such as biomass, fuel assessment, tree height, and land cover classification. Height bins (voxel) method to extract height points information within different height range from LiDAR point cloud is a promising tool to mine canopy structure information for tree species identification. We utilized canopy density for every cell within different height bins and general height statistic parameters from LiDAR and imagery and texture information from National Agricultural Imagery Program (NAIP) to differentiate pine and deciduous in a mixed forest in southeastern U.S.. The Principal Component Analysis (PCA) method was utilized to find the correlation among these bands, and then decision tree method was applied to do classification based on PCA bands. The PCA result shows that there was no significant correlation between these bands, and the first Principal Component (PC) and first 5 PCs only accounted for less than 50% and 80% of the total variance, so the classification accuracy based on these PCs is satisfactory in limited extent. The differentiation between pine and deciduous was not much satisfactory due to sparse distribution of deciduous and loose correlation between the original bands. This project examined the correlation between LiDAR-derived canopy structure information and NAIP-derived spectral information; found that this less correlation could prompt more advanced choice of LiDAR and spectral information to differentiate pine and deciduous based on further physical investigation. So there is merit in including variables within height-bins for tree species classification.

Terry, Martin.
Authors: [1,2]Terry, M, [2]Williams, B., [3]Herrera, T., and [2]Trout, K.
[1]Department of Biology, Geology and Physical Science, Sul Ross State University, Alpine, TX
[2]Cactus Conservation Institute, Alpine, TX
[3]Native American Church of the Rio Grande, San Antonio, TX
Contact: mterry@sulross.edu

The Current Predicament of the Bordas Escarpment —
Ways and Means of Restoring Peyote Habitat in South Texas

Lophophora williamsii (peyote) has been in acute decline as a species for at least two decades in the Tamaulipan Thornscrub of South Texas. Two major causes of the decline are (a) habitat conversion to agricultural and urban uses not compatible with the maintenance of peyote populations and (b) overharvesting for legally protected sacramental use by American Indians, in the areas of viable habitat which remain. While the changes in land use are generally difficult to prevent and impossible to reverse, the decimation of peyote populations located in suitable habitat could clearly be mitigated by adequate human intervention. The latter could logically take the form of cultivation of peyote in greenhouses in which production could be scaled up to the point where cultivated peyote would take the place of wild-harvested peyote. An alternative mode of cultivation, often referred to as wildcrafting, could take place in current or historical peyote habitat, where greenhouse-raised seedling peyote cacti would be re-integrated into their known natural habitat by a process describable as “reverse harvesting”. This form of "repopulation" or “restocking”, in order to be effective in degraded habitat, would have to be accompanied by augmentation/reintroduction of particular plant species considered to be important for the optimal growth of peyote. Several such “companion” plant species, such as *Acacia* and *Leucophyllum* species, are identified and their supportive roles discussed in the context of ecological restoration of peyote habitat.

Vela, Jennifer L.
Authors: [1]Vela, J.L., [1]Alexander, H.D., [2]Moczygemba, J., and [1]Fierro-Cabo, A.
[1]Department of Biological Sciences, University of Texas at Brownsville
[2]Laguna Atascosa National Wildlife Refuge, Los Fresnos, TX
Contact: jlsunderland@hotmail.com

Alternative Restoration Treatments to Maximize Growth and Survival of Tamaulipan Thornscrub Species During Seedling Establishment

