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Restoration of a Suburban Park for Endangered and Sensitive Species; Roy P. Drachman/Agua Caliente Regional Park, Tucson, Arizona

Agua Caliente Spring is in the 101-acre Roy P. Drachman Agua Caliente Regional Park (Park) situated in the northeast corner of the Tucson Basin at the foot of the Santa Catalina Mountains, approximately 15 miles northeast of downtown Tucson. The Parks unique location, topography, and the presence of a spring led agencies to consider restoring the wetlands to their natural habitat. Currently, spring flow is captured by man-made impoundments that have produced three ponds very popular with local residents. These ponds support numerous exotic plant and animal species and exclude the establishment of native fish, amphibian, and reptile species. The topography, soils, and historic plant and animal life of the Park indicate that at one time the pond areas supported cienega, riparian, and mesquite bosque habitats. Restoring the native ecosystem at the Park would create habitat to support rare or endangered plant and animal species including Arizona eryngo, Eryngium sparganophyllum, longfin dace, Agosia chrysogaster, desert pupfish Cyprinodon macularius, Gila topminnow, Poeciliopsis occidentalis, Gila chub, Gila intermedia, lowland leopard frog, Rana yavapaiensis, Sonoran mud turtle, Kinosternon sonoriense, and Mexican garter snake, Thanmophis eques megalops. Four restoration alternatives were identified and presented to the public. The selected alternative attempted to balance the popularity of the open-water areas of the park by leaving one pond untouched, while restoring the less visited areas to a native ecosystem. Public access to the restored portions of the Park and public education were important components of the plan.

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Integrating Restoration Principles into Alternative RCRA Cover Design at Rocky Mountain Arsenal National Wildlife Refuge (RMA), Commerce City, Colorado.

Alternative, but equivalent, designs for RCRA landfills may be more appropriate than prescribed or conventional designs, especially for sites in arid or semi-arid climates. Desiccation cracks in compacted clay, failing of geomembrane liners and poor habitat are among the problems associated with conventional designs. Alternative designs are constructed to mimic natural systems with a sufficient thickness of surface soil to store anticipated natural precipitation while sustaining established vegetation. During periods when infiltration exceeds evapotranspiration (e.g. late winter and spring in the Denver, Colorado region) the surface soil layer of alternative covers acts like a sponge to absorb and store precipitation. Evaporation and plant transpiration

then act as a pump to dry out the soil so that more storage capacity becomes available. The objective of the design is to prevent percolation below the rooting zone thus isolating ground water from contaminated leachate. The process for design and construction of alternative covers at RMA includes modeling to define preliminary design specifications, construction and monitoring of demonstration covers with defined performance criteria, confirmatory modeling to refine design specifications through sensitivity analysis and development of final construction specifications and quality control procedures. Important principles integrated into the design to promote ecological restoration of the sites include sufficient soil depth and fertility to support self sustaining native vegetation communities, cover soil placement density appropriate for vegetation establishment and growth, cover soil texture specifications suitable for vegetation, diverse seed mixes and flexible maintenance activities. Details of these design features are presented.

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Restoration of Resaca Wetlands and Associated Wet Prairie Habitats

Located near the mouth of the Rio Grande and Brownsville, Texas, U.S.A., Palo Alto Battlefield National Historic Site is a broad, largely undeveloped coastal prairie interspersed with small stands of mixed-brush, and several lengthy resacas (Spanish for ox-bow lakes). The battlefield retains some of its original integrity, however, over the last 80 years, grazing, farming, and drainage projects have damaged the soil and vegetation. Each of these alterations has hydrologic implications with unknown consequences. The restoration design process has begun with an assessment of the relationships between hydrology, surface topography, and vegetation using GIS modeling and field experiments. In addition, specific restoration methodologies for returning Spartina spartineae to the previously cultivated fields are being evaluated. Information gathered from this study will be used to develop a final landscape restoration design for the disturbed resacas and prairies within the core Palo Alto battlefield.

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Wildlife Corridors Natural Refuge in Trouble: A Case of Maasai Steppe Heartland in Tanzania.

Wildlife corridors serve as migration routes of wild animals hence connecting different ecosystems where animals live. Maasai Steppe Heartland in northern Tanzania is one of the world's richest remaining refuge for wildlife covering approximately 35,000 km2. The area includes National Parks such as Tarangire, Lake Manyara, and Simanjiro plains and several important National Forest Reserves and wetland areas. Over 350,000 pastoralists populate the area making it

vulnerable to habitat fragmentation. The corridors are useful as they allow movement of wildlife between habitats also acting as breeding ground of certain wild animal species such as zebra (Equus burchelli), wildebeasts (Connochaetes taurinns) etc. Pastoralists use these corridors as grazing areas therefore causing overutilization of resources, which result into resources detoreriation as well as denying wild animals access to the corridors. Overutilization of resources in the wildlife corridors will result into ecological islands hence increasing chances of inbreeding among wildlife. This situation calls for appropriate conservation measures to save the wildlife dispersal areas. Conservation through protection has proved unsuccessful while conservation without protection is also yet to be achieved in this area. Lack of diversification of income generating activities, poor policies, unawareness among local people, weak institutional capacities are the major inhibitors of conservation without protection. For successful participation of local people they should be told how they would improve their welfare by doing conservation. This paper discuses the problems behind the present conservation strategy in the area and proposes techniques for new conservation measures.

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Developing Strategies to Manage Invasive Plants During Grassland Restoration

Invasive plants impede grassland restoration by disrupting ecosystem processes. Managing invasive plants requires manipulating disturbance regimes that favor desirable species and wanted changes in successional trajectories. Reasons for the arrival, establishment, and spread of invasive plants should be understood before effective grassland restoration strategies are developed. Removing an invasive plant species without attention to plant community dynamics often only opens niches for other undesirable species to occupy. Restoration of desirable plant communities that resist invasion is an appropriate goal for grassland restoration programs. The integrated weed management paradigm provides a context for managing invasive plants that focuses on ecosystem processes and not on particular plant species or control practices. Prevention, detection, and control are key components of integrated management strategies. The suitability of weed control tools (biological, chemical, mechanical, and cultural) will vary according to the invasive plant, invaded site characteristics, and management constraints. The merits of each control measure and the potential for complementary or synergistic interactions when applying measures in appropriate sequences and combinations should be considered when developing grassland restoration programs. Herbicides can serve as a catalyst to expedite vegetation change and development of desired plant communities. The variety of herbicides currently available, with different modes of action and selectivity, and readily available precise and accurate application technologies provide land managers with many options to selectively alter plant composition, manage plant community succession, and expedite grassland restoration.

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Bog restoration following peat mining to promote animal recolonization

Peat bogs of eastern Canada face increasing pressure from the peat mining industry. The loss of the natural vegetation cover, the creation of networks of ditches, and the disruption of the hydrological conditions severely influence animal communities occurring in bogs, as shown in a number of recent studies. Peat mining reduces the abundance and species richness of amphibians in bog remnants adjacent to peat mining. Similarly, birds are negatively affected, with few individuals of peatland specialists when in the proximity of peat mining. Small mammals show a different trend, with an increase in non-peatland specialists in mined bogs. Following peat mining activities, sites do not typically return to a peat forming system without active restoration measures. Recent work on an abandoned site in eastern Québec, Canada has been undertaken. The site has been rewetted, bog plants have been introduced, and pools created. Since the start of the restoration efforts, we have monitored the colonization of the site by amphibians, birds, and aquatic insects. Animals found in peatlands of the area have returned to the site, and we have observed shifts in species composition as the system progressively reverts to an acidic peatland.

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Restoring food webs: How do we measure progress?

Food web complexity is one of the signs of successful restoration. Whether one is dealing with endangered species re-introduction, the management of wildlife harvest or hyper-abundant species, an overall measure of food web complexity is a useful guide to restoring an intact ecosystem. Here, I introduce a suite of whole-ecosystem variables, that permit the tracking of food web objectives without intensive trophic analyses. The variables are based on species lists, mean body sizes and (if available) relative species abundance. The simplest of these are derived from body size distributions or species richness. Direct calculation of connectance and the number of food chains in a web can be carried out with a modest amount of natural history information. Food web descriptors can also be weighted by the biomass flowing through each food chain. These approaches are illustrated by a comparison of national park faunas and of different stages of restoration projects.

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Watershed Analysis Process

The BLM/Ely Field Office administers 11.4 million acres of public land within White Pine, Lincoln, and Nye Counties. After the 1999 and 2000 fire seasons in the Western United States, the Ely Field Office recognized the urgent need to restore ecological stability to many landscapes under Ely Field Office jurisdiction, as well as the importance of working collaboratively. Watersheds were chosen as the spatial scale for landscape analysis and management. The watershed analysis process consists of four phases: 1) assessment phase, 2) evaluation phase, 3) determination phase, and 4) implementation phase. The objectives of watershed analyses are to promote healthy, sustainable ecosystems; to restore and maintain public lands to properly functioning conditions (PFC); and to provide for the sustainability of the variety of uses and the communities that are dependent upon productive, healthy public lands. Watershed analysis teams use BLM regulations to guide this analysis and input from the public such as the Eastern Nevada Landscape Coalition Science Committee to implement the most appropriate science in data collection and evaluation.

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Use of GIS Modeling to Quantify Natural Resource Damages for Landscape-scale Restoration Planning

A GIS-based planning effort was utilized to assess natural resource damages and to develop a landscape-scale restoration plan for the Anaconda Regional Water, Waste, and Soil Operable Unit (ARWWS UO) of the Anaconda National Priority List Superfund Site. The ARWWS UO encompasses 10,906-acres near the town of Anaconda, Montana. Natural resources surrounding Anaconda were impacted by smelting operations from the turn of the century until to 1980. The primary challenge posed by this largely denuded site involved determining the diversity and spatial distribution of historic native plant communities on a landscape scale. This determination was made by performing habitat typing in an adjacent, uninjured reference area. Reference area sites contained unique combinations of site physical factors (elevation, aspect, slope, and soil type) and vegetation. Vegetation communities were classified using standard habitat typing techniques. The relationship between site physical factors and habitat types was interpreted through statistical analysis. The findings were extrapolated to the injured area, using GIS modeling to analyze the combinations of relevant site factors and to assign a complementary habitat type. The resulting model described the distribution and extent of native plant communities as they likely occurred prior to injury. The pre-injury vegetation model was used to quantify acreages to be restored and to identify target vegetation types and species assemblages across the injured area. A landscape-scale restoration plan, including alternative restoration strategies, treatment prescriptions, implementation specifications, and cost estimates, was developed based upon GIS-derived information.

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Conservation Development : An Ecological Systems Approach

Conventional development practices often eliminate or significantly compromise natural resources and the associated ecological systems. Native habitats are typically lost, fragmented, or degraded, and hydrologic systems modified, reducing water quality and causing more volatile flows and water fluctuations. Increasing and inevitable development around the globe requires that approaches to development address and reduce these adverse ecological impacts if conservation objectives and sustainable communities are to be achieved. Employing conservation development (CD) principles can reduce or avoid many of these adverse ecological effects and better integrate healthy ecosystems with the built environment, to the mutual benefit of people and nature. At Applied Ecological Services, Inc., our approach to CD focuses on preserving, conserving, restoring, enhancing, connecting, and managing healthy native ecosystems in perpetuity. Alternative, ecologically-based stormwater management plays an important role in most of our projects. We employ natural systems to provide rate and volume control, increase water quality, and create and connect wildlife habitat. Case studies will be presented to illustrate the application of CD principles to site design, implementation, and management. The listener will learn a proven approach to CD projects, specific techniques that can be applied to achieve conservation objectives, and how a CD approach doesn't need to compromise the developer's bottom line and, in fact, can be an effective marketing tool.

