Society for Ecological Restoration, Texas Chapter
and
Texas Riparian Association

Joint Conference

The New Ecology:
Managing for Resilience in a Changing World

Conference Abstracts

Keynote Address by:

John Zak, Ph.D.
Associate Dean, College of Arts and Sciences
& Professor of Soil Biology
Texas Tech University

November 1-2, 2013
Texas Tech University, Llano River Field Station
Junction, Texas

Gratitude

Many individuals played a role in the organization of this conference. From its inception, both the TRA and TXSER 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 colleagues at Texas Tech University's Llano River Field Station for hosting the conference, particularly Karen Lopez, who assisted with the many details of organizing and managing the conference.

We are appreciative to the following organizations for their donations and sponsorship:

HDR Environmental Operations & Construction, Inc., Spring Branch
Native American Seed, Junction
Texas Water Resources Institute, TAMU
The University of Texas at Dallas
Whole Earth Provisions, Inc.

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

Keynote Speaker: Dr. John Zak, Associate Dean, College of Arts and Sciences and Professor of Soil Biology, Texas Tech University
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Why Does Everything in Texas Have to Be Big? - Understanding Ecological Responses to Climate Variability Across a Big State

Dr. John Zak joins TXSER and TRA as the Keynote Speaker for the opening dinner on Friday evening. Zak's core research focuses on the diversity and structure of soil bacterial and fungal communities and their role in regulating the functioning of natural and managed arid ecosystems. His research takes him from the cotton fields of West Texas to the Chihuahuan Desert at Big Bend National Park, to the piney woods of Ft. Benning, Georgia, and back to the watersheds of the Texas Hill Country at Junction. In each of his projects, Zak's lab is focused on understanding how soil microbial dynamics and processes can be self-sustaining such that these systems are sustainable for future generations.

Zak recently undertook the role of TTU's Principal Investigator for the South-Central Climate Change Science Center which seeks to better understand the impact of global climate change on human and natural ecosystems across the South Central U.S. Zak's research provides critical information that can be used by all of us to address water policy issues, to develop conservation, management, and restoration strategies, and to help formulate economic responses that are linked to projections of precipitation patterns and temperature.

In his keynote address, Zak will highlight his work on arid ecosystems and climate change. He will challenge conference participants to think about the impact of temperature and precipitation on terrestrial and aquatic ecosystems as we seek to manage and restore critical and/or degraded habitats in the State of Texas.

Zak obtained both his B.S. and M.A. in Biology from The University of Pittsburgh and his Ph.D. in Biology from the University of Calgary.

Plenary Speaker: Dr. Jacquelyn Duke, Senior Lecturer in Biology, Baylor University
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Outside the 'Zone.' Why We Are All Advocates of Ecology

Dr. Jacquelyn Duke's love of water can be attributed to her younger years growing up in the Texas Hill Country. Small streams there are the essence of "dynamic" - going from bone-dry creek beds to raging torrents overnight. As a child she spent many an hour in North Little Creek, digging for treasure, hunting for arrowheads, skipping rocks, catching frogs and just plain getting muddy. Each time it flooded the creek bed shifted; and while a previous swimming hole might be a bed of gravel, three new ones opened up, making it feel as if an entirely new stream had been born of such fury. How one small, non-living entity could spawn so much life in and among its banks fascinated her as a child and continues to do so today.

Dr. Duke received her B.S. from California State University and an M.A. and Ph.D. from Baylor University. Her research has focused on
the hydrologic connections among streams (aquatic zone), stream bed and banks (hyporheic zone), and stream bank vegetation (riparian zone). Duke's research interests cover intermittent stream and forest ecology, and the highly productive and ecologically important riparian and hyporheic stream zones where much biogeochemical cycling takes place.

Duke's life-long fascination with streams and their dynamic essence, translates to an enthusiasm for exploring biology and stream dynamics through the fresh eyes of her students.

Plenary Speaker: Dr. Christine Hawkes, Associate Professor of Integrative Biology, College of Natural Resources, The University of Texas at Austin
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Understanding and Mitigating Soil Legacies to Improve Restoration Success

Dr. Christine Hawkes received her B.A. in Environmental Studies from Bucknell University and her Ph.D. in Biology from the University of Pennsylvania. Her doctoral dissertation addressed the functional roles of soil microbes in endangered plant communities. She furthered her experience with soil microbial ecology during two postdoctoral fellowships. As a Smith Postdoctoral Fellow in Conservation Biology at the University of California, Berkeley, Dr. Hawkes studied the role of bacteria and fungi in exotic plant invasions. As an NSF Postdoctoral Fellow in Biology, Dr. Hawkes continued her work on plant invasions and began addressing how plant-microbe interactions affected ecosystem responses to climate change at both UC Berkeley and the University of York in the United Kingdom.

In 2005, Dr. Hawkes accepted an Assistant Professor position at The University of Texas, Austin and in 2011 was promoted to Associate Professor. Current research in the Hawkes lab is focused on both basic and applied aspects of plant-microbe interactions and their role in communities and ecosystems. One of her main areas of study is in examining how soil and microbial legacies affect the success of efforts to restore native plant communities and basic ecological functions such as nutrient cycling. She also works to understand how microbial communities can be used as a mechanism for enhancing ecosystem resilience and as a tool for restoration. Other ongoing research projects include prediction of belowground responses to climate change and effects on ecosystem carbon cycling, the role of plant symbionts in plant stress responses, and drivers of microbial diversity across scales.

Presentation Abstracts
(in alphabetical order; * denotes presenting author)

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Using Watershed Planning Activities and Technology to Convey Riparian Management Messages in the Trinity River Basin of Texas

The Trinity River meets the water needs for 45% of Texans, primarily in the urban centers of Dallas/Fort Worth and Houston. Since 2005, landowners, agencies and conservation organizations have been promoting land stewardship practices on private lands in the middle Trinity River basin to benefit wildlife species and water quality and quantity. Riparian management has been promoted throughout this time. Since 2011, a more directed outreach effort using social media outlets, websites, YouTube videos, publications, and workshops have been done to educate landowners on the benefits that land stewardship practices have for their productivity and sustainability. Leveraging resources from the urban areas to enact landscape level change has also been a goal for this project, and I will discuss projects that Trinity Waters and other groups are working on that accomplish that. I will discuss the strategies we have used, as well as share successes and challenges faced so far.

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Assessment of Riparian Vegetation Sensitivity to River Hydrology Downstream of a Major Texas Dam

Dams may impact the health of downstream riparian vegetation communities through flow modifications such as decreased flood frequency and duration. Without historical vegetation data, however, it is difficult to relate changes in vegetation composition to hydrology patterns downstream of dams. We studied bottomland hardwood forests downstream of Toledo Bend Dam on the Sabine River in Texas and Louisiana to determine their sensitivity to minor changes in river hydrology with a particular focus on floods. Current riparian vegetation was characterized within three topographic zones at three selected sites below the dam. Using 80 years of hydrologic records from two gauging stations downstream of the dam, we evaluated trends in flood frequency, flood duration, peak discharge and total flood discharge in those periods before (1926−1965) and after (1971−2005) dam construction, as well as related flood stage to floodplain elevations to link topography to flood frequency. Plant species diversity in this system is highly dependent on minor changes in elevation, and the proportion of wetland-dependent species changes rapidly with only a few centimeters difference in elevation. Since dam construction, total flood discharge and duration at the most upstream gauge on the Sabine River decreased by 49%. Patterns of tree regeneration point to less recruitment by wetland-dependent species since dam construction. These results suggest that minor changes in flood magnitude might limit occurrence of wetland species to the lowest topographic zones and illustrate the need to analyze sensitivity of plants to minor changes in flood characteristics when historical data for the vegetation community are lacking.

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The New Ecology: Managing for Resilience in a Changing World

We live in a time of profound ecological change. What does this mean for restoration ecology and environmental management? Nature is a process of ever-shifting disequilibrium, wherein ecosystems are shaped by an irreversible dynamic of change and novelty, which alters their ecological structure, function, and feedbacks. However, nature, also, is resistant to disturbance with ecosystems persisting as relatively stable communities despite significant changes in structure, function, and feedbacks over time. This resilience amidst change and disturbance is a quality of systems, natural and social, which adapt and endure. For environmental management, resilience can be understood as the underlying capacity of an ecosystem to maintain desirable ecosystem services in the face of human impacts, climate change, and a fluctuating environment. For restoration ecology, we talk about resilience as the ability of an ecosystem to regain structural and functional attributes that have suffered harm from stress or disturbance. The challenge of managing for resilience in a changing world is that urban development and a shifting climate are new profound drivers pushing ecosystems in directions where a retrospective reference to historical ecosystems is often less relevant than a prospective ecological understanding of where these novel ecosystems are heading. In this talk, I will outline the emerging understanding of ecological novelty, resilience, and change, and I will offer some answers to the question of what it means for restoration ecology and environmental management.