Anthropogenic activities that destroy, degrade, or fragment terrestrial ecosystems can have long-lasting detrimental impacts on ecosystem function, services, and biological diversity. The Tamaulipan thornscrub ecoregion of south Texas and northeastern Mexico has sustained considerable loss, degradation, and fragmentation due land conversion for agriculture and ranching, rapid urbanization, and introduction of invasive flora and fauna. In an attempt to restore habitat for endangered and migratory animals, United States Fish and Wildlife Service has undertaken a large-scale thornscrub revegetation effort at Laguna Atascosa National Wildlife Refuge. The primary goal of this study is to develop effective and efficient restoration techniques for ensuring growth and survival of Tamaulipan thornscrub species during seedling establishment. Over a 1-year period, beginning in March 2014, our study will assess the effects of pre-planting burning, seedling shelter tubes, and planting density (high - 0.5 m^2, medium - 1.0 m^2, and low - 2.0 m^2) on seedling height, basal diameter and survival in relation to percent cover of surrounding invasive grasses and severity of browse. We focus on three thornscrub species, Texas ebony (*Ebenopsis ebano*), narrow-leaf elbowbush (*Forestiera angustifolia)*, and spiny hackberry (*Celtis pallida*), representative of the natural vertical organization of vegetation in these ecosystems. We expect that seedling growth and survival rates will increase with the use of seedling shelter tubes, pre-planting burning, and high stand density. A key knowledge gap will be filled by providing data to aid land managers in adjusting current restoration practices for preparing and planting thornscrub in degraded habitats.

Watson, Parker
Authors: [1]Watson, P. A., [1]Alexander, H. D., and [2]Moczygemba, J.
[1]The University of Texas at Brownsville
[2]U.S. Fish and Wildlife Service, Laguna Atascosa National Wildlife Refuge, Los Fresnos, TX
Contact: Parker.Watson129@utb.edu

The Effects of Shrub Encroachment and Shrub Removal Methods on South Texas Coastal Grasslands

Coastal grasslands in South Texas are experiencing aggressive shrub encroachment by honey mesquite (*Prosopis glandulosa*) and huisache (*Acacia farnesiana*). This regime shift from grassland to shrubland may have irrevocable implications for ecosystem function, including changes in hydrology, nutrient cycling, biodiversity, and habitat. The purpose of this study is to first determine if increased shrub cover can lead to changes in understory microclimate across a density gradient. Hobo data loggers and iButtons were deployed in April 2014 in high, medium and low density shrub stands to record understory soil temperature, air temperature, and light for sixteen months. The data are expected to show that shrub understory microclimates differ from pure grass cover microclimates, suggesting a shift from the natural state with implications for grass colonization and growth. The second part of this study assesses the relationship between the grassland's resiliency, the use of different shrub removal methods (mechanical, prescribed fire, and herbicide, used singly or in combination), and shrub density prior to removal. Four experimental blocks were established in areas that utilized different shrub removal methods. Small, medium, and large bare patches, indicative of shrub density prior to removal, were marked within each block and replicated three times. Vegetation and soil conditions were monitored along cross-hair transects within each bare patch every four months beginning in May 2014. Plots treated with mechanical removal, prescribed fire and herbicide are expected to have the greatest regeneration of desired vegetation, suggesting the most efficient means for grassland rehabilitation and management.

Wojda, Matthew.
Authors: [1]Wojda, M.N., [1]Fulbright, T.E., [1]Hernández, F., [1]Wester, D.B., [1]Grahmann, E.D., [1]Smith, F., and 2Hehman, M.
[1]Caesar Kleberg Wildlife Research Institute, Department of Animal and Wildlife Sciences, Texas A&M University, Kingsville
[2]Hixon Ranch, Cotulla, TX
Contact: mwojda123@gmail.com

Large Scale Restoration of Northern Bobwhite Habitat on a Rangeland Dominated by Non-Native Grasses

The introduction of non-native grasses into south Texas has dramatically changed the landscape. Species such as buffelgrass (*Pennisetum ciliare*) and Old World bluestem
(*Dicanthium annulatum*) can reduce plant species richness, degrade wildlife habitat, and disrupt natural nutrient cycling where they dominate. There have been many studies on the negative effects of these invasive species but few studies have focused on the restoration of degraded wildlife habitat in areas where these grasses have become dominant. The objective of our study is to determine the effectiveness of restoring a 120 ha pasture dominated by buffelgrass and Old World bluestems with native vegetation for wildlife on a private ranch in La Salle, County, Texas. Using methods found successful from pilot studies we are repeatedly discing the area until we deplete the seed bank of non-native grasses. Following the discing events the area will be seeded to a diverse mixture of ecotypically adapted native grasses and forbs. Vegetation community, soil nutrient, and soil seed bank characteristics are being documented throughout the restoration process. We will determine plant community composition and soil seed bank composition before and after restoration.