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History of Fire on a Marginal Landscape that Accumulates Fuel ? The Disturbance Model

The continued decline of the sagebrush biome and concern over threatened sagebrush obligate species has increased the debate over the past role and current use of prescribed fire in this ecosystem. However, in this debate the spatially and temporally complex nature of fire is often over-simplified. This paper is based on past and ongoing work across the sagebrush biome in the Intermountain West. Evidence used to describe past fire regimes across different sagebrush plant associations are fire scars from ponderosa pine and juniper, tree age structure, shrub age structure, and fuel characteristics. Fire regimes varied from frequent (10-20 years) low intensity burns in the cooler wetter sagebrush plant communities to infrequent (100 to > 200 years) high intensity fires in the more arid sagebrush plant communities. The spatial variability of fire regimes within and across sagebrush biome was an important factor in creating landscape heterogeneity. However, today the significant shift in fire regimes is creating a more homogenous landscape.

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The Changing West - An Overview

The American West is the fastest growing Region of the United States. From 1976 until 2000, the region's population grew by 61%, with Nevada's population growing at more than 3 times that rate (209%). This growth trend is projected to continue into the next two decades with an increase of over 30%. Nevada's population is anticipated to increase more than 50% in the next two decades. Significantly, during the 20 years following the year 2000, all of the western states, with the exception of California, will have a 100% increase in the population of age 65 and older. The increasing population will have impacts upon undeveloped and recreational public lands in the west. Those impacts will be explored. There will be increasing competition for use of public lands from traditional and non-traditional uses. To accommodate those uses and maintain the ecological integrity of the landscapes, public lands agencies must ?fine-tune? their management mandates for the area of operation taking into consideration increased spatial and temporal scales.

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Summarizing the Future

The vision and the challenges to that vision will be summarized. The future of the Eastern Nevada Landscape Retoration Project will be outlined and progressive indicators described. Recommendations implementing similar efforts will be presented.

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Ecological restoration with the help of plantation forests: effects of overstory species canopy architecture and prior plantation site history

Many of the ecological degradations observed today have deforestation as their root cause. Thus, strategies for effective forestland rehabilitation are needed. Several recent studies have shown the fostering roles of planted forests to restore diverse native forest flora under their canopies. Nevertheless, diversity, density, and growth of recolonizing native flora have been observed to differ considerably between overstory planted species, although less empirical evidences are

shown that correlate planted species characteristics with regeneration parameters. Land use history of planted sites are also hypothesized to exert direct and indirect limitations on successful restoration such as through depletion of forest flora propagules from the soil seed bank (SSB) and/or through site impoverishments that constrain native forest flora recovery. In this study, plantation forests were generally found to foster restoration of diverse native forest flora. Plantation canopy characteristics such as leaf area index (LAI) or canopy closure percent (CCP) were shown to affect the diversity, density and growth of emerging seedlings of the native forest flora. Species with open canopy (low LAI or CCP) such as broad-leaved species were found to foster more diverse and dense native flora with vigorous growth than species with denser/heavier canopy. Third, site history, abandoned agricultural site verses degraded natural forest site, showed very little differences in the diversity and density of recolonizing native forest flora in the presence of an adjacent remnant natural forest. The conclusion is that plantation forests could be employed as rapid and productive restoration strategic tools for rehabilitation of degraded lands with proper plantation species selection.

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Riparian Restoration in Texas with CCRP

The majority of riparian areas in Texas exist on privately owned rangeland, but, there has been little in the way of incentives to encourage good long-term management of riparian areas. Heavy grazing in creek bottoms has caused damage to riparian vegetation. Loss and degradation of natural riparian plant communities has caused a series of environmental problems on-site and downstream. In an effort to provide meaningful incentives to landowners to help restore degraded riparian areas, creek bottoms can be established in Riparian Buffers through the Continuous Conservation Reserve Program (CCRP). Under this program, landowners receive a Signing Incentive Payment of $100 to $150 per acre plus annual rental payments for riparian areas adjacent to seasonal and perennial streams. Rental payments range from about $24 to $55 per acre per year for the 10 to 15 year enrollment period. Payment rates vary geographically and according to stream type. No grazing is allowed during the enrollment period to allow regeneration of natural riparian plant communities. Cost-sharing and practice incentives provide 90% reimbursement for riparian fencing and alternate livestock water development in uplands. A growing number of landowners in central and west Texas have enrolled their creek and river bottoms in Riparian Buffers. Their reasons for enrollment include both conservation and financial motives. CCRP is an example of a federal conservation program that can result in long-term benefits to the environment, society, and the private landowner.

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Natural Revegetation of Abandoned Roads at the Rocky Flats Environmental Technology Site, Golden, CO.

During the late 1970's several gravel roads were abandoned in place and never revegetated at the Rocky Flats Environmental Technology Site (Site), a U.S. Department of Energy facility, near Golden, CO. A study was conducted during 2002 comparing the vegetation on these naturally revegetated roads (abandoned 20+ years ago) to the adjacent native prairie to provide information for revegetation activities at the Site. Roads were examined on the xeric tallgrass prairie (XTGP) and mesic mixed grassland (MMG) communities at the Site. Results suggest the natural revegetation of the roads has been very successful. Foliar cover and species frequency comparisons showed little overall differences between the roads and adjacent prairie. On the XTGP, the roads have reached a mid-successional stage and over the next decade or two should return to the native climax community found on the surrounding prairie. On the MMG roads, little species compositional difference was apparent between the roads and adjacent prairie, suggesting these areas have largely returned to the more climax conditions found on the surrounding native prairie. The species that had become well established on the XTGP road areas included Aristida purpurea var. robusta, Andropogon scoparius, Sporobolus asper, Andropogon gerardii, Agropyron smithii, and Stipa comata. On the MMG roads the most successful species included A. purpurea var. robusta, A. smithii, Koleria pyrimidata, S. comata, and Stipa viridula. The results suggest that A. purpurea var. robusta and S. asper are both good early successional species to include in a seed mix.

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Factors affecting juniper invasion of central Texas savannas

Ashe juniper (Juniperus ashei) rapidly invades central Texas savannas and converts them to woodlands ('cedar brakes') with consequent loss of biodiversity. Fire may have prevented this from occurring in the past. To test this hypothesis, we compared burned and unburned plots in four savanna sites in central Texas. Survival of junipers was lower in burned sites, supporting the hypothesis that fire can slow juniper invasion. Eighty-eight percent of small Quercus fusiformis) that dominate these savannas.

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Robber Baron Cave, San Antonio, Texas: Surface Restoration For Subsurface Species

Known since the 1910s, Robber Baron Cave developed a rich history through its use for many purposes as San Antonio, Texas, grew up around it. Vandalism resulting from the cave's urban location resulted in the installment of a series of four gates beginning in 1980, each more secure than the last, until the placement of what proved an impenetrable 5-ton concrete bunker laced with rebar and accessed through a thick steel door. However, this bunker restricted airflow and nutrients into the cave, which contains six endemic invertebrate species of which two are federally listed as endangered. The Texas Cave Management Association (TCMA) has since acquired the cave and also a grant from the U.S. Fish and Wildlife Service to improve the species' habitat. Originally, TCMA planned to modify the bunker but structural instabilities were discovered that required its complete removal. This allowed restoration of the entrance to its near-original state with a secure but ecologically sound gate that allows the natural passage air, water, nutrients, and organisms. Since some non-listed yet ecologically key cave species exit at night to forage, native vegetation is being restored to the grounds surrounding the entrance. Exotic species have been removed. A landscape architect has designed a plan to be implemented in stages that will not require watering or chemical treatment, and will support the cave's endangered species. When restoration is completed and signage installed, the landscape over the cave will serve as an education resource for the community.

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Great Basin Restoration Initiative and the Eastern Nevada Landscape Restoration Project

The Great Basin is a semi-arid desert in the Intermountain West, U.S.A.that was historically dominated by shrubs with a perennial herbaceous understory and maintained by periodic wildfires. The U.S. Department of Interior's Bureau of Land Management (BLM) oversees nearly 75 million acres of public lands. Biological integrity is at increasing risk as invasive species continue to displace native plants and wildfire size and frequency increase. The Great Basin Restoration Initiative (GBRI) was initiated in 1999 after a disastrous wildfire season (1.7 million acres of public lands were burned) to restore diversity and stability on degraded rangelands and woodlands. This proactive program emphasizes restoration of native plant diversity and structure prior to unwanted disturbances, thereby reducing the threat of invasive species, risks of wildfires and the costs associated with managing these disturbances. The Initiative encourages collaborative, science-based projects that provide economic benefits to local communities. The first priority is to maintain healthy landscapes followed by restoration of priority, degraded landscapes the sustainable use and enjoyment of Great Basin public lands. The Eastern Nevada Landscape Restoration Project is the prototype project for GBRI implementation. It links community, science, and management in a 11.4 million acre project area in eastern Nevada that is the model for restoration activities in the Great Basin. If this Initiative and the regional restoration

projects associated with it are not successful, the largest desert in the United States will continue to unravel ecologically with significant negative impacts to people and natural resources.

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Give Industrial Ecology an even broader space

Industrialization destroys the natural balance of bio-geo-chemical cycle in the earth with its single-line using method of the resource. The resource and pollution crisis of the world urges us to restore the natural balance of the bio-geo-chemical cycle in the earth with human industry being considered into the cycle as an essential element. The put forward and practice of Industrial Ecology(IE) has put restoration study into a new phase. However, most of the current IE studies are focusing on the regional industrial ecosystem, emphasizing their character of roundput, which partially neglects the fact that the optimization of every units (industrial ecological parks) doesn't mean the optimization of the whole system (bio-chemical cycle) because of the interaction effect among them. While lacking consideration of surrounding resource and development opportunity from an even larger space-time scale, the current studies can't solve the problem of industrial conversion in regional or even larger area perfectly. Neither can they guide the practice of industrial conversion in regional, national or global scale. To make up the deficiencies, a new concept, general industrial ecology (GIE), is put forward for the first time. The relationship between GIE and SIE, the basic procedure and research methods of GIE are given out. The principle of IE is extended to include opening, locality and economy besides the original roundput. A case study with the Jyvaskyla industrial ecosystem is given out to clear the difference and relativity between GIE and SIE study, and to confirm the four principles of GIE in practice.

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Whitebark Pine Regeneration Within a Community Context: Restoring a Keystone Species

Whitebark pine ecosystems provide critical habitat for many northern Rocky Mountain species, including grizzly bears. However, whitebark pines are rapidly declining due to the introduced disease white pine blister rust, pine beetle infestations, and fire suppression. Greenhouse propagation and out-planting of rust-resistant seedlings provide a tool for whitebark pine restoration, yet little is known about the ecophysiology of whitebark pine seedlings. This study focuses on interactions between whitebark pine seedlings and understory plant species following

fire. In 2002, experimental plantings were performed in a 1988 burn outside Yellowstone National Park. Whitebark pine seedlings were planted with Vaccinium scoparium, Carex, and bare ground to test the effects of plant species associations on whitebark pine seedling survival and growth. Seedlings planted with Vaccinium scoparium had highest survival, while those planted with Carex had lowet survival. Seedlings planted in bare ground had intermediate survival, but addition of artificial shade increased survival to a level equal to that of Vaccinium scoparium-associated seedlings. Clipping of adjacent Carex or Vaccinium scoparium plants had no effect on whitebark pine seedling survival. Results indicate that under high light and temperature stress present in high elevation burn sites, whitebark pine seedlings may benefit from partial shading. In addition, experimental planting and clipping treatments suggest that adjacent understory plants may have either positive (Vaccinium scoparium) or negative (Carex) effects on whitebark pine seedlings and that these effects may be due to belowground interactions.