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Role for Natural Resource Literacy in Ecological and Riparian Restoration Success

Water, the environment, and natural resources are critical issues for present and future generations, especially with population increases in the next century. An ecologically literate public will be needed to make informed decisions on a variety of issues as resources become limited and damaged ecosystems repaired to recover ecosystem services. Yet studies consistently reveal that the U.S. public suffers from a tremendous environmental literacy gap that is increasing rather than decreasing. Further, >90% of U.S. will live in urban areas and children will have increasingly little contact with nature. Most riparian, river and watershed restoration projects have a public component and require stakeholder support for project success and sustainability. Here, we examine the structure and function of environmental education and literacy at various scales in Texas and results are not encouraging. However, the new Natural Resource and Environmental Literacy Plan for Texas provides a framework for increasing literacy on land, water, climate and ecosystems for a public and generation increasingly removed from the natural resources on which they depend. Riparian and restoration ecologists should consider more direct public engagement in restoration activities and additional education efforts to help the public better understand natural systems and challenges they face.

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Remnant Prairie Reclamation in an Urban Landscape, Houston, Texas

With partial funding from the US Army Corps of Engineers, Harris County Flood Control District is currently constructing a 279-acre stormwater detention basin complex in southwestern Houston, Texas. A 15-acre portion of this complex, centered on two colonies of the federally endangered plant species, *Hymenoxys texana,* is managed as a prairie conservation area. An initial site survey revealed isolated remnants of native gulf coastal prairie within a dense thicket of weedy trees and shrubs. Approximately 7 acres of the overstorey was removed by hydro-axing and used as mulch for the first phase of prairie reclamation. Separate management units were created to track effects of mowing cycle rotation and develop subplot plant inventories, and line-intercept transects were established to biannually monitor native prairie diversity. Over 250 native species have been identified within the conservation area, and diversity has remained constant throughout the four years of the project. Transplants of native species from future detention basin site, adjacent, have been ongoing with the help of contractors and volunteer groups. Future plans to further reclaim native coastal include clearing the second phase of overstorey to expand the prairie conservation area. Detention basin slopes adjacent to the prairie will also be planted with native grasslands to determine best methods, species, and management options for wider scale prairie establishment in Harris County. The ecological habits of *Hymenoxys texana* are also being studied to enhance the population numbers and foster regrowth of the species within the conservation area.

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Water Quality Standards and TMDLs: Foundations of the Clean Water Act

The principle law governing federal and state protection and restoration of surface waters is the Clean Water Act (CWA). Most states have developed water quality protection laws based on this federal act. The core of the CWA is Water Quality Standards (WQS), which incorporate designated uses, criteria, and an anti-degradation policy. When a water body is found to be impaired based on WQS, a Total Maximum Daily Load (TMDL) is required to be developed for each pollutant causing impairment. Implementation of well designed TMDLs assures water quality protection/restoration. An adaptive management process of monitoring, evaluation, and implementation of corrective measures is continually conducted until waters attain non-impaired status. Increasing population across the US has caused many significant water quality protection challenges for state and federal agencies.

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An Analysis of Shoreline Stabilization with Coir Logs for Austin, Texas

Traditional shoreline development often includes the construction of a vertical bulkhead, which can degrade the physical and biological integrity of the shoreline. Recently, a national assessment of lakes by the U.S. Environmental Protection Agency concluded that poor lakeshore habitat is the "most significant stressor in lakes" and that local, state and national initiatives "should center on protecting shoreline habitats, particularly maintaining vegetative cover and controlling development". The City of Austin has tested the installation of "coir" (coconut husk fiber) logs and emergent aquatic vegetation plantings to stabilize eroding shorelines of Lake Austin. Sediment accumulation gauges measured deposition or scour in the near shore environment at coir treatment sites over a period of 204 days as a surrogate for determining an increase in stability and reduction in erosion. Preliminary results indicate that coir log treatment areas exhibit increased stability as evidenced by an increase in sediment deposition within the coir treatment area compared to controls. Additional observations indicate that the coir logs generally maintained their integrity after six months in the lake and that American water willow (*Justicia americana*) exhibited the best survival with seventy-three percent of plantings persisting.

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Mitigating the Impacts of Oil and Gas Development in the "Last Great Habitat": The Eagle Ford Shale

The Eagle Ford Shale (EFS) in Texas has had a major impact on the global and local economy, making this shale formation a worthwhile venture for years to come. However, due to its location, the EFS will significantly influence an area in Texas, termed by scientists, as the "Last Great Habitat" (LGH). The LGH lies south of a line from Del Rio to San Antonio and southeast to Victoria and Port O'Connor. Furthermore, the land in the LGH is almost entirely privately owned. From an ecological standpoint, the LGH is considered "hyper-diverse," containing more vascular plant species than the Florida Everglades. Direct impacts from the EFS on the LGH include loss of habitat and fragmentation due to the construction of roads, drilling sites, pipelines and flowlines, and frac pits. Indirect impacts include soil erosion, the spread of exotic plant species, and increased rainfall run-off. Private landowners in the LGH need to be conscious of the negative impacts as a result of the EFS and understand how to maintain the integrity of the native habitat prior to, during, and after oil field disturbance. Our objective is to explain and illustrate, through a series of steps, the mitigation techniques used on the San Pedro Ranch to combat the aforementioned concerns of oil and gas development in the Last Great Habitat.

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Age of Residential Development and Recipient Habitat Explain the Distribution and Abundance of Invasive Woody Plants in Central Texas Woodlands

We investigated the environmental factors that affect the distribution and abundance of non-native woody plants in central Texas woodlands. Because many invasive species in this region are also landscaping plants, we hypothesized that the closer a site was to a developed area and the older the development the more non-native species it would have as a result of ongoing propagule and colonization pressure. We also examined the effects of proximity to city centers, roads, and creeks as well as native species richness, vegetation type, canopy cover, slope, aspect, soil type, and road density.

We used generalized linear models and the Akaike information criterion to identify the best models. The best model of non-native species had two predictors: age of development and vegetation type. The best model of native richness had three predictors: vegetation type, slope and soil type. Non-native richness was higher near older development and in floodplains; native richness was not affected by the age of nearby development and was higher in non-floodplain woodlands.

These results indicate that there is an 'invasion debt' resulting from ongoing propagule pressure, so we can expect abundances of non-native species to increase in the future near more recently developed areas. Efforts to restore native plant communities in these woodlands will be unsuccessful in the long-term if new or recurrent exotic introductions are not stopped. Our results also emphasize the importance of considering propagule pressure and dispersal in general, not just the invasibility of a community and the invasiveness of a species.

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Novel Landscapes: Challenges and Opportunities for Design Education

This paper asserts that novel landscapes will become an important component in educating future practitioners, including restoration ecologists and landscape architects. Novel landscapes are communities that are compositionally unlike any found today (Williams and Jackson 2007), driven by human-induced environmental change or by the introduction of non-native species (Lindenmayer et al. 2008). Recent challenges to the use of native vegetation in restoration efforts argue that historical referent landscapes will become ecologically outdated due to rapidly changing environmental conditions (Davis et al. 2011; Marris 2011). Novel landscapes are well documented (Parmesan 2006) and are predicted to expand (Williams and Jackson 2007). In the absence of historical precedents, how are design educators to train landscape students to become knowledgeable about and effective practitioners working in novel landscapes? What will future landscape practitioners need to know in order to create resilient *futurescapes*? I propose three areas of learning to enhance design education: (1) **ecological literacy** that prioritizes landscape function and processes; (2) **field-based experimental research design** opportunities; and (3) the larger **political and ethical contexts** of novel landscapes. Implementation of these ideas requires design faculty collaborate with: (1) field ecologists and ecology students to provide design students meaningful research opportunities that assess landscape function and (2) social scientists and environmental philosophers to explore effective political processes, identify ethical principles to guide restoration and management goals and address environmental justice concerns. These proposals emphasize interdisciplinary approaches for integrating design and ecological education in order to create effective future practitioners in rapidly transforming environments.