Wood, Troy.
Authors: [1]Wood, Troy E., [2]Bowker, Matthew A., and [2]Doherty, Kyle.
[1]U.S. Geological Survey, Southwest Biological Science Center, Flagstaff, AZ
[2]Northern Arizona University, Flagstaff, AZ
Contact: twood@usgs.gov

Development of Native Plant Materials for the Colorado Plateau

The Colorado Plateau Native Plant Program was established to increase the availability of genetically appropriate native plant materials for use in seeding treatments. A key step in this process is characterizing eco-genetic diversity within a target species so that this diversity can be maintained during development and matched to site at use. As an example, we will present a common garden analysis of ecological differentiation among blue grama grass (*Bouteloua gracilis*) populations sampled from across the Colorado Plateau, and its implications for developing seed lines of this species. Next, we will discuss our Program's work on cultivation, establishment, and ecology of biocrusts, which are a crtiical component of most Plateau ecosystems. These research elements will be placed in the broader context of the Program's ultimate goal of restoring native plant communities that are resilient to historical and novel stressors.

Posters

Brown, Larrimy.
Biology Department, University of Texas at Tyler.
Contact: lbrown29@patriots.uttyler.edu

Molecular Phylogenetics of North American Ribbonsnakes

The eastern (*Thamnophis sauritus*) and western (*T. proximus*) ribbonsnake are currently distinguished solely on morphology (e.g. coloration) and geographic distribution. Both species also currently include multiple subspecies defined on similar grounds. We used mtDNA sequencing and molecular barcoding data to determine if the two currently recognized species and their respective subspecies can be supported using molecular phylogenetic analyses. Our results indicate that 1) the eastern and western ribbonsnakes are separate species, 2) the four eastern subspecies are supported by our analysis, 3) the five western subspecies are not supported by our analysis. The lack of genetic differentiation in the western ribbonsnake may result from intensive hybridization.

Clark, Nora.
Authors: Clark, N., Lowery, S., and Ingraldi, M.
Arizona Game and Fish Department, Flagstaff, AZ
Contact: nclark@azgfd.gov

Monitoring the Pulse of Wetland Restoration in Arizona: Arizona Game and Fish Department In-Lieu Fee Restoration Program

The Arizona Game and Fish Department in collaboration with the Army Corps of Engineers is implementing an In-lieu Fee Wetland Restoration Program. This program is designed to offset injures to jurisdictional waters and in the process enhance and protect wetlands systems delineated in Arizona. In order to evaluate and make predictions on future management needs within our restoration project areas, we employ a monitoring regime that improves our understanding of the ecological systems using an adaptive management framework. Monitoring data is used to establish measurable objectives (desired conditions) for restoration efforts and track the progress of these efforts. This robust program consists of a three phase monitoring regime: (1) baseline, (2) five year post-restoration and (3) long-term effectiveness. Herein, we describe the details of the monitoring approach and provide an example of a monitoring project that is in progress.

Dunagan, Lawson.
Authors: [1]Dunagan L., [1]Garrison, T.O., [1]Harveson, L.A., [1]O'Shaughnessy, R., and [2]Gray, S.S.
[1]Borderlands Research Institute for Natural Resource Management, Sul Ross State University, Alpine, TX
[2]Texas Parks and Wildlife Department, Alpine, TX
Contact: lawdun@live.com

Pronghorn Restoration in the Trans-Pecos: The Importance of Fence Modifications

Since the introduction of domesticated live-stock and fences to the Trans-Pecos area, a steady decrease in the Pronghorn (Antilocapra americana) population has occurred. Fences, especially net wire fencing pose a huge barrier in the natural movements for pronghorn. Pronghorn are concentrate selector feeders and during drought years, fences without modifications can confine the pronghorn to limited resources within an area, and at the same time make the pronghorn more vulnerable to predation. During past and present studies, in 2013 on the Marathon study site there were 55 fence modifications opening up 70,000 acres and in 2014 on the Marfa South-East study site 411 fence modifications opening up roughly 130,000 acres of pronghorn habitat, this is not including fences that have been replaced by pronghorn friendly fence by land owners or fence already accessible for movement. Incorporating connectivity is vital to pronghorn restoration efforts.