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The Ecological Costs of Doing Nothing

Fire disturbance has played an integral role in the ecology and development of semi- arid plant communities throughout western North America. Altered fire intervals and regimes since European settlement have led to pervasive alterations in species richness, diversity, fuel loads, and associated processes such as nutrient cycling and biogeochemistry within native rangeland plant communities. The application of state- and-transition succession models to many western plant communities indicates that woody plants have increased to a point where understory species compositions have crossed thresholds, limiting resiliency and the understory's ability to respond to typical fire disturbance. Loss of the understory component increases the potential for invasive non-indigenous species establishment and subsequent negative effects on soil erosion potential, fire interval and regime, and wildlife habitat. Active and passive fire suppression has created a homogeneous landscape that now threatens to limit our management options, reducing our ability to provide ecosystem services valued by society. The pristine-management-paradigm defines ecological systems as static entities that can be held in a static condition once they reach the climax stage, if protected from fire and other disturbances. If the goal is preservation of management options, this trend cannot continue. The management paradigm must be changed, the successional process across millions of acres must be changed or future generations will inherit a landscape devoid of many of the values we now enjoy.

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All Things are Related: Indigenous Knowledge and Evolutionary Biology

Despite a long history of denigration of indigenous knowledge by the Western cultural tradition, there are likely to be valuable insights generated by including the traditional philosophical

approaches and knowledge of indigenous peoples into contemporary studies of ecology and evolutionary biology. These traditions emphasize connection and relatedness between different types of organisms, and also understand that changes in phenotypes and behavior of plants, animals, and even human beings. The Cartesian machine metaphor has yielded some progress in scientific investigation, but has impeded progress in many areas, especially those related to process and function. I provide examples of how the indigenous approach might yield insights into those areas of scientific investigation that have proved most resistant to the machine metaphor. One area of particular promise is the role of high quality individuals in affecting both local population dynamics and microevoutionary change, which has been largely ignored by Western science, but is clearly part of the indigenous traditon as evidenced by stories and traditions about "keepers of the game" or "animal masters," which are animals that have major influence on local population dynamics. Such phenomena are related to the idea of "Effective Population Size" which is important in modern conservation biology. In addition this phenomena provides insights into how the process of macroevolutionary change is likely to funciton. In addition, cultural transmission in animal populations of foraging techniques and local geography has long been a part of indigenous knowledge, but has only recently been described in Western science.

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The restoration of cut-over peatlands and its relevance to conservation

The concept of restoration is defined differently depending on the objective determined by the society, sponsors, regulations or scientists involved. Even though it does not necessarily aim at reconstructing the original ecosystem that was existing before exploitation activities started, it should usually help to bring back the primary functions that prevailed prior to disturbance. In North America, techniques developed for restoring peatlands after peat harvesting aim at re-establishing a vegetation cover dominated by Sphagnum as well as restoring hydrological conditions. The restoration should reinstate typical peatland functions such as productivity leading to peat accumulation and the recycling of nutrients. Reclamation is an alternative promoted in many countries, where cut-over peatlands are transformed into tree plantations or used for the production of small fruits. The success of these options is also evaluated in Canada. However, only restoration can contribute to the Canadian policy of No Net Loss, which aims at maintaining wetlands in the landscape. Moreover, restoration should play a significant role for peatland conservation as disturbances are regionally concentrated. In that respect, biodiversity is distributed unequally and should receive our attention in all regions. Finally, restoration cannot replace in situ conservation of intact peatlands, because peat resource is not renewable in a human time scale.

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Effects of red cedar removal on the bird community at the Niobrara Valley Preserve, NE

The 70-mile Niobrara National Scenic River includes the Niobrara Valley Preserve, a 25-mile section of river managed by the Nature Conservancy. The Niobrara River valley is a unique forest habitat on the edge of the Nebraska Sandhills grasslands. During recent decades of lower fire occurrence, portions of this forest have intruded into grasslands on the Niobrara Valley Preserve. The Preserve is presently in the process of carrying out a management objective to remove red cedars to restore former grassland habitats in the upland of the Niobrara valley. The ecosystem transformation will restore the natural vegetative state, but it will almost certainly affect the wildlife inhabiting the areas of red cedar intrusion. This research project, scheduled to begin in 2004, is designed to determine how soon grassland bird communities colonize the restored grassland. This field experiment will be used to provide guidance to future management actions on the Niobrara National Scenic River.

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The folly of coral reef restoration programs following natural disturbances

An argument can be made that we should conduct research to acquire knowledge and skills sufficient to attempt coral reef restoration, especially related to the recent losses of acroporid corals throughout the Florida reef tract. A compelling analogy can be made that restoring hard bottoms back to high-cover acroporid-dominated systems is similar to replanting clear-cut forests. It must be recognized, however, that substantial variability previously existed related to the spatial and temporal distribution of Acropora-dominated reefs in recent and historical times throughout the Keys. Management goals need to be carefully crafted within constraints defined by what we know of historical conditions and present-day interactions and processes that influence the ecosystem. Present-day processes that act against sustained acroporid reef development such as winter cold fronts, disease outbreaks, coral bleaching events, predation by mobile fauna, and hurricanes will continue. Therefore, management to restore acroporids will always be constrained by the boundaries of historical conditions and present-day processes. Based on these factors, we conclude that species-specific restoration efforts will likely result in garden-type experiments without ecological or geological consequences along the Florida reef tract. One such example is an Acropora nursery program established by a volunteer group at Western Sambo Reef in February of 1998. There, a severe winter storm (The Ground Hog Day Storm of 98?) injured remnant stands of A. palmata. Divers recovered some 49 broken coral branch fragments and these were attached to concrete pads forming Acropora rosettes. Only seven months later, in late September 1998, Hurricane Georges ravaged the middle and lower Florida Keys including the reef at Western Sambo moving all of the rosettes from their original positions. In total, only nine

pieces of the transplanted Acropora on the rosettes survived this storm, an 82% loss. These results show the folly of such restoration attempts, and also raise significant scientific questions about restoring sites injured by natural disturbances.

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Escondido Creek Enhancement Project: Ecological Principles Translated into Design and Implementation

Enhancement of Escondido Creek in San Diego County, California, involves the removal of over 3,500 non-native eucalyptus trees (e.g., Eucalyptus globulus and E. camaldulensis) and 15 additional invasive exotic plant species listed by the California Exotic Pest Control Council (CalEPCC), followed by native plant revegetation to restore the creek to its re-distrubance condition. The project is being performed within 92 acres of dedicated conservation easements along 1.8 miles of the creek and is converting 21 acres of non-native habitat dominated by invasive exotics to native willow woodland and oak-sycamore habitat with appropriate perennial and annual species. Because the majority of the area is comprised of sensitive native habitat including mature oaks (Quercus agrifolia) and sycamores (Platanus racemosa)with diameter at breast heights (DBH) over 36 inches, and most of the eucalyptus trees to be removed are over 125 feet tall, creative and sensitive methods of access and exotic plant removal have been developed. So that native plant material genetically adapted to the site is installed after invasive exotics are removed, the project includes on-site collection of seed and cuttings to provide over 660 pounds of seed and 7,300 container plants specified by the project plant palettes. Translation of the project's ecological principles and goals into construction plans and specifications and implementation has been a collaborative effort between restoration ecologists, resource agency regulators, planners, engineers, landscape architects, and the localEscondido Creek Conservancy. This presentation will highlight the project's primary ecological principles, the collaborative design process, and implementation results.

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Monitoring Riparian Restoration Sites for Vertebrate Use: A Case Study Along the Central Coast of California.

Areas are often restored to provide habitat for vertebrate wildlife.However, many restoration plans lack specific goals to test the assumption that the restored area provides the necessary

habitat components needed by wildlife.It is often assumed that, by planting vegetation, adequate habitat has been created and species will colonize a site.To carry out restoration goals more efficiently, projects should have long-term monitoring programs in place to validate vertebrate use of restoration sites.We will discuss an ongoing vertebrate monitoring project being conducted at a California Department of Transportation riparian restoration and mitigation bank site in Monterey County, California.Specific recommendations include the use of a baseline inventory to establish a group of focal species to monitor over a 5-10 year period , and the use of adaptive management to fine-tune restoration goals.

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North American approach to the restoration of Sphagnum dominated peatlands

Peatland restoration is recent and has seen significant advances in the 1990s. A new approach addressing the North American context has been developed and is presented in this paper. The short-term goal of this approach is to establish a plant cover composed of peat bog species and to restore a water regime characteristic of peatland ecosystems. The long-term objective is to return the cutover areas to functional peat accumulating ecosystems. The approach developed for peatland restoration in North America involves the following steps: 1) field preparation, 2) diaspore collection, 3) diaspore introduction, 4) diaspore protection, and 5) fertilization. Field preparation aims at providing suitable hydrological conditions for diaspores through creation of microtopography and water retention basins, re-shaping cutover fields and blocking ditches. It is site specific because it depends largely on local conditions. The second step is the collection of the top 10 centimetres of the living vegetation in a natural bog as a source of diaspores. It is recommended to use a ratio of surface collected to surface restored of 1: 10 order to minimize the impact on natural bogs and to insure rapid plant establishment. Diaspores are then spread as a thin layer on the bare peat surfaces to be restored. It has been demonstrated that too scant or too thick a layer decreases plant establishment success. Diaspores are then covered by a straw mulch which provides improved water availability and temperature conditions. Finally, phosphorus fertilization favours more rapid substrate colonization by vascular plants, which have been shown to help stabilize the bare peat surface and act as nurse plants to the Sphagnum mosses.

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A Monitoring System for Adaptive Management of Longleaf Pine Ecosystem Restoration in

North-Central Florida

Longleaf pine(Pinus palustris)was once the dominant tree species throughout 24.3 million ha of forest land in the southeastern United States. A small fraction, perhaps as little as 1.2 million ha, remains today . The vast majority of this forest is fragmented secondary growth that regenerated after the railroads expedited the logging and clearing of these forests. Through a cooperative project with the University of Florida, a system of monitoring and assessing longleaf pine ecosystem restoration was established. The foundation of the monitoring program is a network of 484 geo-referenced permanent sample points from which characteristics of vegetation composition and structure were collected at the groundcover, mid-story, and tree canopy layer. The methodology and observed variables vary among these three classes to ensure reliable estimates. A statistical analysis which compares areas of the property that had been subject to anthropogenic disturbance, with reference sites, was used to determine a preliminary list of focal species for future monitoring.

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Understanding patterns of coastal marsh surface sediment deposition to achieve restoration goals

Many efforts to restore estuarine habitats focus on preserving or recreating tidal marshes. One of the most pervasive threats to coastal marsh survival is sea-level rise or local subsidence. Thus soil building, through sediment deposition and organic matter accumulation, is a critical function of a restored tidal marsh. Studies of marsh surface sediment deposition and soil development in healthy, stressed and restored marshes show complex spatial patterns in sediment deposition that operate at a variety of scales. Supplies of sediment vary within estuaries creating gradients at the system scale while small-scale marsh hydrology and the dynamics of the sediment deposition process introduce complexity at the local scale. Field studies show that in microtidal coastal Louisiana, the role of proximity to tidal creeks is a less important control than in macro-tidal marshes of eastern England. Understanding such differences is crucial for planning effective restoration of tidal marsh habitat. Similarly, the temporal control on sediment deposition must be understood. The role of tides vs extreme events, such as storms and floods, in soil building also varies among systems. Thus in some areas restoration success may be more dependent on stochastic events than detailed design features of the restoration plan.