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Comparing and Connecting Grassland Conservation Efforts:
Urban Prairies and Landscape-Scale Restoration

As we are well into the second decade of the 21st century, population redistribution in Texas and the Great Plains continues to create a new environment for grassland conservation. Urban centers are expanding and fragmenting much of our state's remaining prairies. Meanwhile, rural areas in the west continue to depopulate. These changes will bring about a need for growth in two seemingly contrasting efforts. Urban conservation and restoration efforts are on the rise as Texans realize the importance of quickly vanishing prairies as centers of biodiversity. Farther west and throughout the Great Plains, larger tracts of land are available for landscape-scale grassland restoration, or the 'rewilding of the west'.

With this new era of conservation before us, it is wise to compare, contrast and connect these trends that are already occurring. Why connect the two? When working in an ecosystem that has faced a close-call with annihilation and drastic changes from a variety of threats, the benefits of working together are tremendous. There is a lot that the two can learn from each other's successes and failures to improve not only restoration efforts but human-environment relationships anywhere that grasslands exist. Even in the desolate plains, people will always be a part of the equation.

This synthesis examines the roots of landscape and urban restoration in the Great Plains with an emphasis on Texas, the notable differences in the recent evolution of the two disciplines, and how they can be tied together in order to increase the effectiveness of both. With consideration and communication, Texas may very well emerge as an example of successful grassland restoration even in the face of 21st century growth.

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Identifying Alteration of Natural Flow Regimes to Assess Stream Health: A Summary of Two EPA Region 6 Healthy Watershed Projects

Natural flow regimes are an integral part of every healthy watershed, and changes to flow components often result in severe water quality impairments. Unfortunately, increasing pressure from agricultural withdrawals, drought, habitat loss, urban development, and climate change have resulted in widespread hydrologic alteration. As such, the ability to develop ecologically sound management recommendations and assessment methodologies for the protection and restoration of natural flow regimes is of great interest to EPA Region 6. This presentation summarizes two recently completed projects designed to assess alteration of flow regimes under a Healthy Watersheds integrated assessment framework. The first project educates readers in using flow duration curves to define hydrologic conditions and healthy flow regimes and associated stream characteristics. It is a guidance document that can help states in setting hydrologic targets for watershed based plans and/or TMDLs and which could aid development of hydrologic criteria in water quality standards programs. The goal of the second project was to assess human alteration on natural flow regimes utilizing Indicators of Hydrologic Alteration (IHA) analysis in a Healthy Watersheds assessment framework. The Hydrologic Alteration project identifies the extent, impact, and location of human alteration of natural flow regimes in New Mexico and will be useful to inform planning and implementation goals of environmental efforts to protect the waters of New Mexico.

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Arundo donax Control and Restoration on Lady Bird Lake in Austin, TX

Arundo donax (giant cane) is a tall, perennial reed-like invasive grass species common in riparian areas. In 2011, *A. donax* covered 3.4 acres along Lady Bird Lake shoreline, prompting City of Austin control efforts. Proximity to public trails resulted in some patches being cut in August 2011, with re-growth allowed prior to herbicide treatment in October. Four treatment groups were delineated by cut/not cut treatment and herbicide type. Patches of monoculture *A. donax* received a glyphosate/imazamox combination, while patches with adjacent desirable vegetation (mixed patches) received imazamox alone, since glyphosate can impact non-target plants. Patches were grouped by canopy cover, slope steepness, and distance from water, and then evaluated in 2012 for number of live and dead stalks. The fraction of dead stalks was compared between treatment types and environmental conditions. Results showed that environmental conditions did not significantly affect the fraction of dead *A. donax*, while the herbicide treatment type did. Significantly higher fractions of dead stalks were noted with imazamox on uncut *A. donax* and glyphosate/imazamox on cut plants with re-growth > 10ft. This suggests that it is most effective to not cut plants prior to treatment, and then use imazamox on mixed patches and the glyphosate/imazamox mix on monoculture patches.

These lessons were applied to treatments in 2012 and 2013, with good control achieved in 2013 with the herbicide mix. 2013 restoration efforts focused on native plantings in the littoral zone to limit shoreline erosion resulting from the loss of plant cover on steeper slopes.

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Grow Zones: Function Over Form in Riparian Restoration of Urban Creeks

Decades of mowing and recreational use and a waning urban forest have led to bank erosion, poor water quality, and limited habitat in riparian buffers in parks around Austin, TX. Through a joint program between parks managers and stream ecologists these degraded areas are being reclaimed as "Grow Zones", where a facilitated succession approach, within an adaptive management framework, is allowing the restoration a range of basic ecological functions. In 21 parks in Austin (and counting), maintenance practices along streams were dramatically altered, seeds and saplings were planted, and a broad stakeholder group took ownership of these stream segments. In an effort to measure restoration success, an intense monitoring program was initiated that compared 15 measures of ecological function between reference and degraded urban riparian zone locations.

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Management and Control of Buffelgrass and Kleberg Bluestem to Promote Native Vegetation

Buffelgrass and Kleberg bluestem are 2 non-native grass species introduced to south Texas for cattle forage production and erosion control in the early 1900s. These 2 grasses have become a serious threat to biodiversity and the integrity of wildlife habitat by spreading into and replacing native plant communities. To date, little research has been conducted regarding management of these grasses for wildlife; attempts at their control have been unsuccessful or short-lived. Because of this lack of basic knowledge, we initiated research on the Hixon ranch in La Salle County, Texas to test treatments that include combinations of fire, grazing, herbicide application, and planting native species. Our experiment is a randomized complete block with treatments replicated twice in grassland dominated by buffelgrass and twice in grassland dominated by Kleberg bluestem. We used the Daubenmire frame method to estimate herbaceous canopy cover. Preliminary results indicate that herbicide treatments using Fusilade had no effect on exotic grass and forb cover when compared to control plots. Treatments incorporating soil disturbance and planting native species resulted in 64% less cover of exotic grasses and 151% greater cover of forbs 2 years post treatment.

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Burning and Grazing Exotic-Grass Monocultures to Manage Northern Bobwhite Habitat

Since the 1930s, exotic grasses such as buffelgrass have been introduced on southwestern rangelands for cattle production. Buffelgrass invasion results in less forb cover and degradation of northern bobwhite habitat. Bobwhites use buffelgrass adjacent to woody plant communities but avoid it otherwise. We initiated this study to evaluate if patch-burning and grazing would (1) result in increased use of exotic grass-dominated landscapes by bobwhites, and (2) increase bobwhite density.

Our research was conducted in La Salle County, Texas (2009-2011). We designated 2, 500-acre pastures dominated with buffelgrass to receive a patch burn-graze treatment and 2 were grazed only. We burned patches in January 2010 and 2011 and followed with grazing when emerging grass reached 6 inches. Vegetation was sampled each October. Bobwhites were captured, fitted with radio transmitters, and located 2-3 times per week April-September. Bobwhite density was estimated using fall covey call counts.

Heterogeneity and plant species richness was increased in pastures patch burned and grazed. Bobwhites used stands of exotic grass similarly in pastures grazed only compared to pastures patch burned and grazed. Bobwhite densities increased in patch burned and grazed pastures. Under the conditions of our study, grazing alone provided adequate control of monotypic stands of exotic grass. Useable space may have been more dictated by the availability of woody plants and their associated herbaceous understories than our treatment. We suggest that bobwhite managers within the western Rio Grande plains focus on the conservation of non-manipulated woody plant communities and the restoration of dense canopied woody plants.

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Keep Off The Grass? Mechanical vs. Hand Thinning in the Eastern Hill Country

A brief practitioner review of soil and herbaceous conditions following hand thinning and mechanical thinning on lands managed to optimize a) aquifer recharge, and b) nesting habitat for black-capped vireo. Modified quantitative methods are used to analyze "quick and dirty" data for practical land management decision-making. Concludes with notes on apparently shifting economic factors and identification of socio-ecological thresholds to inform management practices.

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San Marcos River Habitat Conservation: An Experience in Sustainable Riparian Restoration in City Parks

A look at the successes and challenges of riparian vegetation restoration from the watershed manager and the contractor on site's point of view.