Grabau, Matthew.
Authors: [1]Grabau, M.R., [1]Hovland, L., [2]De Vor, B., and [3]Zamora, F.
[1]GeoSystems Analysis Inc., Tucson, AZ
[2]Greenheart Farms, Arroyo Grande, CA
[3]Sonoran Institute, Tucson, AZ
Contact: matt@gsanalysis.com

Direct Seeding and Seedling Production to Enhance Riparian Restoration

Several large-scale cottonwood (Populus spp.) and willow (Salix spp.) riparian restoration efforts are underway in the Southwest. Vegetative propagation is typically used to generate planting stock since these genera are easily established from cuttings. However, if source plants are not carefully selected, vegetative propagation can negatively impact genetic diversity, structural diversity, and sex ratios. Conversely, direct seeding can be used to improve diversity and reduce restoration costs. It had been speculated that a short window of viability for cottonwood and willow seed would make large-scale seedling or seedling production impractical, and seeding attempts prior to 2006 were largely unsuccessful. However, natural and assisted regeneration of riparian areas inspired a step-wise feasibility to develop reliable seeding practices. We found that seed viability can be extended to several years by freezing, which allows long-term revegetation coordination and flexibility in seeding dates. We completed direct seeding demonstrations at locations along the lower Colorado River in the United States and Mexico to show that direct seeding can be successful given favorable soil moisture conditions. We continue to work with restoration plant material providers to develop seedling propagation techniques with large-scale seed collection, treatment, and automated seeding for plant stock. We anticipate this method to become the principle production practice for this grower. Finally, by clearing vegetation and providing irrigation for moist soils, we have begun taking advantage of seedfall from planted or remnant vegetation to expand adjacent restoration sites.

Key, Kayla.
Authors: [1]Key, K., [2]Gluesenkamp, A., [2]Williams, M., [2]Banta, J., and [1]Placyk, J.S. Jr.
[1]The University of Texas at Tyler
[2]Texas Parks and Wildlife Department

Comparative Niche Modeling in Common Gartersnake (*Thamnophis sirtalis*) Subspecies.

The common gartersnake, *Thamnophis sirtalis*, is known for its extensive geographic distribution that ranges farther north than any other snake species in the Western Hemisphere and from the Atlantic Coast to the Pacific Coast of the USA. Given the wide geographical range of *T.sirtalis*, it often displays morphological characters that differ from one geographic range to the next and this has resulted in 11 subspecies being described. Although there is much information on the evolution, ecology, and life-history of *Thamnophis sirtalis,* as a species, information on specific subspecies can be vague or non-existent. In Texas, three of *Thamnophis sirtalis* subspecies (*T. s annectens*, *T. s. parietalis*, and *T. s. sirtalis sirtalis*) occur in relatively close proximity often times having range overlap. *T. s. annectens* was initially described in 1950 based on morphology and geographic distribution that differ from *T. s. parietalis* and *T. s. sirtalis*. No further work has been conducted to verify its taxonomic status or explore its specific habitat requirements. This information is pertinent to conservation efforts as *T. s. annectens* has recently been listed as state imperiled in Texas. By comparing ecological niche models for *T. s. annectens*, *T. s. parietalis*, and *T. s. sirtalis*, we can examine the different environmental variables that may be important to each subspecies and explore the potential use of niche modeling as a tool for species delimitation.