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Effects of Prescribed Fire on the Composition and Structure of Vegetation in Four Central Missouri Ozarks Oak Savanna Remnants

Savannas and woodlands are among the most diverse natural communities in the Midwest. Unfortunately, because savannas require a disturbance regime which includes fire which has been suppressed since European settlement, they are among the most endangered as well. The purpose of this study was to assess quantitatively, by comparing the vegetation composition in burned and equivalent non-burned plots in four Central Missouri state parks, the consequences of fire as a management tool for promoting the restoration and preservation of Central Missouri Dry-chert and Limestone/dolomite savannas. Ground layer, understory, and canopy cover vegetation was sampled in 40 plots within four state parks containing remnant oak savannas and woodlands. Univariate analyses determined that ground cover species promoted by burning had significantly higher Coefficient of Conservatism values than species which were suppressed by burning. Mean Coefficient of Conservatism, Floristic Quality Index Assessment, species richness, and ground cover all increased significantly when compared to non-burned sites. Multivariate analysis found that Helianthus hirsutus (Bristly Sunflower), Potentilla canadensis var. villosissima (Five Finger Cinquefoil), and Antennaria spp. (Pussy's Toes) were promoted by burning while Juniperus virginiana (Eastern Red Cedar), Symphoricarpos orbiculatus (Buckbrush), Ambrosia artemisifolia (Ragweed), Toxicodendron radicans (Poison Ivy), and Diospyros virginiana (Persimmon) were all suppressed by burning. Mean species richness, species diversity, mean Coefficient of Conservatism, and Floristic Quality Assessment Index all increased as a result of prescribed fire.

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Imazapic (Plateau) Herbicide for Weed Control and Native Groundcover Restoration on Mined and Unmined Lands in Florida

The effects of imazapic herbicide applications at 4 rates (0, 2, 5, and 8 oz. Plateau/acre) and 3 time periods (pre-emergent [December, shortly after seeding], early post-emergent [late May-early June], and late post-emergent [early October]) were evaluated on 3 soil types (flatwoods soil, sand tailings, and overburden) that were newly seeded with native upland groundcover species. Imazapic was also tested in mid August at 5 applications rates (0, 2, 5, 8, and 12 oz. Plateau/acre) on unburned and burned (treated 3 weeks following the burn) portions of a 5 ½ year old seeded overburden site. Pre-emergent herbicide applications prevented many desirable species as well as undesirable species from germinating. Early post-emergent applications at 8 oz. per acre controlled several weedy species and undesirable species without adversely affecting most desirable native species. Species controlled included bahiagrass, natalgrass, crabgrass, foxtail, and Cyperus. Tolerant natives included Andropogon, Aristida, Eragrostis, Schizachyrium, Chamaechrista, Liatris, Pityopsis, and Solidago.. Sorghastrum secundum was injured. Cynodon

dactylon and Imperata cylindrical were not controlled. The late post-emergent treatment effects were similar to the early post-emergent applications except that the early treatments provided control through the important summer growing season.

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Stochastic Competition Models for Forcasting Response of Invasive Plant-invested Communities

For invasive plant managers to make well-informed decisions, technology that estimates the probabilities that various species and functional group compositions will result from management must be made available. We selected the deterministic carrying capacity and time series models that most accurately predict grass and leafy spurge abundances in competition experiments using jackknife cross validation. The best-predicting models, with parameters estimated from the competition experiments, were then used to predict data from herbicide, revegetation and selective plant removal experiments. Predicted lines were centered on observed values for most of these accuracy assessments indicating that there were no consistent differences between the system used to develop the models and the system used to assess them. Bayesian parameter estimation techniques were then used to develop stochastic versions of the best-predicting deterministic models. Prior probability distributions on competition parameters were developed from herbicide, revegetation and selective plant removal experiments. These prior distributions and non-informative prior probability distributions describing intrinsic rates of population increase, carrying capacities and standard deviations of error terms were updated with data from competition experiments using likelihood functions. Because the response variables from the stochastic models are probability distributions, probabilities that particular shifts in leafy spurge and grass production will result from management actions are estimated.

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Sphagnum at work : their functioning as peatland engineers

Sphagnum mosses are key plant engineers in the initiation, development and maintenance of peat bog ecosystem. Consequently they are given primary importance in the restoration process of exploited peatlands. A review of the factors that can influenced the regeneration of Sphagnum fragments (individual stems) in its first years of establishment will be presented. Apical bud dominance do not appear to retard regeneration in the field, this might be linked to a degenerative phase first. The regeneration depth of several Sphagnum species is usually best in the top 6 cm

fragments with good regrowth that can be found down to 22 cm along the stems for certain species. Physiologically, individual stems of Sphagnum have stronger limitations towards desiccation when not living in colonies. Shading up to 80% is not a problem for up to at least 3 months of growth. Periods of flooding can advantage some Sphagnum species more than others. On bare peat with water table remaining below the peat surface, only areas where pore-water pressures is consistently above ?100mb and volumetric water content above 50% can be found with some Sphagnum regeneration. Mechanical micro-disturbance of establishing Sphagnum fragments is a problem that needs further investigations in peatland restoration.

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Promoting Conservation Through Youth Programs: A Case Study of the Bobwhite Brigade

The success of any ecological restoration effort relies upon communication, hence awareness, among stakeholder groups. A pilot program was initiated in 1993 to train high school youth in natural resource management and leadership skills in order for them to become master volunteers. Dubbed ?The Bobwhite Brigade?, this youth corps was built around the popular and charismatic bobwhite (Colinus virginianus). Cadets (high school sophomores and juniors) undergo an intensive curriculum in quail biology, applied ecology, critical thinking skills and leadership development to equip them as spokespersons for conservation. Upon graduation from the Brigade, cadets are required to conduct at least 3 educational programs to various audiences (youth and adult), and are encouraged to give additional programs. The original camp has been cloned in Texas to include ?Buckskin Brigade? (using white-tailed deer [Odocoileus virginianus] as the featured species) and ?Feathered Forces? (using quail and wild turkey [Meleagris gallopavo]). Through 2002, over 600 youths have graduated from the Brigade, and have presented an estimated 4,000 educational programs. These programs have included news and magazine articles, TV stories, public service announcements, and direct contacts through tours and field days. Aside from its demonstrated success with youth, the Bobwhite Brigade has been a vehicle to promote networking by various agencies, non-governmental conservation organizations, private industry and landowners. Finally, the underlying message preached throughout the Bobwhite Brigade is one of ecosystem management and indeed how ?the whole is greater than the sum of the parts.? We have found that the conservation education (including sometimes nebulous topics like ecosystem management) can be delivered in a very tangible manner with a very popular, non-controversial organism. The Bobwhite Brigade model can be adapted easily for other species and environments.

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Cistern Spring Restoration and Salamander Habitat Enhancement

Cistern spring is located on preserve land that is part of the City of Austin's Balcones Canyonlands Preserve (BCP) system. This spring is typical of the Jollyville Plateau (Northern segment of the Edwards aquifer). It is a localized discharge from a karst opening from the base of the Edwards geologic formation. Recent human impacts drastically altered the natural flow of this spring effectively eliminating all available habitat for spring dwelling organisms. The primary goal of this restoration project was to establish habitat for the rare Jollyville Plateau salamander (Eurycea tonkawae). This species of salamander is found only in pristine springs and spring runs of the Jollyville Plateau region of Travis and Williamson Counties, Texas. It is hoped that with the improved habitat, the Jollyville Plateau salamanders will naturally migrate back to this site. Secondary goals are to create a refugia for locally rare spring associated vegetation. The primary topics of this paper will be: methods used to restore this spring and improve habitat for spring associated flora and fauna, monitoring for the presence of salamanders, and funding for the project via a cost sharing grant form the Partners for Fish and Wildlife program.

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All Restoration is Indigenous

In the mid-Atlantic, where I live almost all land is owned and already developed by non-indigenous peoples. Our problem, like Europe's, is that there are many layers of land-uses by different peoples since colonial settlement. As one SER member from England noted, his goal was to become ?indigenous?. While we, in the US, cannot expropriate the word indigenous, to have landscapes that are indigenous to varying degrees requires behaving as-if-indigenous. The staff at Bowman's Hill Wildlife Preserve, for example, is as close to a landscape-dependent tribe of caring people that the native species of my area now have. These people, with others at botanical and conservation institutions, spend most of their time trying to sustain regional bio-diversity in a natural setting- for it's food, medicinal, genetic, scientific, esthetic and sacred value. They are painstakingly putting together a science of landscape management to make up for the fact that they no longer have a tradition of landscape lore and custom to depend upon. Without their constant interventions, many species would diminish or disappear. We need to achieve this same level of engagement with the natural landscape community-wide, in order to sustain biological richness. Obviously indigenous practice and culture are a leading edge in our adaptive coexistence with the natural world. I want to look at a variety of approaches to reintroducing us to the real world (versus the imagined or reconfigured landscape), from school curricula and interfaith councils to landscape contracts and farm practices.

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Which Master do you Serve- the Client or the Ecosystem

Living an ethical life by definition means living sustainably. As John Cairns, Jr. proposed in his "declaration of an eco?ethic"? "We pledge to adjust our individual and societal behavior so that it is compatible with biosphere integrity instead of further modifying the biosphere so that our technological society can expand and grow." I want to describe how this effort has affected a practice, a practitioner, and an individual. When we started Andropogon, the founding partners had a mission to serve the larger ecosystem in the planning and design process. The primary client is only a moment in time to the land in question. At Andropogon we work to embed all short-term decisions about the site in the context of the longer-term values of the landscape and the community. A key strategy is changing the context in which decisions are made in order to create opportunities for more ethical decisions. As a practitioner my understanding of the meaning of "local" intensifies every year. At this time my work is primarily focused on my home county and addresses matters related to the local economy, community values, monitoring programs, and local control and local expertise. Restoration is a local on-the-ground heuristic. No one can practice restoration without confronting the impacts of our lifestyles. As an individual my efforts have centered on the issue of consumption. Mindful that an ethic is about "doing", not "saying", we give credibility to what we say by demonstrating these values in daily life.

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Reclaiming Resources for Future Generations

This paper will present an overview of U.S. Fish and Wildlife Service's Natural Resource Damage Assessment and Restoration Program. The Comprehensive Environmental Response, Compensation and Liability Act (Superfund), Oil Pollution Act, and Clean Water Act authorize trustee agencies, such as the U.S. Fish and Wildlife Service, to obtain restoration for natural resources impacted by oil and chemical spills and releases (e.g., runoff from Superfund sites). Restorations include habitat enhancements (marine and freshwater wetlands and uplands), protection of habitats through easements and acquisition, population supplementations, and population enhancement through a variety of innovative techniques. The process for achieving these restorations will be discussed. Several case-specific examples will be provided to give an overview of the range in types of restoration projects, partnerships developed and natural resource benefits.

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Ecology and Design: Merging Biology, Restoration Ecology and Design - Provenance Green Community, Henderson, Nevada

Following an intensive toxic materials testing and remediation effort at a World War II weapons production site in Henderson, Nevada, the LandWell Company is proposing the development of a Green Community on this brown field site. LandWell's green building mission includes the creation of a series of wildlife corridors meandering through the community. These corridors were intended to connect Las Vegas Wash, a species-rich desert riparian system currently undergoing major ecological restoration, with the Provenance community. We performed a series of baseline studies to test the feasibility of creating wildlife corridors in an urban context, and to understand habitat requirements of target species that would use these corridors. Overlaying these survey results in our GIS database with a series of other relevant planning data created a network of opportunities and constraints for wildlife use. We then assigned a ranking system to model the most and least opportune locations for wildlife use within the community and evaluated this model based on site-specific and subregional habitat linkages and wildlife movement. The modeling results revealed that the size of the community, development density, and lack of habitat linkages would not support the creation of functional wildlife corridors. Therefore, we created wildlife habitat in the northern part of the community as an extension of Las Vegas Wash and an adjacent waterfowl preserve, and native desert greenbelts suitable for the use of certain types of urban-adapted wildlife. We designed this greenbelt system to fulfill multiple functions as ecological open space, community linkage, and water conveyance, retention and treatment.