Melani Howard: The upper San Marcos River is undergoing habitat improvement through multiple projects that are a part of a regional Habitat Conservation Plan. These projects include sediment removal, development and implementation of a watershed protection plan, invasive fish and snail removal, litter removal, bank erosion stabilization, recreational controls, aquatic and riparian vegetation restoration which includes restrictive access plantings and invasive plant removal.

Vincent Debrock: Riparian restoration in a highly used watershed presents multiple challenges. First, the removal of invasive species is highly visible invoking diverse public perceptions. Additionally, up to 90% of vegetation may be removed due to its status of invasive vegetation. Solutions included public planting workshops and bilingual signage used to educate and involve the public and 99% of Invasive plant material was repurposed for erosion control. The biggest challenge is working within a limited funding source to cover over two miles of stream bank.

Restrictive access plantings were used to guide the public to existing and new river access points to minimize bank erosion and trampling of the protected Texas wild-rice in the long term. Plants were chosen for their capacity of survival with little maintenance after the establishment period, and for their capacity of preventing the public to step through the area. Plant choice, Sourcing, establishment and maintenance issues are discussed.

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Hydrologic Response of Hillslope Seeps and Headwater Streams of the Fort Worth Prairie

There has been relatively little research comparing the relationships among vegetation, topography, and hydrology of hillslope seeps and headwater streams in the Fort Worth Prairie located in the north central region of Texas. Unlike the classic tallgrass prairies described in the Midwest, these riparian zones are often dominated by annuals. Due to the ephemeral or intermittent nature of headwater stream hydrology, the high variation of soil moisture restricts tallgrasses from dominating riparian headwaters. This study quantified the hydrologic regime of a Fort Worth Prairie hillslope hollow, by analyzing the temporal and spatial soil moisture response to precipitation and drying, its impact on runoff generation, and the vegetation-soil moisture relationship. The study occurred from August 2012 - March 2013, during drought-like conditions that prevented streamflow. Results show the hillslope completely saturates during wet periods and during dry conditions saturation is most extensive along the hillslope base. Autumn vegetation most accurately aligns with moderate soil moisture conditions. This research describes Fort Worth Prairie headwater stream and seep habitats and provides a basis for how they function hydrologically in order to create a foundation for improved habitat management, protection, and restoration of riparian headwaters in North Central Texas.

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Invasive Species Data Collection: An Ecological Approach to a Complex Problem

Driven by the adoption of a city-wide invasive plant management plan and the awarding of a Cities of Service grant from Bloomberg Philanthropies, the City of Austin undertook an intensive survey of invasive plant species during the summer of 2013. Over the course of three months, data was collected at more than 2200 points representing 1800 acres of land. City of Austin staff developed a Geographic Information System (GIS) property prioritization schema using available datasets relating to land management, designed a comprehensive data collection method to obtain invasive species presence and age class structure data, and coordinated sampling efforts with trained volunteers. This data will be analyzed across multiple parameters; density at different successional stages will be looked at in relation to native species diversity, distance to development, distance to creek, etc. Staff will use this data to provide ecologically informed city-wide management recommendations for invasive species management.

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Does Ecotypic-Based Genetic Diversity Improve Productivity? A Mesocosm Study with *Spartina alterniflora*

Increased genetic diversity of habitat-forming species correlates with high productivity and disturbance resistance. Typically, salt marsh restoration utilizes grasses from one donor site, yielding low genetic diversity because of clonal reproduction. Creating a marsh with ecotypes from multiple sites should be an inexpensive, efficient way to increase genetic diversity, which may increase productivity and resistance of the restored plants. To quantify the benefits of increased genetic diversity within a single plant species, I performed a mesocosm experiment utilizing ecotypes of *Spartina alterniflora* from three locations on the northeastern Texas coast. I compared growth patterns among low and high genetic diversity treatments across a range of salinities (10, 20, 30 ppt) during June-October 2012. Plant morphological characteristics were recorded to compare diversity treatment performance. At the highest salinity, stem growth was 50% greater and new leaf growth was 60% higher in polyculture treatments compared to monocultures. A discriminant function analysis supported polycultures outperformed monocultures for leaf metrics at 30 ppt. The benefits of genetic diversity were most reflected in the polyculture treatment at the highest salinity. Based on these analyses, plant productivity might be enhanced if marsh planting utilizes multiple ecotypes.

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Top 5 Tips for Working on Stream Projects with Teens: Lessons from Austin Youth River Watch

Teaching the next generation about stream restoration is something we can all feel good about, and involving them in our projects is even better. It's also true that working with teens is not as easy as it sounds! In this session, we'll give you practical tools to make your next stream- or river-related project even more successful because of teen involvement.

For the last 21 years, the high-school students in Austin Youth River Watch have monitored water quality at stream and river sites all over the Austin metro area. Data sets from these 23 sites (and counting) are submitted to and reviewed by local and statewide agencies. Our work benefits the community, and the kids are learning science -- plus, they love it. Now, in the last two years, we've begun adding stream-restoration service projects to our repertoire of student programs. We've learned some lessons the hard way, and we're here to share those lessons.

In this session, we'll talk about the benefits of working with teens, and we'll share information about Austin Youth River Watch's model. We'll give you our Top 5 Tips for working with teens, and we'll answer your questions about how to build competitive proposals in this growing field of "youth engagement."

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Utilizing Mechanisms of Competition to Guide Integrated Pest Management of KR Bluestem (*Bothriochloa ischaemum*)

Control of non-indigenous, invasive, C4 grasses (NIIG) in perennial C4-dominated rangelands presents a unique challenge as management approaches designed to target the invasive can result in collateral damage to resident perennial, C4 grasses. In addition, restoration of indigenous high forage species is often foiled by novel biotic and abiotic conditions that limit re-establishment. In an attempt to identify non-herbicide approaches to control NIIG we investigated a three approaches employing prescribed burns, mycorrhizal fungi addition, and indigenous species restoration as biocontrol. Preliminary soil foodweb analyses suggest that sites dominated by KR bluestem (Bothiochloa ischaemum, hereafter referred to as KR), were dominated by bacterial species and lacking in mycorrhizal fungi. In addition, rhizosphere analysis of KR and sympatrically growing indigenous species reveal divergent microbial communities. Competition studies in the field and greenhouse designed to assess the effect of commercial mycorrhizal inoculants suggest that mycorrhizal addition initially increases indigenous species establishment but eventually favors KR. It has also been shown that growing season (late summer/early fall) burns may serve to control KR. Nonetheless, our experimental work demonstrates that soil water status, plant physiology and phenology, and fire conditions must be taken into account to avoid collateral damage to resident indigenous species. Finally, in a manipulative experiment we assessed the value of restoration as a biocontrol tool. We found that species identity was critical, particularly under drought conditions, and that restorationists would maximize their success in controlling KR by focusing on those species that established at the highest rates.

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Habitat Restoration Over 24 Years on a Central Texas Ranch: Methods and Results on Heavily Browsed and Over Grazed Land Invaded with Exotic Species

Restoration work on this 450 hectare ranch in Spicewood, Texas has resulted in significant increases in the diversity and quantity of grasses, forbs and woody species which had been nearly or totally eliminated through previous management. When restoration started in 1989, the vegetation was typical of most of the present day Texas Hill Country, with most of the palatable native grass species gone or greatly reduced, and the surviving forb and woody component reduced to extremely low browse value species.

Management and restoration techniques are being developed and modified to be practical for use on the large areas of prairie, savanna, woodland and riparian habitats of this ranch. These include controlled burns, selected removal of juniper (*Juniperus ashei*), reduction of white-tailed deer (*Odocoileus virginianus*), limited cattle grazing, high fencing, seeding, exotic species control, and propagation research.

For successful reestablishment of woody species and perennial forbs we have developed a process of simultaneously reducing the deer population while increasing the available browse through a sequence of species reintroductions. We start with plants that are only somewhat palatable to the reduced deer population then gradually introduce additional species as the increase in available browse allows their survival. The locally harvested seed required for these reintroductions is often started within exclosures to increase available seed quantities for wider use on the ranch.

This project is demonstrating that even though restoration of the high value browse species of this habitat is a much slower process than grass restoration, it is possible.