Lowery, Shawn.
Authors: Lowery, S., Ingraldi, M., and Clark, N.
Arizona Game and Fish Department, Flagstaff, AZ
Contact: Slowery@azgfd.gov

Arizona Game and Fish Department's In-Lieu Fee Restoration Program

The Arizona Game and Fish Department in collaboration with the Army Corps of Engineers is implementing an In-lieu Fee Wetland Restoration Program. This program is designed to offset injures to jurisdictional waters across Arizona. We are designing and implementing a management and monitoring wetland restoration program using an adaptive management framework to create, enhance and protect wetland systems throughout Arizona in perpetuity. As of April 2008, the Corps of Engineers, together with the Environmental Protection Agency (EPA), issued new national regulations ("Mitigation Rule") governing compensatory mitigation for activities, authorized by permits issued by the Department of the Army under Title 33 Code of Federal Regulations (C.F.R.) parts 325 and 332. The new Regional Compensatory Mitigation and Monitoring Guidelines provide direction in selecting appropriate compensatory mitigation sites and in preparing mitigation plans to compensate for unavoidable impacts to waters of the United States. Herein, we describe the state of Arizona's restoration activities implemented through our In-lieu Fee Wetland Restoration Program.

McKay, Michael.
Authors: [1]McKay, M., [1]Garrison, T., [1]O'Shaughnessy, R., [1]Harveson, L.A., and [2]Gray, S.
[1]Borderlands Research Institute for Natural Resource Management, Sul Ross State University, Alpine, TX
[2]Texas Parks and Wildlife Department, Alpine, TX
Contact: Restlesscowboy78@aol.com

Pronghorn Fawn Survival in the Trans-Pecos Region of Texas

Historically, pronghorn (Antilocapra americana) populations in the Trans-Pecos region of Texas were healthy upon the first arrival of settlers to the area. After years of habitat fragmentation and overhunting, the population dropped from a high of 17,000 individuals in the 1980's to 5,200 as of the year 2000. Populations steadily declined 2011 when translocation efforts were initiated to restore and supplement pronghorn to region. Following these translocations, fawn survival studies helped to provide cause-specific mortality and recruitment data. Fawns were captured using the hoop-net method. Pronghorn were blindfolded and personnel measured new-hoof growth, neck circumference, body measurement, and equipped them with Very High Frequency collars. All precautions were taken to ensure fawn health and prevent mother abandonment of fawns. This required all equipment to be scented with creosote (Larrea tridentata) before and during captures. Time handling fawns was minimized to reduce stress. They were monitored daily for 30 days post-capture and then weekly until the collars fell off. With the exception of the current survey, annual increases are shown for not only survival rates, but birth rates of Pronghorn fawns as well. Initially, fawn mortality was measured at 92% in 2011 and only decreased slightly in 2012 to 85%. 2013 showed the most notable improvement at 50%; however the study for 2014 provided limited sample size presenting a high mortality rate. Pronghorn fawn surveys are an invaluable tool in measuring population numbers and restoring the species to a healthy level so they can relive historical population numbers.

Morris, Christopher.
Authors: Morris, Christopher and Avila, Sergio.
Sky Island Alliance, Tucson, AZ
Contact: christopher@skyislandalliance.org

Giving Birds a Lift in Northern Mexico: Habitat Restoration for Neotropical Migratory Species

More than 200 species of birds migrate seasonally each year between North America and the American tropics. Recent funding provided under the Neotropical Migratory Bird Conservation Act (managed by the U.S. Fish and Wildlife Service) ensured that overwintering and stopover habitat critical to these species' survival would benefit from ecological restoration. Located at a key location along the Pacific Flyway, creeks born from forested mountains rising above desert grassland (a.k.a. Sky Islands) in northwest Sonora, Mexico became the focus of this work.

Sky Island Alliance and our partners met with local ranchers in Sonora to discuss the shared vision of improving ecological conditions and water availability on working ranchlands. With the aim of improving the highest quality habitat available (riparian corridors dominated by willow, cottonwood and sycamore) we surveyed the ranches and prescribed treatments to include reforestation, erosion control and the installation of barbwire fencing to exclude livestock from certain sensitive areas. Prior to restoration efforts, technicians with the University of Montana surveyed select transects for vegetation structure via the Greenline method and also identified distinct bird species by sight and sound.