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Using an amphibian index of biotic integrity to develop successful mitigated wetlands

One major cause of decline of amphibians has been attributed to loss of habitat. In general, construction of mitigated wetlands has not produced wetlands of a quality that replaces wetlands used by amphibian species in decline. We have been working to construct wetlands that add habitat used by amphibian species in decline. To measure success in this endeavor, we used an amphibian index of biotic integrity first developed by Micacchion in 2000. We found some limitations and made some modification to Micacchion's AmphIBI. This paper presents those results.

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Flood Management and Improvements to the San Antonio River - Past, Present. Future

Originating from springs flowing from the Edwards Limestone Aquifer located hundreds of feet below the ground, the waters of the San Antonio River have sustained human occupation along the banks of the river for thousands of years. Throughout the 1700s, development of what is now known as the City of San Antonio occurred when Spanish Colonial Missions were established near the river. As San Antonio continued to grow, the river periodically flooded which brought destruction and loss of life. A large flood in 1921, which took some fifty lives and caused millions of dollars in property damage, was the catalyst for the construction of several flood management projects such as the Olmos Dam, the ?Great Bend Cutoff? and the River Walk. The development of the River Walk provided flood protection while maintaining the historic tradition and natural beauty of the river. Responding to another devastating flood in 1946, the United States Congress authorized the San Antonio Channel Improvements Project. This project consisted of the channelization and general improvements to manage flooding on the San Antonio River and four of its major tributaries. This project also included the construction of two tunnels that bypass floodwaters beneath downtown San Antonio. Presently, all of these projects combine to provide significant flood protection for the City. Future plans for the San Antonio River, through the San Antonio River Improvements Project, consist of ecological restoration and recreation features for nine miles south of downtown and ecologically sensitive river improvements with some restoration features for four miles north of downtown.

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The Shock of the New

Why do ecologists generally try to recreate a specific target community, when nature is about flux and dynamics? This paper will propose a a way of working through creative conservation that works with the dynamics of nature rather than working against the grain. In this way we create new habitats that can develop and change over time and that are not direct attempts to mimic precise species assemblages. Landlife proposes a system whereby the starting point becomes the more critical part of the project and simple but carefully chosen sowings of wildflower species are made. A simple matrix of species is established with confidence, allowing nature to mould the final result with an appropriate level of management, rather than seeking complexity at the outset. By keeping things simple much larger projects can be attempted to achieve greater benefit. Creative Conservation has also involved sowings on unusual substrates such as, crushed concrete and stripped topsoil, or by inverting topsoil over subsoil. Landlife has developed the craft of establishing wildflower landscapes on a large scale involving and celebrated by local communities,

and has built the UK's new National Wildflower Centre. This promotes the benefits of wildflower landscapes and creative conservation to a much wider audience than more traditional conservation groups or academic institutions.

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At the Crossroads: Transportation Design, Tribal Values, and the Ninepipe Wetlands

Re-design of a 55-mile highway (US 93) through the Flathead Indian Reservation in western Montana has created an unprecedented opportunity to restore landscape systems that support the cultural, spiritual, and subsistence life of the Confederated Salish and Kootenai tribes. The road corridor bisects the Mission Valley and the Ninepipe National Wildlife Refuge, one of the most significant wetland systems in western Montana. Ninepipe contains thousands of pothole wetlands shaped by glacial activity several thousand years ago, and is home to grizzly bear, deer, painted turtles, fish, amphibians, waterfowl species, raptors, and owls. The fragmentation of this highly sensitive ecosystem by an existing highway was the focus of a supplemental environmental impact study, which considered radical alternatives such as re-routing the road around the wetland complex, or re-designing the current roadway to incorporate wildlife crossing structures, reconnect hydrology, and reinstate native plant communities. Ultimately the road that is constructed will repair prior damage to this unique wetlands complex, and better protect traditional cultural values represented by wildlife and wetlands. This remarkable case study demonstrates the application of a context-sensitive design approach; how transportation projects can provide major restoration opportunities; the role of landscape architects in restoration design and planning; the need to integrate cultural values and biological values in a cultural landscape restoration approach; and the challenges to making the case for the integrity of a unique landscape entity like Ninepipe.

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Restoration of Nesting by Endangered Kemp's Ridley Sea Turtles (Lepidochelys kempii) in Texas

Since 1978, an experimental, project has been ongoing to restore nesting by endangered Kemp's ridley turtles (Lepidochelys kempii) at Padre Island National Seashore (PAIS), Texas, USA. Today, over half the Kemp's ridley nests documented in the USA are found at PAIS. From 1948-2002, 119 confirmed nests were found on the Texas coast, with 106 of the 119 located between 1995-2002. During these eight years, 13 turtles that were reared in captivity for their first 9-11 months of life (head-started) at the National Marine Fisheries Service Laboratory in Galveston,

Texas laid 22 of these clutches. These 13 turtles ranged from 10-15 years in age when first detected nesting. Ten had been experimentally imprinted to PAIS and the other three had been taken directly from Mexico as hatchlings and subsequently head-started. These turtles represented the first experimentally imprinted sea turtles confirmed to have returned to their imprinting site to nest, first confirmed nesting outside of captivity by head-started sea turtles, and first documentation of known-aged Kemp's ridley turtles nesting outside of captivity. These are minimum estimates of nesting by turtles from the experimental project since some nests were likely missed and the nesting females were not observed at about half of the confirmed nests. Although these findings suggest that the experimental project enhanced nesting numbers in Texas, more adult Kemp's ridley turtles are found washed ashore (stranded) dead in Texas than in any other state in the USA and nesting could be impacted by this mortality.

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Vegetation and soils along recently restored streams in the North Carolina Piedmont, USA

The number of stream restorations is rapidly increasing, yet there is very little literature assessing these projects. Restoration typically involves vegetation removal, severe soil disturbance, and replanting. Rarely are the effects of this soil disturbance on native plants considered. Soil disturbance is also implicated in the introduction and proliferation of exotic invasive species, which are a severe problem along Piedmont waterways. We surveyed the vegetation and the soil physical and chemical properties of ten restored streams in the central Piedmont of North Carolina to establish baseline information in a long-term study of the development of restored streams. The restorations range from one to four years old. Percent cover of native species of vegetation ranged from 42 to 146 percent. Non-native species invasion was high in many sites and inappropriate non-native species were planted at some sites. The survival of planted vegetation was low at all sites. Only seven of the 31 native species and only one of the two non-native species planted were found. Competition for soil resources between invasive species and planted native vegetation could contribute to high mortality of seedlings. Low levels of phosphorous and high bulk density are also limiting vegetation growth at some sites. Little or no care is given to the vegetation after planting. Stream restorations could be improved by expanding the goal of improved water quality and aquatic ecology to include a functioning riparian community.

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Current State of the Problem - How do professions deal with ethical issues?

We will explore: 1) what motivates professional organizations to create codes of ethics, conduct, and practice, 2) the purported function and value of these codes, 3) what actions the codes typically cover, 4) how organizations similar to the Society for Ecological Restoration enforce codes and treat violators, 5) what might motivate the Society for Ecological Restoration to create a code of ethics, and 6) how that code might be created.

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Education In the Field: Youth Corps as Partners in Restoration Activities

Education and involvement of young people in habitat restoration projects will help them to be cognisant of their role in the natural environment and inspire them to be participants in its stewardship. The Environmental Corps is part of the American YouthWorks charter school in downtown Austin, Texas. The program has grown from its beginnings in the late 80s as an environmental science class, and since 1996 has managed a six-month to two-year Americorps environmental service program for urban youth. This program trains students in trail building, carpentry, landscaping, horticulture, urban forestry, erosion control and habitat restoration work as well as ecological process concepts, stewardship principles, work ethics, and general life skills. The education and mentoring that comes from the partnership between young people and field professionals is a valuable part of this program. In this presentation, staff of the Environmental Corps will discuss the process of putting a youth crew in the field with an ecological restoration professional. This includes a student orientation, many hours of on-the-job training, and a dedicated support team. In addition to the job skill training that our students receive, much time and energy is spent in developing the potential of the young people we work with. We will speak to the challenges of balancing between working with our student's personal growth and the physically demanding aspect of the fieldwork. We will also discuss the curricula and the idea of experiential education that permeates our program and serves to root the students deeper into their own community's natural environment.

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Stand age structure, fire, and restoration of piñon-juniper ecosystems of the western United States

Piñon-juniper woodlands and savannas of the western U.S. are commonly thought to have unnaturally increased in density and invaded adjacent grasslands and shrublands since

EuroAmerican settlement. Fire suppression and livestock grazing are considered likely causes of these changes in stand structure that, in turn, are potentially responsible for decreased plant diversity, increased erosion, and increased occurrence of unnatural, stand-replacing fires. Management and restoration decisions are carried out over large piñon-juniper landscapes based on these guiding assumptions; however, there is little reliable evidence concerning the natural fire regime of piñon-juniper ecosystems, and very little research establishing age structures of pre- and post- EuroAmerican piñon-juniper ecosystems over large landscapes. We examined the age structure of a large (177,000 ha) piñon-juniper landscape in southwest Colorado using a stratified random sample and dendrochronology techniques. We discovered a large component of post-EuroAmerican settlement aged trees generally mixed within old trees in most stands. We found almost no evidence of low-intensity surface fire, but some evidence of stand-replacing fire; thus, it is not clear that fire suppression is responsible for these young age cohorts. Climatic changes, weather patterns, livestock grazing, and other land uses may be responsible. Moreover, wide age variation within and between stands exists; thus, restoration strategies that seek to indiscriminately remove piñon-juniper woodlands through mechanical treatment are misguided. Restoration goals should be based upon adequate assessment of age structure and fire regimes, with a focus on landscape and stand age heterogeneity. We developed a rapid stand-age assessment strategy to aid restoration needs.

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Responses of Bottomland Hardwood Forest Species to Urban Flooding Regimes

Restoring wetlands in urbanizing environments is complicated by drastically altered hydrologic regimes. Increased impervious surface cover typically causes flood frequency to increase, but flood duration either increases or decreases depending on the degree and spatial location of urbanization within the watershed. Plant species may be differentially affected by altered hydrologic regimes, possibly requiring new mixtures of species for restoration projects. We tested the effects of various flooding regimes on growth and survival of 3 bottomland hardwood forest species, which included buttonbush (Cephalanthus occidentalis), green ash (Fraxinus pennsylvanica), and shumard oak (Quercus shumardii). These species were chosen to represent those classified as wetland obligate, facultative wetland, and facultative species, respectively, and are native to North Texas. Treatments included 1 rural flooding regime in which seedlings were flooded 3 times during the growing season for 7 days per flood, and 2 urban regimes both of which were flooded 6 times during the growing season, 1 with a 4-day duration and the other with a 10-day duration. Leaf area index, stem length, and stem dieback were measured to distinguish differences in species responses to altered flooding regimes. Results will indicate which class of species is best suited for wetland restoration within urbanizing areas.

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Prescribed fire as an ecological restoration tool: Differential phytosociological responses following winter, summer, and fall fire in a temperate savanna in Central Texas.

The savannas of the Hill Country of Central Texas have undergone significant change and are in dire need of restoration. The introduction of intensive livestock grazing and suppression of fires over the last 150 years or so, combined with climatic drought cycles, have resulted in an increase in many woody species and a decrease in the abundance and diversity of many grasses and forbs. Prescribed fire can be an effective tool for landscape restoration; however, differential effects of prescribed fire season have been rarely investigated. In this study, four treatments (n = 6) of prescribed fire (winter, summer, fall, no fire) were installed across 24 randomly selected plots (approx 0.75 ha), for two consecutive years. Compositional and production data indicate significant differential responses to fire season, suggesting that fire timing may be used to further manipulate the landscape to fit the desired outcome.