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Slender Rush-pea (*Hoffmannseggia tenella*): Conservation through Management—A Case Study

Slender rush-pea (*Hoffmannseggia tenella*) is an herbaceous legume endemic to Kleberg and Nueces Counties, Texas. Classified as 'Endangered without Critical Habitat,' the most important factor threatening slender rush-pea is habitat disturbance—both from agriculture and invasive plants—particularly Kleberg bluestem (*Dichanthium annulatum)*. One hypothesis suggests that slender rush-pea may be relatively insensitive to shade but that it can be negatively impacted by competition from Kleberg bluestem. Specific mechanisms involved in slender rush-pea's interactions with surrounding grasses, however, have not been thoroughly investigated.

We have begun a field-scale study of slender rush-pea at the St. James Cemetery in Bishop, TX. We are manipulating the biotic environment of slender rush-pea plants by removing above-ground or above- and below-ground competitors; prescribed fire is also included as a habitat treatment. Objectives are to (1) determine slender rush-pea response to removal of neighbors, (2) evaluate effects of fire on growth and survival, and (3) describe the ecological neighborhood surrounding each plant in unmanipulated and burned habitats.

Pre-treatment plant morphological data will provide valuable baseline information to characterize morphometrics of this species. Preliminary results suggest that competitor removal may affect number of leaves per plant; other morphological responses (number and length of stems) appear less affected by neighbors. This information will enhance our understanding of the ecological factors that affect slender rush-pea and guide development of effective management practices designed to conserve this species.

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Landa Lake Invasive Species Removal Project

In April 2013, the City of New Braunfels, in accordance with the Edwards Aquifer Recovery Implementation Program (EARIP) Habitat Conservation Plan (HCP), initiated a project to eliminate or reduce the density of non-native animal species in the Comal River ecosystem. The target non-native species included the vermiculated sailfin armored catfish (*Pterygoplichthys disjunctivus*), tilapia (*Oreochromis aureus*), nutria (*Myocastor coypus*), and giant ramshorn snail (*Marisa cornuarietis*). These non-native species are thought to compete for resources (e.g., habitat and food) with the native species of HCP concern; due to their life history traits, the armored catfish and nutria also are potentially responsible for a substantial amount of damage that has been observed along Landa Lake's embankments.

The field effort comprised 22 days in 6 field sessions conducted April-August 2013. A total of 6,010 lbs. of biomass was lethally removed from Landa Lake, including 393 vermiculated sailfin catfish, 2,248 tilapia, 40 nutria, and 995 giant ramshorn snails. Trends in tilapia relative weight were of specific interest due to their utility as indicators of population health and ecosystem dynamics. It was expected, and observed, that with increased removal pressure and a significant loss of population, the remaining individuals should increase in size due to the loss of interspecies competition and abundance of food resources. Noticeable impacts were also observed on the nutria and armored catfish populations. Subsequent removal efforts must be made every year for the foreseeable future in order to fully remove these species and to significantly impact the tilapia population within the lake.

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Reconnecting a Community to the Creek: The J.J. Seabrook Stream Restoration, Rain Garden, and Urban Trail Project

The J.J. Seabrook Stream Restoration, Rain Garden, and Urban Trail Project will transform an unremarkable reach in East Austin to a thriving creek corridor that benefits the environment and the local community. The primary goal is to restore the ecology, stability, and water quality of the stream system. Additional goals include creating a unique sense of place for the local community and providing pedestrian and bike connectivity through the neighborhood and park.

The project's stream features include a nested channel system to enhance hydrological and ecological connectivity, replacement of a culvert with a pedestrian bridge to reconnect the stream, habitat features, and native riparian landscape. Habitat features include riffle/pool complexes to support two distinct geomorphic reaches within the park, strategically-placed cypress bogs, and log habitat structures. A defined riparian buffer zone will be established, with plant types specific to East Austin streams and the wetland, facultative, and obligate planting zones. Native soils laden with seedstock will be preserved and redistributed to reestablish local wetland plants. Finally, an adaptive management plan including land management changes was developed to support the restored stream corridor long-term.

Water quality in the stream will be improved by capturing and filtering pollutants in from the contributing watershed. Water quality features include reduced impervious cover, bioswale, rain gardens and where feasible, storm drains in the park will be truncated, with stormwater routed through swales before entering the stream. The design phase is expected to continue through November 2013. Construction is expected to begin in early 2014.

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Arundo donax on the Blanco River

Arundo donax, also known as giant cane, is an exotic, invasive species on the Texas noxious plant list. In recent years, sightings of Arundo on the Blanco River have become alarmingly frequent. There are at least two 5+ mile stretches of the Blanco where Arundo is the most common plant in the riparian area. Since Arundo propagates by being broken off (both through resprouting of the nodes and regrowth from the broken shoots), and Arundo is very common in the upper reaches of the Blanco, we are potentially one flood away from disaster in this watershed.

The Nature Conservancy feels that by acting now, we could be ahead of the game and be able to reduce (with a goal of eliminating) Arundo on the Blanco. We are currently gathering data and searching for funding to begin an eradication program. This program would be similar in design to the Nueces River Authority's "Pull. Kill. Plant." program in the Nueces River basin, focusing on multi-year herbicide treatment of large plants, and hand-pulling small plants and pups.

Arundo populations will be identified through on-the-ground and aerial (helicopter) surveys. Landowners with plants will be contacted through County parcel information, surrounding landowners (word of mouth), and through blanket postcards or flyers.

The Nature Conservancy plans to collaborate with many entities on this project, but most important will be our landowner partners.

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Detection Probability for a Cryptic, Endangered Cactus: Implications for Restoration and Conservation

The Tobusch fishhook cactus, *Sclerocactus brevihamatus* ssp. *tobuschii*, is a small (< ~8 cm), endangered cactus with a distribution limited to 8 counties in the Edwards Plateau. Most populations are small (<200 individuals), and populations of any size are vulnerable to rapid decline from periodic weevil outbreaks. We installed permanent $10m^2$ plots at The Nature Conservancy's Love Creek Preserve (Bandera County) and at the Shield Ranch Camp Wood (private land; Real County) in areas where Tobusch fishhook cactus occur. All cacti in the plots were marked with numbered aluminum tags and their locations were mapped. We also recorded the size of each cactus. Plots were visited every 2-4 weeks throughout the spring and early summer in 2013. At each visit, we tagged, mapped, and measured any additional cacti we found. On average, the number of cacti mapped in each plot increased by 84% with repeated visits (n=5-7), with 2 plots more than doubling the number of cacti. Because these cacti are small, they are easily covered (and subsequently uncovered) by leaf litter, gravel, and loose soil during rain events and other disturbances. Our results suggest that most Tobusch fishhook cactus populations may be much larger than they appear, and that repeated surveys of this and other cryptic plants are necessary to understand their true abundance.

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Application of a Floristic Quality Index to Determine Vegetation Trend on the Clymer Meadow Preserve, Hunt County, Texas

Clymer Meadow is one of the largest and most diverse remnants of the Blackland Prairie of Texas. It supports both the Eastern gamagrass-Switchgrass- Yellow Indiangrass-Maximilian sunflower vegetation type (G1) as well as the Little bluestem-Yellow Indiangrass-Big bluestem-Prairie bifora vertisol herbaceous vegetation type (G2). In 1996, a vegetation monitoring program was formalized. Ten permanent 60mx60m plots were established wherein plant cover and frequency were evaluated. Values of relative cover, relative frequency and importance value were derived. Sampling on all or a portion of the plots was conducted in 1996, 1999, 2002, 2006 and 2013. In 2013 all data were subjected to evaluation via Floristic Quality Index. An increase in FQI was observed across sample dates.

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Development of a Regional Scale Tool to Assess Riparian Integrity in Austin, Texas

Riparian zones along a stream have significant influence on the integrity of the adjacent aquatic ecosystem. Traditional field methods of assessing riparian zones in large stream networks may be prohibitively time consuming and expensive. Remote sensing can be used to characterize the riparian zone in aggregate and identify areas with a high potential for functional deficiency. The City of Austin has developed a Geographic Information System (GIS) based assessment tool to evaluate stream corridor riparian integrity at a watershed scale. Aerial vegetative classifications and land use data from two riparian buffer widths (50 ft. and 400 ft.) were combined in a multivariate spatial cross-regressive model to specify the overall riparian integrity of a watershed-scale reach. Accuracy checks showed the index results to be representative, with some problems arising in simple (non-branching) drainages and in certain commercial land use dominated areas. The results of the model can be used to assess and predict stream water quality variables and are an excellent screening tool for prioritizing riparian restoration efforts.