100+ volunteers invested more than 1,500 hours to plant 1,200+ Goodding's willow saplings. By restoring channels that had been cut off from a spring run, we also recreated a *ciénega* ("wet meadow" in Spanish). Eighteen kilometers of new fencing was installed to protect the riparian zones and, when combined with existing fence and topography, this resulted in over 25 linear kilometers and approximately 1,465 acres protected.

Mulkey, Leah.
Authors: [1,2,3,4,5]Mulkey, L., [1]Hinojosa, B., and [1]Hoge, B.
[1]University of Houston-Downtown
[2]National Science Foundation Noyce Teacher Scholarship Program
[3]University of Houston-Downtown Scholar's Academy
[4]Kappa Delta Pi
[5]International Golden Key Society
Contact: Leahm@texasmulkeys.com

Diatom Anomaly at the Greens Bayou Wetlands Mitigation Bank

Diatom community succession is currently studied at the Greens Bayou Wetland Mitigation Bank (GBWMB) in Harris County, Texas. The GBWMB is a man-made wetland built to replace destroyed wetlands and to provide flood control, protect water quality, and to both provide and protect fish and wildlife habitats. Diatoms are naturally occurring single cell organisms with silicate shells that are not artificially introduced to the GBWMB. The diversity and number of organisms collected in the death assemblage provide evidence of succession and the overall health and mitigation success of the wetland. This wetland has undergone many changes over the past ten years to reach stability in recent years. In 2007, there was a dramatic change in the number and types of organisms found in the death assemblage. The reason for this anomaly was determined to be caused by an influx of rain from two hurricanes, four marine genera brought to the bank by tidal surges of the hurricanes, and eutrophication due to construction of tributary waterways.

Pawelek, Keith.
Authors: Pawelek, K., Smith, F., and Falk, A.
South Texas Natives Project, Caesar Kleberg Wildlife Research Institute, Texas A&M University, Kingsville
Contact: keith.pawelek@tamuk.edu

Vegetation Restoration in the Eagle Ford Shale Oil & Gas Play

The Eagle Ford Shale oil and gas play (EFS) is one of the most significant oil and gas finds in the continental United States in the last 50 years. *South Texas Natives* is an eco-regional plant materials development and restoration initiative headquartered at the Caesar Kleberg Wildlife Research Institute at Texas A&M University-Kingsville. STN and its primary partner, the USDA NRCS E. "Kika" de la Garza Plant Materials Center (PMC), have co-developed 24 native plant germplasm seed sources in the last decade and a half. Most all of the EFS lies within the service areas of STN and the PMC, thus needs for restoration plant materials and appropriate native plant restoration techniques for the EFS rapidly began reaching us in 2008.

In order to identify the issues, we began experiments to quantify native plant restoration successes resulting from the common planting techniques used by industry, and to quantify the performance of various commercially available native plant seed sources developed by STN and the PMC. Projects were undertaken on active exploration and pipeline construction sites at 3 locations in the EFS area. We will present the results of these experiments, and present the challenges and benefits faced in this work and in garnering widespread adoption of the best restoration techniques by operators. While many successes have been achieved, significant future challenges exists, as do the likelihood of other emerging high-priority restoration research needs over the projected life of the EFS Play.

Phillippe, Austin and Elizabeth Van Horn.
Trinity University, San Antonio, TX
Contact: aphilli2@trinity.edu or evanhorn@trinity.edu

Assessment of Cedar (*Juniperus ashei*) Removal on Native Grassland Re-establishment in the Texas Hill Country