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Time for a change: design of community level assessments of stream restoration and channelization projects

Past reviews of stream restoration and channelization projects have discussed population and community responses of fishes and macroinvertebrates to habitat alterations. However, these reviews did not provide information on spatial and temporal scales used to observe the responses. Additionally, previous reviews of stream restoration projects tended to focus on description of restoration techniques. Results of all assessments are scale dependent, and there is a need for understanding how community responses to stream alteration projects (restoration and channelization) vary with changing scale. Determining trends in assessment design of past studies will provide insights to the spatial, temporal, and community scales that need to be examined by future studies. We conducted a literature review to determine what scales (spatial, temporal, and community) and analytical methods were used by community level assessments of stream alteration projects. We selected literature that examined fish and macroinvertebrate community responses to restoration projects within channelized streams and channelization projects conducted for flood control. We found that assessments of stream restoration and channelization projects most frequently used a reference condition design, monitored responses of fish communities, and were conducted at limited spatial (one stream) and temporal (one year) extents.

Our results suggest that more multi-scale assessments and increased documentation of responses of macroinvertebrate and combined fish and macroinvertebrate communities to stream alteration projects are needed to increase our understanding of the influence these habitat manipulations have on stream communities.

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Restoration of Swift Foxes in the Northern Great Plains

The swift fox once occupied most of the Great Plains of North America from west-central Texas to the prairies of Alberta. Settlement of the Great Plains led to decline in swift fox numbers and by 1900 the species was rare in the northern parts of its range. Since the 1960s, swift foxes have shown limited range increases, however, they have been unable to establish populations in much of the northern portions of their historic range. Factors limiting expansion of swift foxes are unknown and swift fox are absent from areas where habitats are apparently suitable. The only significant northern expansion of swift fox distribution has occurred because of reintroduction programs in southern and northern Montana. We are conducting two swift fox reintroduction efforts in South Dakota where the species is listed as threatened. Thirty swift foxes were released in 2002 and 2003 on the 570-km2 Bad River Ranch (BRR) southwest of Pierre, South Dakota. Thirty foxes will be released in 2003, 80 km southwest of the BRR in Badlands National Park. These two efforts are similar except that coyotes were reduced prior to and during the reintroduction at the BRR, but not at the BNP. Rather, at BNP, swift fox release sites were located on the periphery of coyote territories. Similar pre-release and post-release data are being collected at both sites. This provides us with an opportunity to compare causes of mortality, survival rates, and reproductive rates of swift foxes restored to areas via differing methods of protection from coyotes, the major source of mortality for foxes.

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Securing Water for Riparian Restoration in Arid El Paso, Texas

Restoration of riparian ecosystems in the Rio Grande Valley near El Paso, Texas, presents multiple challenges. The Rio Grande in this region is a highly modified river, its riparian systems are severely degraded, and its flows are completely allocated to agricultural, municipal and industrial use. With competition for limited water supplies intense, creative approaches are needed to make any water available for restoring and maintaining native riparian ecosystems. Rio Bosque Wetlands Park and Feather Lake Wildlife Sanctuary, both in El Paso, are two sites where

restoration is moving forward through cooperative partnerships with regional water-management entities and integration of water deliveries for restoration with existing water-management practices. Rio Bosque receives treated wastewater from an adjacent wastewater-treatment plant. Feather Lake receives urban storm runoff and carriage water from an irrigation lateral. This paper will examine progress in restoration work at these two sites, present lessons they have to offer other riparian-restoration efforts in arid landscapes, and discuss challenges both sites face in the future.

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Ethical considerations in community-based research and education programs

Research and edcuational opportunities abroad have expanded to include a broad range of natural and social systems. Students and faculty working in natural-resource based communities have encountered many serious challenges to be able to engage in programs that first do no harm and second, provide a meaningful educational experience. Involving students in hands-on restortation and management activities has required a methodical approach that starts and ends with direction from local decision-makers and also involves the community in the implementation and evaluation of the program. Establishing project boundaries based on local mandates is essential and is often in conflict with the demands of short-term programs. Many programs desire a cross-cultural or service component but are not in a position to invest in the time and energy required to develop the key relationships needed to opreate in an appropriate fashion. Successful examples of research and education programs in ecological restoration and natural resource management have incorporated a step-wise approach to program development utilizing local faculty at all levels of the program.

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An Urban Community-Driven Restoration Project

Cathedral Park, owned by the Episcopal Diocese of West Texas, is a neighborhood project to restore 19 acres of degraded land in downtown San Antonio. It has endured 50 years of indiscriminate dumping causing significant water retention problems and allowing an invasion of exotic species. This property has substantial community interest because it lies at the headwaters of the San Antonio River, the Olmos Creek flows through it, and it has been inhabited for over 11000 years. The objectives: remove the trash; control the water flow by re-grading areas and

directing the natural springs to flow to a pond and onward to the Olmos Creek; control access by fencing, trail construction, and a walkway along the Creek for viewing during high water. Upon completion of these tasks, we will replace exotic plants with natives and create an educational, and spiritual place for neighbors and city residents. This small center-city property is of clear historical interest to San Antonio and lies in the path of a future greenbelt through the city that would allow animals to traverse a major metropolitan area. Its location near Incarnate Word and Trinity Universities offers potential for restoration partnerships involving student-created animal/plant surveys and global positioning mapping. Project leaders created a partnership with the Air Force recruits in San Antonio who perform their community service working on the tasks in the Master Plan. This project is a perfect example of a community working together to salvage important open spaces. http://www.cathederalpark.org.

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Tillage and revegetation effects on subalpine meadow restoration after invasive species management in Glacier National Park.

Using herbicides to control invasive species causes major ecological disturbance to a plant community, providing space and resources for subsequent plant colonization. Efforts to minimize exotic plant reinvasion are enhanced by restoration of desired vegetation following weed control. Reintroduction of a native plant community to treated areas may preempt nutrient, water and light resources against future exotic invasion, reducing the need for herbicide reapplication. We hypothesized that establishing native grasses and forbs would reduce the competitive ability of spotted knapweed to reinfest grassland plots after the broadleaf herbicide clopyralid was applied. Seven treatments with five replicates were randomly assigned to 35 plots at each of two sites in and near Glacier National Park. The seven treatments were: 1) control (no treatment); 2) herbicide only; 3) herbicide and broadcast seeding; 4) herbicide and soil tillage; 5) herbicide, broadcast seeding and soil tillage 6) herbicide, broadcast seeding and directing planting; and 7) herbicide, broadcast seeding, soil tillage and direct planting. ANOVA contrast analysis indicated that spotted knapweed cover was significantly reduced by the herbicide treatment. However, contrasts also indicated that knapweed cover was higher in tilled versus untilled plots and in planted versus unplanted plots. No seeding effects were found. Spotted knapweed densities were highly variable between all plots, and ranged from 85-4055 plants per m2. No significant effects on spotted knapweed densities were found for any of the treatments.

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Fire as a Restoration Tool: What About Bambi?

The applications of fire in ecological restorations range from altering the composition and structure of native and non-native vegetation to reinviting the prodigal flame?as a vital process?back into ecosystems long bereft of fire. Too often, though, burn plans and prescribed fire prescriptions lack any recognition of or guidance regarding the ethical dimensions of fire use. While a proto-code of ethics has emerged in the fire management community in the form of minimum impact suppression tactics (MIST), examples of institutionalized ethical standards and expectations in prescribed burning are more elusive. This is particularly acute vis-à-vis the effects of fire on wildlife. Just because the pre-restoration distribution and abundance of animals occupying a site may run counter to our desired future condition for that site does not imply that our means (e.g., how to implement a burn) justify the ends. Moreover, even when the effects of fire on wildlife are minimal, or justifiable, this neither negates the existence of ethical concerns nor obviates the need to circumscribe them by standards of conduct. In this context, I discuss the extent to which ethical discourse enters, or ought to enter, prescribed fire planning and implementation, and what this means for developing a professional code of ethics for SER.

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The Prehn: Milking for Water-Locating Reliable Seeps An Untapped Source of Water and Using the Appropriate Construction

We discuss a method of finding reliable sources of water oozing from the ground[not springs] and,which evaporates into the air, thus wasted water. This method of locating reliable sites uses natural indicators and is a way to capture usually wasted sources of water. His experimental sites have exceeded production expectations. Some sites produce several hundred gallons a day, and some produce thousands of gallons of water a day. Importantly, once the simple location and construction methods are learned anyone can construct their own seep systems. In addition, this method is less expensive then drilling for water.

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State And Transition: Getting Our Arms Around Assessment

Knowing what to restore across millions of acres, with three major federal land management agencies and other lands, could not be understood with the past ecological thought and management direction. Our past discussions focused on uses rather than on problems like invasive species, altered fire regimes, climate change, and legacies from hard lessons in the continuing saga

of experimenting with land uses. The latter are the management problems we must face. Because restoration depends on limited funding, hard choices require identification of priorities. A landscape in trouble alters natural processes like fire and plant succession, or it replaces native species with invasive species that change its basic structure and function. A landscape in crisis calls for the use of triage. Decisions must be made on where, and if, to invest limited management resources. But vegetative states must be recognized especially at the critical stage of approaching a threshold prior to crossing into another state. Once a plant community transitions so that it cannot renew itself after normal disturbances, it is a new state. The previous state is not restored without adding energy and expense. However, investing extra expense per acre in restoration without investing adequately in management to prevent other acres from crossing ecological thresholds will continue to spiral a landscape downward. The use of state and transition vegetation models provides an excellent and applicable tool for assessing the state and condition of vegetative communities and provides an appropriate context for management triage.

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Poudre River Enhancements

The Poudre River is the most significant natural feature within the City of Fort Collins and currently serves as a major trail corridor. EDAW is part of a multi-disciplinary team to develop a stabilization, ecological restoration and recreation master plan for a 1/3 mile reach of this river near downtown Fort Collins. EDAW's task is to work with stream hydraulic engineers to develop stabilization and flood management measures that accomplish multiple objectives, including river clean-up, aesthetic improvements, and enhanced river access and recreational opportunities. Recommendations developed through this process will be used as prototypical solutions to apply to other improvement projects along this important habitat and recreational corridor.

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Manipulation of resource heterogeneity in restoration of arid grasslands and shrublands

Degradation of arid ecosystems is often signaled by the changes in the distribution of soil and water resources and by changes in plant species composition. For example, shrub invasion of grassland typically leads to resource redistribution into larger resource islands that are more widely spaced and more different from the surrounding matrix than those associated with grasses, while increased grass cover has the opposite effect. In both cases, positive feedbacks often develop, reinforcing the altered resource distribution and increasing resistance to management

efforts to restore the pre-existing plant community. Changes in vegetation spatial structure can alter other important ecosystem processes as well. In parts of the western USA, the more continuous fuel of cheatgrass increases fire frequency, extent and intensity, which is unfavorable for most shrub restoration. In shrublands at Jornada Experimental Range in southern New Mexico, the larger interspaces between shrubs allow increased erosion, which may hinder grass establishment. Managed redistribution of resources, such as concentrating resources in grasslands to encourage the establishment of shrubs or reducing the spatial heterogeneity of resources in shrublands to promote the establishment of grasses, may be an effective component of restoration projects,. The effectiveness of manipulating the spatial distribution of resources for the restoration of shrubs in cheatgrass-dominated grasslands and the restoration of grasses in mesquite and creosote-dominated shrublands is predictably influenced by site and species characteristics and by the degree to which important ecosystem process such as fire and erosion are modified by changes in the spatial distribution of resources.