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Ecological and Societal Resistance to Prescribed Extreme Fire Inhibit Management Efforts to Restore Degraded Texas Rangelands: Can We Overcome These Constraints?

Ecosystems with diminished environmental services require innovative resource management strategies. Conventional restoration practices have been historically ineffective and/or economically cost prohibitive in repairing degraded rangelands. Despite extensive management efforts, woody plants and cacti continue to invade and negatively affect rangeland ecosystems throughout Texas. We established two identical experiments in different shrub-dominated ecoregions of Texas to assess whether interventionist approaches were capable of overcoming the resilience of the dominant woody plant community. Using different combinations of prescribed extreme fire and herbicide applications, our objective was to alter the ecological trajectory of the system beyond the effects observed with conventional management techniques. At both study sites, prescribed extreme fire significantly reduced resprouting shrub densities compared to unburned plots. These findings differ from other studies that report fire changing the structure of shrubs but not their densities. A potential reason for these differences is that fire treatments in this study were conducted during severe drought conditions and we produced unusually high maximum fireline intensities. The second intervention approach was not supported because extreme fire and herbicide treatment combinations did not significantly reduce shrub densities more than using herbicide alone. Our findings demonstrate that novel intervention approaches, like prescribed extreme fire, can trigger unexpected, high levels of mortality in resprouting shrubs and begin to restore degraded rangeland ecosystems, but we acknowledge that widespread application of this management strategy hinges on our ability to shift social perceptions influencing the application of fire on the landscape.

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An Urban Riparian Restoration Program at the Human-Ecology Interface

Riparian zones in urban systems are critical and complex transition zones between human use and basic ecological function, historically with the former driving land management practices. Twenty years of intensive stream and reservoir monitoring have demonstrated very clearly the variety of water quality and quantity problems that urbanization and climate change brings. Biologists and ecologists with the Watershed Protection Department have pulled together a novel approach to urban ecosystem restoration that is based on minimally managed succession, broad stakeholder partnerships, a functional monitoring component, and a conservative approach to resource management. In an effort to create functional ecosystems in riparian buffers, a series of restoration practices are underway: the Grow Zone Program, ecological stormwater management (rain gardens, bioswales), a functionally-based invasive plant management approach, and an aggressive outreach component to deliver science to the people. Backed by a sustainability-driven regulatory environment, drought, and climate change, this lean program has made significant progress in changing the way land managers and citizens think about the value and aesthetics of the riparian buffers corridors that tie us all together.

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Proactive Management of Aquatic Invasive Species Through a Watershed Protection Plan and Partnerships, Upper Llano River, Texas

There are more than 50,000 alien invasive species in the United States that have tremendous negative ecological and economic impacts that total almost $120 billion per year (Pimental et al. 2005). In the Upper Llano watershed in the Texas Hill Country, there are several invasive aquatic plants (elephant ear - *Colocasia esculenta*, giant reed - *Arundo donax*, and Chinaberry - *Mezlia azedarach*) that are beginning to aggressively colonize the banks of the Upper Llano rivers and displace native vegetation. These invasive plants pose a number of ecological impacts: elimination of native vegetation, alteration of soil conditions, water use, fire, geomorphic and fluvial processes and wildlife. To protect the health of the Upper Llano watershed, the Texas Tech University Llano River Field Station and other partners are working to develop and implement a proactive Healthy Watershed Protection Plan (WPP) through a federal Clean Water Act 319(h) grant. One partnership to begin addressing invasive species in the watershed was formed with Texas Parks and Wildlife Department, and willing landowners to initiate a major effort to control elephant ears on the South Llano River. The 2012-2013 control effort involved mapping of distributions and a sequence of 7 herbicide treatments with great success. The next phase of invasive control will target the North Llano River elephant ears and other invasive aquatic plants. Successful implementation of the WPP will be achieved through stakeholder participation, local and regional partnerships, an implementation plan, and coordinated public education campaigns. Proactive actions in addressing incipient watershed issues, like invasive species, are cost effective relative to reactive responses. Such conservation efforts avoid future water quality and quantity impairments, and benefit not only local stakeholders, but also downstream users and future generations.

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Alternate Prairie Restoration Strategies Implemented at Lewisville Lake Environmental Learning Area (LLELA) to Address Extended Drought Conditions

Much of the mid-western portion of the North American continent has experienced severe and extended drought conditions for nearly a decade. As a result, it has been necessary to alter prairie restoration strategies.

Prior to the drought periods, LLELA's grassland restoration practices included planting large, unirrigated areas. In 2005, 70 acres of a diverse native prairie mix were planted with a no-till drill. Over the next two hot, dry years, seedlings emerged and perished in the heat of summer without rain. Since then, most summers have been much warmer and drier than normal. Predictions are that this trend may continue for some time.

Revised restoration strategies provide for restoration of smaller areas (prairie starter plots) which are established primarily by transplanting plants with well-developed root systems and secondarily with seed. These plots are irrigated when necessary. Plants established in these plots on the restoration site are grown in an on-site nursery from seed and root stock harvested from local prairie remnants. This restoration strategy shift from a relatively R-selected to a more K-selected survival strategy is imperative in the face of long-term climate change and the rapid loss of prairie remnant sites.

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A Preliminary Report on Northern Bobwhite Quail Reintroduction at Lewisville Lake Environmental Learning Area (LLELA)

Northern Bobwhite Quail populations have been in decline for more than a decade across their historic range. Since quail are a valued game bird, much attention and resources have been focused on this problem without resolution. Habitat fragmentation, habitat degradation, predation, disease, climate change all have been implicated as potential causes for this decline.

The literature contains many attempts to reestablish sustainable quail populations in areas of their former range. These include the use of "surrogators" and releasing pen-raised birds, with and without trapped and transported wild birds. Few if any of these has been successful in establishing sustainable populations.

This project tests the use of a "cooling station" module placed in good quality quail habitat to assist in providing the necessary life requisites to initiate quail reproduction and survival. Six modules of slightly different design were placed in quail habitat and managed throughout the breeding season. Twenty-five pen-raised northern bobwhite quail were released at each of the 6 stations in mid-April. Several stations were surrounded with an electric perimeter fence installed with a solar fence charger to discourage predatory mammals from frequenting the immediate area and game cameras stationed to document activity. All birds were banded and 50 hens were fitted with radio transmitters prior to release.

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Seeds of Change: A Progressive Approach to Sustainable Urban Stormwater Drainage Management

Typical urban stormwater control projects involve grading slopes, adding riprap, seeding with non-native vegetation and placing the drainage on a frequent mowing cycle. The City of Fort Worth's drainage projects have followed this standard procedure; until now. In this age of increased concerns of fossil fuel consumption, air quality issues, and a city's livability index, Fort Worth's Stormwater Department is taking a new look at its practices. A transition is taking place. Leaders in the Stormwater Department and the Fort Worth Nature Center & Refuge have planted a 'seed of change'. Using an organic grassroots approach, two pilot projects will replace standard stormwater construction and maintenance practices with native vegetation. Through collaboration with various agencies and involving the community in volunteer opportunities (outplanting, monitoring and invasive species control) and public outreach, the project goals to reduce maintenance and fuel costs, connect urban wildlife habitat and provide a higher quality of life for citizens will come to fruition. This presentation will discuss the evolving shift in practices to a progressive stormwater management approach and how 'planting a seed' can lead to the germination of an idea that comes to fruition on the ground through collaborative site projects.

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Boggy Creek Riparian Restoration: Willowbrook Reach Case Study

In 1997 the City of Austin's erosion control team evaluated reaches in most of the major urban streams in Austin. The results of this evaluation process were used to prioritize erosion concerns for future capital improvement projects. The Boggy Creek reach at Willowbrook rose to the top of the list in 2010 but neighborhood opposition to the engineered hardening of the stream banks led instead to a vegetation based riparian restoration and re-evaluation of urban stream erosion and the benefits of vegetation for erosion prevention. This case study looks at how this opportunity came about, impacts of the passive restoration that had been occurring and the active methods that were implemented to jumpstart succession and restoration goals. A comparative photo examination will be used to better describe the vegetation changes and channel condition of this reach.