Fire suppression coupled with increased grazing pressure has resulted in an increased abundance of *Juniperus ashei* (Ashe's Juniper, a.k.a. "cedar") in the Texas Hill Country. While native to Texas, *J. ashei* encroaches into natural savannas, ultimately creating "cedar breaks" that allow little growth in their understory. *J. ashei* has since become the focus of an intense removal campaign aiming to increase native grassland diversity; however, its removal can result in increased susceptibility of cleared areas to establishment and spread of the invasive, C4 grass *Bothriochloa ischaemum* (King Ranch Bluestem). This study is designed to provide guidance to land managers on the most effective approach to native grass restoration following *J. ashei* removal. Typically, direct seed sowing is the most widespread method for grassland restoration, though mixed results are reported in south Texas. Based on previous studies, we hypothesize that *1. grassland restoration will be more successful in areas where* J. ashei *is removed, and 2. plug establishment will be more effective than direct seed sowing.* Three indigenous species will be seeded or plug planted in either intact *J. ashei* woodland or adjacent cleared areas in a 3x2x2 (species x establishment method x habitat) in a fully factorial randomized complete block design. The species chosen for the study include: *Sorghastrum nutans* (yellow Indiangrass), *Schizachyrium scoparium* (little bluestem), and *Bouteloua curtipendula* (sideoats grama). Plots will measure 3x2 m. We also conducted a cold stratification study to improve germination rates for our greenhouse grown plugs wherein seeds of native grass species were subjected to sub-freezing temperatures for 0, 1, 2, or 3 weeks. Seeds were then germinated in sterile petri dishes. Plans for our manipulative field experiment and cold stratification study will be reported.

Sain, Melody.
Authors: [1]Sain, M., [1]Williams, M., [1]Williams, L., [1]Placyk, Jr. J., [2]Small, R., and [1]Banta, J.
[1]Department of Biological Sciences, University of Texas at Tyler
[2]Department of Ecology and Evolutionary Biology, University of Tennessee, Knoxville, TN
Contact: msain@patriots.uttyler.edu

Testing Whether Ecological Differentiation Supports the Taxonomy of Three Hibiscus Species in Northeast Texas

Ecological and evolutionary theory state that sympatric species should be differentiated from each other ecologically if in fact they are truly different species. We tested whether the nomenclature of three congeneric and co-occurring herbaceous perennial marsh plants (*Hibiscus dasycalyx*, *Hibiscus moscheutos*, and *Hibiscus laevis*) is supported. Specifically, we used ecological niche modeling methods to test for ecological non-overlap among the species. One of these three species, the Neches River Rose Mallow (*H. dasycalyx*) has recently been listed as a threatened species under the Endangered Species Act by the US Fish & Wildlife Service, so determining whether it is, in fact, a unique entity is of special interest. Our study provides another tool besides phylogenetic analysis to help biologists and conservation managers make decisions about species delimitations.

Salinas, Narda Gisela.
Authors: [1]Salinas, N., [1]LaManna, J., [1,2]Walther, J., [1]Abbott, J., and [1]Belaire, J.A.
[1]St. Edwards University, Austin, TX
[2]Environmental Survey Consulting, Austin, TX
Contact: nsalina2@stedwards.edu

Evaluating Woody Plant and Ant Communities in a Restored Historic Dumpsite

Ecological restoration is a relatively young practice whose full affects are still unknown. In the 1940s in Austin, TX, a municipal dumpsite was established in what is now the Wild Basin Preserve, breeding habitat for the endangered golden cheek warbler (Dendroica chrysoparia) and part of the Balcones Canyonlands Preserve. It was not until the 1980s that a portion of the rapidly eroding dumpsite was restored to match the vegetation and geological formations of the preserve. After a year of growth, the restoration was considered a success, but no data was gathered on the woody plant growth. To better understand the effects of the restoration after thirty years of unmanaged growth, this project consisted of finding the restored site, surveying the woody plant vegetation and ant communities in the area, and comparing the woody vegetation and ant communities to those of an undisturbed nearby reference site. We found that Ashe Juniper (Juniperus ashei) dominated both the restored and reference site, although its relative abundance was greater in the reference site. The woody plant species richness of both sites was comparable, although species composition differed between the two sites. Using an indicator species analysis and a multi-response permutation procedure, epigeic ant species composition was assessed to determine site-site differences, establishing a baseline from which future changes can be evaluated. With a better understanding of restoration ecology, practices can be improved to better restore habitats like the Wild Basin Preserve.