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One-Hundred Years of Ecosystem Change and Ecosystem

Following European settlement there have been pronounced changes across most of the plant communities in the Great Basin, one being the increase in both the distribution and density of pinyon and juniper woodlands. Prior to European settlement woodland species were generally confined to more fire safe sites but through a reduced occurrence of fire now occupy three to four times more area. The expansion woodlands now cover a wider range of sites that represent some of the areas most productive and diverse Artemisia dominated communities. A second widespread change is the replacement of many perennial dominated communities by cheatgrass and other exotics. As tree dominance in the expansion woodlands increases, the cover and productivity of shrubs and herbaceous vegetation declines, and a greater susceptibility to intense crown fires results that is now driving an increase in fire size and intensity. These fires on tree dominated sites are also helping to convert these sites to dominance by herbaceous exotics. Where the introduction of exotics has occurred, particularly with cheatgrass in sagebrush dominated communities, the frequency of fire is on the increase, the successional dynamics are altered, and conversion to exotic dominated communities is increasing. Once cheatgrass is an important part of the woodland or sagebrush dominated community, treatment to avoid the potential problems becomes difficult and expensive. The many vegetation changes that have occurred over the last century, and the changes in the kind and consequences of fire they are driving, present many challenges for the restoration of the affected sites.

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Restoring Wilderness: The Legal and Philosophical Challenges of Design

With recreation overuse and loss of ecological integrity, wilderness areas often require restoration. However, if legally designated wilderness is characterized as an area ?where the imprint of man's [sic] work is substantially unnoticeable? (U.S. Wilderness Act of 1964) and if restoration involves human design, then we are confronted with a puzzle about how to understand and practice restoration in wilderness. Apparently, we must either hide design or at least temporarily compromise wilderness. In , Eric Higgs attempts to address this puzzle by emphasizing the restoration of wildness rather than wilderness and by understanding restoration as a conversation with nature that involves wild design. We assess the legal and philosophical implications of his proposals and conclude that they are not sufficient to adequately address the tensions implicit in wilderness restoration. We defend the limitations on human activities associated with wilderness and argue that the metaphor of design is ill-suited for wilderness restoration. Metaphors associated with healing nature seem more promising in this context, and we show how these provide a preferable understanding of the human role in the restoration of large-scale wildlands. After sketching the implications of our position for restoration practice, we briefly address objections to concepts of ecosystem health.

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Controlling Tamarisk in a Highly Sensitive Environmental Area.

Tamarisk was discovered on a tract of land set aside for the protection of water quality and quantity (City of Austin Water Quality Protection Lands) in March 2003. This was the first confirmed tamarisk infestation in Hays County, Texas. The location is a former rock quarry near Buda, Texas. At some point in the past, the quarrying operation intersected a portion of the Barton Springs segment of the Edwards Aquifer, leaving the aquifer exposed at the surface. This combination of such a highly sensitive environmental feature, a notoriously invasive species such as tamarisk and the nature of being the first known infestation in the county required an approach that would maximize the effectiveness of treatment while minimizing the risk to the exposed aquifer. To further complicate matters, the tamarisk had become established over 30 ft off the ground on the steep quarry walls, as well as in direct contact with the exposed aquifer.

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Floral legacy of an Urban Wetland System Located in a Public Park: History and Opportunities

Historically, the vegetation at Agua Caliente Park in Tucson, Arizona likely consisted of riparian deciduous forest within and surrounding the spring and spring-run channel(s), bordered by mesquite bosque and Sonoran Desertscrub. Human alterations began over 5000 years ago when prehistoric peoples made use of the area resources. More intensive uses in the recent past have included ranching and cattle grazing, a U.S. Army base camp and a health resort. Stock ponds and other excavations have been filled with spring flow. Today, the vegetation within the park reflects both its natural legacy and the many ways these resources have been modified. A perennial warm spring flowing into three large ponds remains. Where a citrus orchard once stood, a mesquite forest has naturally regenerated. Palms surrounding the spring and pond provide the Hollywood impression of a desert oasis. Channels connecting the spring and ponds support a mixture of native and non-native emergent wetland vegetation. Many species that once occurred within the park are currently absent, yet a few that are locally rare remain. The park offers a rare perennial wetland in a highly urbanized desert valley. Relatively inexpensive opportunities for restoration and education regarding this increasingly rare resource include the following: reintroduction of native cienega plant communities; rehabilitation of highly eroded and trampled vegetation around the pond and channel margins; development of a medicinal herb trail; interpretive displays explaining the past and current configurations of the park and supported species; and plant identification workshops and materials for both native and non-native species.

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Ecology and Design: The Tuolumne River Gateway Park and the South Lake Tahoe Bike Path and Plaza

These two projects exemplify the integration of human use and values with ecological uses and values. The Tuolumne River Gateway Park (TRRP) is a 90-acre parcel located in the middle of the 7-mile TRRP. Funded by the City of Modesto, the City of Ceres, and Stanislaus County, the objectives of the park's design are focused on both human and ecological values, such as the creation of a regional landmark to bring together diverse cultural communities and promoting the river as a valuable natural resource. The design also included flood control measures without limiting human access to the river. The South Lake Tahoe project is a plaza and bike path system along the lakeshore. Consisting of a wet meadow and lagoon, the plaza area replaces a small marina and detention basin and thus provides improved ecological benefit as well as an aesthetically pleasing environment for human use.

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Restoration of wetlands in the Yangtze Estuary

In order to protect the land from the tide, dykes had been built along the shore in Yangtze Estuary. But the construction of the dyke led to the change of environment, wildlife communities, and the loss of the wetland ecosystem service. A wetland restoration research has been carried out at the East End of Chongming Island, Yangtze Estuary, since 2001.The area of this study is about 86 km2. Two main dykes in the area was constructed in 1992 and 1998 respectively. Based on the analysis of the ecological status and developing trend of the area, the restoration aim was set to recovering the function as the fresh water wetland of the estuarine super-tidal wetlands. And four different parts of the restoration work would be carried out: 1.Improve the hydrological condition to purify the water in the area. 2. Enhance the water area by excavating to provide suitable habitats for waterfowl. 3.Improve the soil quality, such as enhance the organic matter content and reduced the soil salinity. 4. landscape architecture. All the work including that described in 1-3 above was based on the landscape design, and the performing process of 1-3 was also the process of landscape construction. It was required to follow the rule of aesthetics and also landscape ecology. Some of these jobs have been put into practice now.

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Ecological Restoration and Monitoring of a Superfund Site; Use of Species Richness Indicators

The Baird & McGuire Superfund Site in Holbrook, Massachusetts consists of approximately 17½ acres of land that has undergone extensive soil and groundwater remediation. The Baird & McGuire Company operated a chemical manufacturing and batching operation on the site from approximately 1912 to 1983. The company produced disinfectants, soaps, floor wax, and pesticides at the facility. Years of improper onsite waste disposal practices led to a serious contamination problem at the facility and in the nearby Cachato River. To address the soil contamination, over 225,000 cubic yards of soils, subsoils, and vegetation were excavated and incinerated onsite. The groundwater and soil remediation efforts had, by necessity, a significant effect on the existing ecological communities. Approximately 7½ acres of palustrine forested and scrub/shrub wetlands, 10 acres of upland forest, fields, areas of industrial development, and 1,000 linear feet of an intermittent tributary to the Cachato River were removed during the remediation process. Restoration plans were finalized in 1993, the site was graded and replanted in the summers of 1996 and 1997, and in 1998, wetland and upland vegetation monitoring plots were established within the restoration areas. The plots have been monitored annually and qualitative assessments of community health and wetland functions, as well as a quantitative comparison of species diversity/richness, have been made. This information was used to make mid-course adjustments to the restoration design and is being used to formulate a longer-term monitoring study of this landscape-scale restoration effort.

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The Paradigm Shift in Collaborative Efforts

This presentation explores collaboration as an emerging paradigm in natural resource management. The health and vitality of ecological systems are deteriorating as natural systems are strained or unraveling from forces such as invasive species, wildfire, or erosion. Today, decision-makers are being held accountable to insure that multiple uses and ecological systems are intact and sustainable. Decisions must embrace the needs of multiple interests while insuring that landscapes, population dynamics, and ecological health are intact. Compared to the days when decisions could be forged over the hood of a pickup, the task of managing natural resources on public lands has become very difficult. A new paradigm in resource management is developing. It is called collaboration. Collaboration will be explored as a process that engages parties of diverse interests in processes of dialog and in the framing of management strategies around complex issues. Collaboration does not take decision authority away from people; it helps people make more informed decisions. Collaboration merges the social and biological sciences into a learning environment to build levels of trust and shared vision in natural resource management. The relationship of collaboration to resource management will be explored as a means for resource professionals, community leaders, political bodies, and other affected interests to collectively identify, analyze and formulate shared vision for management of public lands.

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Balancing Conservation and Development: Restoring the Buffalo Bayou to an Ecologically Functioning System

Sponsored by the Buffalo Bayou Partnership, in conjunction with the City of Houston, Harris County and Harris County Flood Control District, the Buffalo Bayou and Beyond Master Plan presents a bold new vision for the Buffalo Bayou corridor as it meanders through downtown Houston. Guided by the overarching principle of balancing conservation and development, the Plan seeks to restore the Buffalo Bayou to an ecologically functional system while encouraging sustainable, green urban redevelopment. Along appropriate reaches of the bayou, it is intended that the banks of the Buffalo Bayou be regraded to create a wider cross-section and series of terraces, to support varieties of bottomland and wetland vegetation. Fluvial features once found within the Buffalo Bayou corridor, such as oxbows, meander splays, ponds and wetlands will be recreated within the bayou's new ?floodplain;? creating diverse and sustainable riparian habitat areas for native species of plants and animals. Retention areas will be created where water can be biologically treated through wetland processes, resulting in improved water quality, a replenished groundwater system, and a diminished need for dredging further downstream. These improvements will result in a new, environmentally-friendly landscape that requires less

maintenance and allows for greater floodwater storage volume during periods of flooding. The Buffalo Bayou Partnership and others are also examining a framework eco-plan at the regional level, whereby the Buffalo Bayou corridor is connected to the unique ecosystems and ecotones surrounding the Houston metropolitan area through a network of open space and riparian corridors.

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Restoration of Threadleaf Sedge (Carex filfolia Nutt) at Scottsbluff National Monument

Threadleaf sedge (Carex filifolia Nutt.) is an important cool-season species of the mixed- and short-grass prairie. It is a source of high quality forage, and its dense roots stablize the soil. Threadleaf sedge has not been successfully established in grassland restorations because of low seed production and low germination. However, transplanting of threadleaf sedge has proven to be a viable restoration technique. Our objectives were to investigate the fertilizer response of threadlead sedge transplants in the greenhouse and in the field. We collected threadleaf sedge sod at Scottsbluff National Monument (SCBL) in November, 2002, transported it back to the University of Nebraska-Lincoln, divided plants, and planted them into Cone-tainers. Four rates of fertilizer (0, 20, 40, and 60 ppm NPK) were applied every three weeks. Following six months of greenhouse growth, plants will be transplanted back to SCBL on a restoration site. In the greenhouse we will be able to determine survival rate and above- and below-ground biomass. In the field, transplants will be monitored for survival.

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Breeding Birds on Reforested Bottomlands in Forested and Agricultural Landscapes

Restoration of bottomland forest adjacent to mature forest has been advocated for conservation of forest birds. We assessed avian densities and nesting success on 36 reforested bottomland sites (2 ? 16 years post-planting) within two different landscape contexts: (1) sites that abutted large tracts of mature bottomland forest or (2) sites adjacent to agricultural fields that were distant from large tracts of mature forest. Grassland birds (Red-winged Blackbird, Dickcissel, Eastern Meadowlark, Northern Mockingbird, and Mourning Dove) characterized sites that abutted agricultural fields. White-eyed Vireo and Indigo Bunting, birds typical of shrub-scrub habitats, characterized sites adjacent to mature forests. Brown-headed cowbirds were more abundant near

mature forests. Generalized nest survival of all songbirds (~17%) was similar on sites adjacent to agricultural fields and on sites abutting forests. Of 2142 nests that had eggs or chicks, 611 fledged young. Estimated nesting successes (Mayfield) were: Yellow-breasted Chat (37%), Orchard Oriole (36%), Indigo Bunting (29%), Northern Cardinal (27%), Yellow-billed Cuckoo (26%), Dickcissel (18%), Mourning Doves (17%), Northern Mockingbird (14%) Red-winged Blackbird (14%), and Common Grackle (6%). Predation was the primary cause of nest failure. Overall parasitism rate was low.