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Ecoculture: Emergence in Urban Ecology

Recent studies involving humus accumulation and humification over time in post-disturbance (strip mined) mineral soils have given us a clearer picture of soil genesis and soil ecological succession as a counterpart to plant successional models. The importance of biologically active soil to the health and diversity of terrestrial ecosystems is well documented, but only recently have we begun to understand the emergent nature of soil, and how soil is at once created by and contributes to the overall productivity of an ecosystem. Emergence in this context describes the accumulation of humus, organic matter, and mineral particles, as well as increases in root mass and microbial presence, both in quantity and diversity, leading to an overall net gain in soil depth and ecosystem vigor.

As stewards of the urban landscape we are compelled to manage our green spaces so that they are culturally functional, ecologically productive and sustainable. Landscapers and gardeners, with good intentions, have traditionally followed agricultural and horticultural land management models rather than ecological, resulting in spaces that are largely carbon depleting and water repellant. Land management decisions have been based on product and design and not on process or function. It is obvious we need an alternative model for the management of our landscapes and diminishing resources. This presentation, through case studies and exploration of basic ecological theory, proposes a method of restoration and conservation that is both obvious and novel, applicable to the site and parcel scale, and ripe for deeper field demonstration and study.

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The Hydrologic Cycle: Restoring Hydrologic Function via Ecological Enhancement OR Making the Rain That Does Fall More Effective from Healthy Uplands to Continuous Base Flow

Walk and talk with Elisabeth Welsh, a twenty-two year veteran of water quality and quantity issues in the Central Texas area. We will walk through the hydrological cycle from the uplands, where we will do a hands-on experiment to test the water infiltration capacity of the soil, to the water, where we will look for benthic macroinvertebrates (water bugs) that help us understand the health of the aquatic ecosystem. While we walk, Elisabeth will highlight the relevance and interconnectedness of these two stops in the workshop through a discussion of her work with River Watch and the current water quantity and quality issues of the Texas Colorado River. River Watch is an afterschool water quality-monitoring program for underserved high school students. That data is contributed to the database of the Colorado River Watch Network at the LCRA. We want all the River Watchers to become environmental stewards and to graduate from high school. River Watch is expanding the opportunities for environmental stewardship for our students through special service learning projects that focus on enhancement of hydrologic function via ecological enhancement along the urban creeks and the Colorado River in the vicinity of Austin, Texas. This workshop will give you an on the ground experience to help you understand these concepts in situ. Plan on getting wet. Please wear closed toed shoes.

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Restoration of Native Submersed Aquatic Vegetation for Endangered Species: Year One

The Edwards Aquifer Recovery Implementation Plan (EARIP) process led to development of the approved Habitat Conservation Plan (HCP) for the Comal Springs and Comal River system (Comal system) in New Braunfels, Texas. In relation to the Comal system, the EARIP process and HCP identifies a variety of options to improve and increase habitat of threatened and endangered species, including the fountain darter (*Etheostoma fonticola*), Comal Springs salamander (*Eurycea* sp.), Comal Springs riffle beetle (*Heterelmis comalensis*), Peck's cave amphipod (*Stygobromus pecki*) and the Comal Springs dryopid beetle (*Stygoparnus comalensis*). The aquatic vegetation restoration conducted in two Project Areas in 2013 contributes to implementation of Phase I of the HCP. At specific locations within these Project Areas, non-native vegetation species have become predominant. Increasing native vegetation will benefit the fountain darter by increasing available habitat and improving the quality of existing habitat, potentially resulting in higher fountain darter densities in these areas. Improvement of, and increased areas of, fountain darter habitat is also beneficial to many other native aquatic species.

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Drought-Induced Woody Plant Mortality and Community Composition Shifts in an Encroached Texas Savanna: Comparing the 1950s and the 2000s

Following an exceptional drought from 1951-1957, a study was conducted to quantify rates of dieback for various woody plant species. In 2011 and 2013, we repeated this study within three long-term grazing treatments that were established in 1948 in order to assess recent patterns of drought-induced woody plant dieback and determine community responses to woody dieback across the landscape. Droughts from 2000-2013 were the second most severe since 1919 and were only surpassed by the prolonged drought from 1951-1957. We established ten transects in each of three grazing treatments to quantify the frequency and cover of live and dead individuals for all woody species and compared rates of woody plant dieback among height classes, soil categories, total woody densities, and pastoral treatments. Drought-induced shifts from one woody plant community to another did not occur uniformly across the landscape. Species-specific patterns of dieback were contingent on localized interactions between topoedaphic factors and long-term land use and occurred as a result of differences in ecohydrology among soil types, species-specific water use strategies, density dependent mortality relationships, and legacy effects resulting from long-term livestock management practices. Small-scale vegetation shifts pose a challenge for scientists attempting to develop accurate predictions of species-level responses to climate change. Additional studies to assess the importance of land management, woody plant densities, plant demography, and ecohydrological differences among soil types are needed to develop predictive models which properly reflect the complex patterns of woody plant drought dieback.

Posters

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Assessing Ashe's Juniper (*Juniperus ashei*) Mode of Removal on Grassland Species Composition in the Texas Hill Country

While native to central Texas, cedar is often found in dense monocultures, known as "cedar brakes," where native herbaceous grassland species are virtually absent. Aiming to increase native grassland diversity, Cedar is removed through various techniques such as chainsaws or "cedar-eater" and the felled wood is either left in place whole, or mulched, or removed from the area. Different modes of cedar removal appear to alter opportunities for native species repopulation while others appear to facilitate invasive herbaceous species. Among these and of major concern is KR bluestem (*Bothriochloa ischaemum)*, a highly invasive and homogenizing perennial used to improve degraded rangelands and stabilize soils along roadsides.

We hypothesize that method of mechanical removal, post-removal wood management, and proximity to major roads act as determinants of grassland species composition following cedar removal.

Landowners have helped identify cleared areas and corresponding land use history at 25 sites in Kerr and Bandera Counties. At peak flowering, in October of 2013, at each site, 50 m parallel transects were established in paired cedar brakes and cedar cleared areas. Data collected from 10 1 x 1 m plots along each transect on percent cover of all herbaceous and woody species are presented. Results from this study are providing guidance on efficacious methods of cedar removal that maximize richness and diversity of native Texas grasslands.

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Interactive Effects of Prescribed Fire and Grazing on Woody Encroachment and Invasive Grass Abundance in a Southeast Texas Coastal Prairie

Encroachment by woody brush species and exotic plant invasions by old world bluestem grasses threatens coastal prairies in South Texas. Developing effective restoration techniques for encroached and invaded coastal prairies requires a more complete understanding of the effects of fire and grazing, two fundamental ecological processes in this system. We established a full-factorial, completely randomized experiment to examine the interactive effects of prescribed fire and ungulate grazing on invasive grass abundance, herbaceous community structure, and woody vegetation density in a Southeast Texas twisted acacia-mesquite invaded prairie.

The experiment is located on a 950 acre pasture in Welder Wildlife Refuge. The pasture has been periodically grazed, burned and has received one aerial herbicide application. We established thirty-six 10mX10m plots. The six randomly assigned treatments include: i.) summer burned and fenced, ii.) summer burned and unfenced, iii.) winter burned and fenced, iv.) winter burned and unfenced, v.) fenced and unburned, vi.) unburned and unfenced (control). We collected pre-treatment data including shrub species demography, plant community composition, and soil characteristics and erected grazing exclosures in May 2013. We conducted independent prescribed fires for each summer burn plot in August 2013. We will conduct winter prescribed fire treatments in December 2013. Comparing differential plant community responses to prescribed burn season in combination with grazing will provide important insights into the factors influencing woody vegetation dynamics and invasive grass growth and survival. This study will provide a baseline of information to the development of management for preventing further encroachment and invasion into grasslands.

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Quantitative and Qualitative Assessment of a Proposed Method for Chemical Abstraction of Diatoms from a Clay Soil Matrix

The use of diatom populations as a gauge of the health of a wetland ecosystem is generally accepted, and many studies of the progression of an ecosystem through time incorporate data from diatom populations in the recent geological record as counted in samples of silt or soil deposited centuries ago. Accuracy in identifying the individual species present in a sample is generally achieved by separating the diatoms from the soil matrix in which they are found either mechanically, or, where practical, chemically and then preparing slides of the samples. The particular composition of the soil in the wetland environment here under study has made the chemical treatment of diatom samples difficult, as both the soil matrix and the diatom shells are primarily composed of silicon dioxide. The method presented here solves this problem by incorporating a heavy salt solution to float the diatoms after treatment in order to separate them and make counting on slides easier. The resulting samples are easier to identify then the standard mechanically separated slides and higher magnification is possible, without significant loss of diatoms during treatment.