Schroeder, Garrett.
Authors: Schroeder, G., McDougal, T., Luthy, D., Booker, E., Alexander, X., Goedeke, J., Wheatley, K., Jenkins, J., Allen, K., Aldmon, C., and Forbes, W.
Geography Program, Stephen F. Austin State University, Nacogdoches, TX
Contact: shroederga@titan.sfasu.edu or forbesw@sfasu.edu

Geography Student Internship Involvement with Longleaf Pine Restoration at The Nature Conservancy's Roy E. Larsen Sandyland Sanctuary, Silsbee, Texas

Geography students have served as interns from 2009 to 2014 at The Nature Conservancy's Roy E. Larsen Sandyland Sanctuary, located in the southern part of East Texas. Interns have primarily worked on longleaf pine habitat restoration through prescribed burning, manual brush removal, herbicide application, and mapping of management units. The internships have mutually benefited students and the Sanctuary, through assistance with accomplishment of work tasks and hands-on experience with natural resource management. One of the six interns is now employed full-time at the Sanctuary. Students have taken a Biogeography class prior to their internship. A few also took a class in Local Flora at our University to prepare for the internship. The Biogeography class may help with monitoring to continue the relationship between Stephen F. Austin State University geography program and The Nature Conservancy.

Stropki, Cody.
Authors: Amato, V.J.W., Stropki, C. L., Lightfoot, D., and Russell, A.
SWCA Environmental Consultants, Albequerque, NM
Contact: cstropki@swca.com

Effects of Fire Severity on Herbaceous Vegetation Recovery, Following a Southwest Ponderosa Pine Wildfire

This poster presents research on the effectiveness of aerial seeding conducted on private lands by the Natural Resources Conservation Service (NRCS) following the Trigo Wildfire of April 2008, which burned 13,709 acres of ponderosa pine and mixed conifer in the Manzano Mountains of central New Mexico. The general objectives of this research were to (1) determine the effects of fire severity on the recovery of forest understory vegetative communities and determine how different plant species respond to fire severity; (2) determine the response of intentionally seeded grass species used in restoration efforts by the NRCS (annual rye grass (*Lolium perenne*) and tall wheat grass (*Thinopyrum ponticum*)) to high and low fire severity; (3) evaluate the relative recovery responses of native and exotic plant species to fire severity. Three years of post fire monitoring revealed that both native and non-native seeded species were dominant throughout the 3 years of measurement, with timing of species dominance related to time since fire. Immediately post fire, areas were colonized with native forbs, shrubs and grasses; as time progressed natives became less dominant and seeded species dominated cover.

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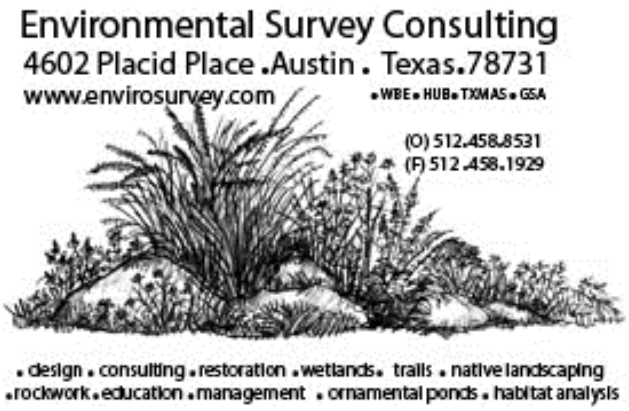

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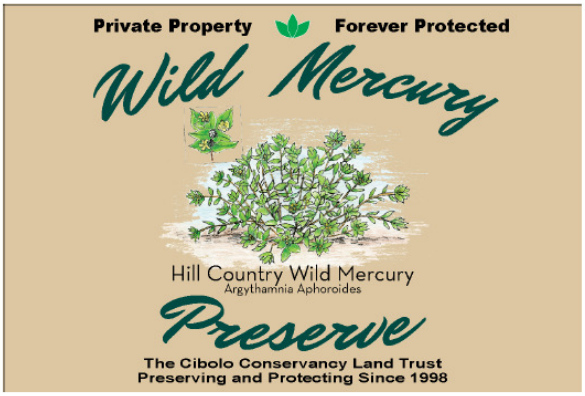

Contact: David Davidson, San Antonio, TX
ddavidson2314@earthlink.net

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