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Characteristics of Stock-Piled Topsoils in the Western Rio Grande Plains

Energy development in south Texas has increased in recent years. Impacts of energy development can be reduced with responsible restoration. Often removed topsoil is segregated and stockpiled during construction. Little information exists on effects of stockpiling on soil microbial community composition and functionality and seed bank dynamics. A topsoil's seed bank includes seeds of the existing plant community as well as seeds from historical plant communities. Thus, depending on local site history, seed banks may include both native and invasive species. The topsoil is also the reservoir for a rich microbial community that is essential for ecosystem processes.

We are studying seed bank dynamics and microbial responses in stockpiles. Soil samples are collected from stockpiles in three study areas in the western Rio Grande Plains. Stock piles are sampled at different depths as they age; seed banks in the samples are examined under greenhouse conditions. Samples from stock piles are evaluated for microbial community structure according to ester linked-fatty acid methyl ester (EL-FAME) profiles, enzyme activities of C and P cycling, and selected chemical properties.

We will characterize how stockpiling topsoil affects soil microbial community composition as well as soil microbial biomass and carbon and nitrogen dynamics. Preliminary results suggest that microbial community structure and enzyme activities can change by stockpiling; seed banks differ between stockpiles and adjacent undisturbed areas; and effects are site-specific.

Our results will provide insight into management of stockpiled top soils and will contribute practical information needed to enhance chances for successfully restoring disturbed sites.

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Effects of Tanglehead (*Heteropogon contortus*) Invasion on Ecosystem Processes in the Texas Coastal Sandsheet

South Texas has experienced increases of several invasive grasses including Old World Bluestem (*Bothriochloa* spp. and *Dicanthium* spp.), buffelgrass (*Pennisetum ciliare* [L.] Link) and tanglehead (*Heteropogon contortus* [L.] P. Beauv. *ex* Roem & Schult.). There is little knowledge on the effects of tanglehead ecosystem processes such as energy cycling, nutrient cycling, and microbial soil processes in this region. To examine the effects of tanglehead invasion on microbial soil processes we are currently evaluating microbial community size and structure in three different types of vegetation communities in the Texas Coastal Sandsheet, representing a tanglehead invasion gradient including: 1) native plant community, 2) tanglehead-native mixture, and 3) tanglehead dominant. Soil microbial communities were evaluated for microbial biomass C (MBC) and N (MBN) as well as community structure via FAME profiles. Soil MBC and MBN were higher in native communities than in native/tanglehead mixture and tanglehead-dominated communities. Nonmetric multidimensional scaling ordination reveals shifts in the microbial community composition related to changes in fungal abundance. The changes in microbial community size and structure suggest potential changes in soil quality and microbial functioning due to tanglehead invasion. Further research will help to determine the extent of these effects and how to more efficiently focus management and restoration efforts in south Texas.

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Diatom Succession at the Greens Bayou Wetlands Mitigation Bank, The Tenth Year of a Ten-Year Study

Diatom community succession is being studied at the Greens Bayou Wetland Mitigation Bank (GBWMB) in Harris County, Texas. The GBWMB is a manmade 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 celled organisms 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. In the tenth year of the study, succession trends appear to show a recovery from the recent drought. This is indicated by the re-stabilization of the diatom community and return to diversity measured in years prior to the drought.

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Determining Impact of Small Mammal and Insect Herbivory and Transplant Resilience of the Federally Endangered Navasota Ladies'-Tresses (*Spiranthes parksii*)

Navasota ladies'-tresses (NLT) is a federally endangered terrestrial orchid endemic to Texas. Since being placed on the endangered species list in 1982, populations have been located in only 12 counties in the Brazos Valley of central Texas. Increased development in the Brazos Valley has led to NLT habitat degradation and loss. In some cases, transplanting is the only option for protecting the species and meeting Endangered Species Act mitigation requirements, but transplant susceptibility to stress and herbivory has not been thoroughly explored for this species.
In order to better understand NLT response to transplanting, we will transplant individuals from an area threatened by construction to deed restricted areas established for NLT conservation. This presents an opportunity to learn more about the resilience of transplanted individuals. We will establish experimental plots that exclude small mammals and insects. We will also experimentally manipulate soil moisture. The goal of this research is to 1) identify and determine the effect of small mammal and insect herbivores on transplants and existing NLTs and 2) determine the ideal soil moisture conditions for improving transplant success.

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Life History of the Endangered Poppy, *Argemone pleiacantha* Subsp. *pinnatisecta*, Along an Elevational Gradient

The Sacramento prickly poppy, *Argemone pleiacantha* subsp. *pinnatisecta*, is an endangered poppy endemic to the Sacramento Mountains of New Mexico. Little is known about the life history of this species, therefore more information is needed to provide a background for conservation efforts and formulate an effective conservation plan. We conducted life history surveys on 135 individuals in Alamo Canyon, which is separated into four sites by elevation, ranging from 4900 feet at Lower Alamo to 7100 feet at Upper Alamo. For each individual, height of the tallest stem, number of stems, number of reproductive stems, and number of buds, flowers, capsules, and dehiscent capsules was recorded. We will explore the effects of elevation on life history traits with one-way analyses of variance.

Increasing precipitation with increasing elevation was observed with rain gauges installed throughout poppy range. As a result, it is predicted that growth including height and stem number, and reproduction, including reproductive stem number, and number of buds, flowers, capsules, and dehiscent capsules, will increase with increasing elevation. This study will quantify poppy growth and reproduction along an elevational gradient. The results will provide a baseline of information to more effectively manage this species by providing a better understanding of its life history.

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Season of Prescribed Burning on Old World Bluestems

Non-native Old World bluestems are an increasing threat to native vegetation and wildlife conservation throughout the Texas Plains and Gulf Coast Prairies. Particularly, Kleberg bluestem (*Dicanthium annulatum* [Forssk.] Stapf) has created vast acreages of monocultures, and land managers have experienced difficulties restoring the native perennial grass community. The purpose of this research is to determine how varying the season of prescribed burning affects the relationships between Kleberg bluestem and other native vegetation.

This study is being conducted at the South Pasture Research Facility in Kleberg County, Texas. We have established ten permanent plots with grazing exclosures, each approximately 10 m^2, to investigate the influence of season of burning on fire effects. Four plots are being treated with summer burns and four plots with winter burns while the remaining two plots will receive no burning treatment. We are sampling vegetation before and after burning treatments for species composition and associations between neighboring plants, as well as individual perennial grass morphology, mortality and recruitment, and herbaceous community production.

Data collection and summer burning have already been conducted and preliminary results are being analyzed. By studying the effects of different seasons of prescribed burning, we hope to improve current understanding of the best use of fire for managing invasive, non-native grasses.

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Riparian Reference Plant Composition Study and Template

A result of an expanding and increasingly urbanized metropolitan area, the riparian vegetation communities of Austin-area streams continue to transform further from their natural state. In an effort to maintain the ecological function and the natural character of Austin watersheds, the City of Austin Watershed Protection Department has identified a need to characterize an archetype, or background condition of Edwards Plateau and Blackland Prairie riparian communities for use as a template for both the development community and stream restoration projects. Species composition, spatial arrangement and physical attributes of vegetation communities for 12 sites located in both smaller and larger watersheds were characterized using multiple belt-transects. Multivariate analyses including detrended correspondence analysis (DCA), analysis of similarity (ANOSIM), and similarity percentage (SIMPER) were performed by Community Analysis Package software. Results show that there was a significant difference in plant community composition in all compared drainage area and ecoregions for both ground cover and overstory communities ($p<0.05$). The analysis of similarity showed that the samples should be grouped by ecoregion and location within the watershed for overstory and ground cover communities. Recommended vegetation templates are presented as a guide for comparison to other riparian communities in the Austin area, and also a reference point for restoration of degraded systems. These quantitative species distribution lists are an invaluable resource for riparian ecologists in this region.

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