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The Impact of Yellow Sweetclover (Melilotus officinalis) on Native Plant Communities

Single exotic species have been found to change basic ecosystem processes and transform the ecosystems they have invaded. A nitrogen-fixing species can increase nitrogen levels, change nitrogen-cycling in the ecosystem and potentially facilitate the further invasion of other exotic species. Yellow sweetclover (Melilotus officinalis) is an invasive, nonnative, biennial legume that has become abundant in the historically low-nitrogen, perennial dominated ecosystems of the Great Plains. Sweetclover distribution has expanded through intentional plantings for forage crops, soil stabilization, and bee keeping. Sweetclover is also widespread due to its high reproduction rates, persistent seedbanks, and ability to grow in a variety of habitats. The ecological impact of abundant sweetclover is unclear. To address sweetclover's impact on grassland ecosystems and native plant communities this study examines two questions: 1) Do sweetclover's nitrogen-fixing capabilities cause it to change ecosystem nitrogen cycling through enriching a low nitrogen system with nitrogen? and 2) Do invasions by sweetclover and subsequent nitrogen enrichment facilitate the invasion and dominance of other exotic species? Yellow sweetclover was studied at Badlands National Park, South Dakota in both western wheatgrass (Pascopyrum smithii) mixed-grass prairie and Badlands sparse vegetation. Initial observational studies of the association between sweetclover cover and native and exotic species abundance were ambiguous. To clarify relationships, experimental studies are being used to determine whether nitrogen is a limiting resource in these ecosystems and the effects of increasing nitrogen levels on species composition and abundance. Together these studies allow a better understanding of sweetclover as a potential transformer of ecosystem processes.

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Monitoring soil and vegetation dynamics of revegetated mine tailings as quality indicators for

sustainability criteria

Soil and vegetation dynamics of revegetated tailings dams are largely unknown.These ecological criteria are of interest to determine the degree of nutrient cycling and vegetation development, which will reveal the sustainability status of the restored areas.The edaphic and biological driving parameters of these systems also need to be identified to establish which factors will determine restoration outcomes. This study focused on the soil chemical dynamics and vegetation compositional trends over a six year period, on four different slopes of revegetated gold tailings dams. Soil chemical analyses and vegetation assessments were conducted each year on the studied tailings dams, and the climate was also monitored.The data were statistically and multivariately analyzed, and significant results presented clear trends of system development. It was established that the soil profile depleted chemically to a state of severe deficiency. Floristically, 61% of the species identified belonged to the family Poaceae, but there was a notable increase in weeds in the last three seasons. The most important factors determining species resemblance included the effect of slope related microclimate, soil moisture, pH fluctuation, and basal cover. Although the revegetated areas are ecologically young, vegetation development seemed to be slow. Within this context, the study revealed that vegetation success criteria on mine discard should not be evaluated in terms of the principles of the classical ecological theory emphasizing the relation between diversity and stability, but rather be quantified within the ability and state of the tailings system.In terms of closure criteria, the revegetated systems should be approached as unique systems for which new principles have to be derived, and which should be monitored comparing similar inert success.

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Can we restore urban riparian corridors to resist invasion by exotic plant species?

Forested riparian corridors can provide valuable ecosystem functions in urban areas and serve as refuges of biodiversity in an otherwise degraded landscape. However, these remnant forests often are subject to high invasion rates by exotic species due to frequent disturbance, adjacent development, and high edge-to-area ratios. If these forest communities are to be sustained, restoration efforts should focus on enhancing the resistance of these forests to future invasion. This study examines factors at a variety of scales that are correlated with high rates of exotic species invasion. To evaluate the contribution of landscape-scale attributes to invasion patterns, we chose 25 greenway segments in Raleigh and Cary of varying widths and surrounding development density. A modified belt transect approach was used to survey the extent of invasion of these urban greenways by a suite of 15 common invasive exotic plants. The cumulative frequency of occurrence and mean percent cover of exotics were significantly negatively correlated with corridor width and positively correlated with the surrounding building density. However, the within-site variability of species? distributions was high. This local scale variability

was examined with a plot level study, designed to capture the contributions of site factors, such as soil fertility, light availability, and forest structure on exotic species invasion. Together, these approaches indicate that both landscape-level and site-level factors control the extent of exotic species invasion in urban forest corridors. Thus, restoration efforts should focus on processes at both scales to enhance resistance to future invasion of these sites.

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Ethical Dilemmas in Ecological Restoration

In a poster presentation at the 2002 SER meeting, we asked attendess to contribute their thoughts on the ethical challenges they faced as restoration researchers and practitioners. This lively discussion has prompted us to propose a more structured session for SER members to contribute their thoughts and ideas for addressing the unique ethical challenges of restoration ecology. The goals of this symposium are to: (1) provide an opportunity for members to reflect upon ethical issues; and (2) gauge the interest and support for developing a professional code of ethics for the society. Recently, attention to research ethics has increased in many disciplines as granting agencies develop requirements for researchers to be trained in ethics. We are moving beyond the challenges of human subject research and now are talking about the dilemmas involved in manipulative experiments, publication of non-significant results, and defining our role as scientists and advocates. Concurrently, the growth of ecological restoration has involved more people in complex decisions regarding the planning, implementation, and evaluation of restoration efforts. Therefore, the first part of this symposium will provide a set of perspectives on ethical dilemmas in restoration while the second will ask the members to consider how to best address these as a professional society. We will host a round-table discussion as part of these sessions for members to contribute their thoughts on ethics in restoration, their ideas for a professional code of ethics, and their motivation for continuing this discussion.

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The Cajun Prairie Restoration Project: Fifteen Years of Volunteer Effort

The Cajun Prairie once consisted of nearly one million hectares (ha) of tallgrass prairie in southwestern Louisiana, but it has been reduced to less than 25 ha. Remnant prairies along railroad rights-of-way are lost annually to a variety of insults. In 1988, volunteers began a restoration project in Eunice, Louisiana under our leadership. Fifteen years since its inception has

produced a diverse re-creation of the native prairie floralscape with more than 250 plant species. The restoration site is a diverse insect habitat. In 2003, the Cajun Prairie Habitat Preservation Society purchased the 4 ha site. The project is a model for more than ten newer restorations and provides propagules for those restorations. Management of the site involves mainly annual burns and persistent control of the invasive Chinese Tallowtree. Plans are underway to develop the site into a nature center with paths and signage.

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Pastures for Upland Birds: Restoring Native Plants in Bermudagrass Pastures

The conversion of large areas of the Post Oak Savannah to improved forage grasses, such as bermudagrass (Cynodon spp) and bahiagrass (Paspalum notatum), has been a major reason for the decline of wildlife species in the region. Bobwhite quail (Colinus virginianus) and Eastern wild turkey (Meleagris gallopavo silvestris) are two important game species that been impacted by this vegetation conversion. Pastures for Upland Birds (PUB) is a research, management, and demonstration program designed to determine cost-effective strategies for establishing native grasses and forbs in bermudagrass pastures, while providing technical assistance and cost share incentives to private landowners. During spring and fall 2001, and spring 2002, study sites were established in Falls and Grimes Counties. At each site, 2 rates of Glyphomax Plus herbicide (41% glyphosate) and a combination of different native seed mixes and methodologies were applied. Preliminary results indicate about 98% initial bermudagrass control on sandy soils versus about 43% control on clay soil. Seeding success was low and highly variable in 2001, but much better for 2002. In addition, the Texas Cooperative Extension Service established 6 demonstration sites in 2001 and 6 more in 2002 in South Central Texas. These sites will be monitored for at least two more growing seasons in order to report more conclusive results that can be applied to private land habitat restoration in Texas. Results from the research and demonstration sites will be discussed.

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So Far, So Good: Ten Years of Restoration at Cape Florida

The Cape Florida Project is a restoration of coastal habitat at a state park on Key

Biscayne,located four miles south of downtown Miami. In 1992, Hurricane Andrew charged across South Florida, leveling 98-percent of the trees at Cape Florida State Park. Ironically, the storm achieved what resource managers had attempted for years--the removal of exotic species from the 436-acre site. The park had been overrun with Australian-pines. It was an ecological disaster long before Hurricane Andrew. Shortly after the storm, the American Littoral Society teamed up with the Florida Park Service to restore Cape Florida's habitats. The Society launched a public outreach campaign to involve the community in the park's restoration. Over the past ten years, thousands of people have participated--from members of inner-city church groups and employees of Fortune 500 companies to homemakers, tax attorneys, and school children. Today, over 300 species of native plants are represented in six distinct habitats. There are over 165 species of birds listed for Cape Florida, with 12 known to use the site for nesting. Forty-two butterfly species, six native species of mammal, and 16 native reptile and amphibian species call Cape Florida home. Fifty-two of the species listed at Cape Florida are threatened or endangered, including the North American crocodile, taking up residence in the restored mangrove forest. Yet, it is the broad-based community involvement that may have the most lasting impact. Without local stewardship and political good will in such an urban setting, success might have been short-lived.

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New Landscapes - New Lives: Ecological Restoration Benefiting Biodiversity and People

The technical aspects of implementing ecological restoration for many environmental scenarios are generally well understood. However, too often the long term management implications for maintenance of the biodiversity gain thus produced require funding commitments beyond the scope of most funding programmes. A more holistic approach that uses ecological restoration as a basis for wider socio-economic gains is the ideal solution. This is of most benefit when restoration is taken on a landscape scale. Cornwall, England is home to some of the most ground-breaking landscape-scale restoration initiatives, including the world-renowned Eden Project. The New Landscapes ? New Lives initiative is a partnership of organisations involved in landscape-scale ecological restoration projects. Taking holistic approaches members of the partnership are currently developing land management systems that will: encourage biodiversity; encourage economic growth in tourism and agriculture; build links between ecosystems and local communities and restore ecosystem processes that maintain biodiversity for the long term. This paper will outline some of these projects and identify the principles underlying them or potentially wider applicability to ecological restoration projects elsewhere.

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Biodiversity and Restoration in a Mexican Cloud Forest Landscape

The landscape in central Veracruz, Mexico, consists of fragments of tropical montane cloud forest isolated by different land uses. Our study sites represent the variety of situations that exist in the region: 15 forest fragments, four active and four abandoned coffee plantations, 14 abandoned pastures, and eight restoration plantations. Our objectives were to determine how each landscape element acts as a repository of part of the regional biodiversity, and to test the potential of native tree species to be used in restoration. We determined woody plant richness at a landscape level, tested shade tolerance of seedlings in field and controlled conditions, and established restoration plantations using native species. Results indicated that landscape elements have different but complementary tree species composition. Seedling performance of shade tolerant species (Fagus grandifolia var. mexicana and Symplocos coccinea) is more successful under closed canopies, whereas species with less shade tolerance (Quercus acutifolia and Carpinus caroliniana) can be used to rehabilitate disturbed fragments or edges. Synchronously, mixed plantations were evaluated for their suitability in rehabilitating areas with different land use histories. C. caroliniana and Liquidambar styraciflua are suitable species for reforestation. Podocarpus matudae performed well in intermediate disturbed sites, and Juglans pyriformis is useful for rehabilitation of degraded sites. We concluded that a regional conservation approach will be required to preserve the biodiversity found in each fragment and agroecosystem. Simultaneously, based on their differences in shade tolerance and plantation site quality, different tree species are recommended in areas that need to be rehabilitated.

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The History of Convergent Collaboration in Eastern Nevada

The changes in vegetation of eastern Nevada had reduced the sustainability of traditional uses of the Great Basin resources including wildlife and livestock. The threat to the ecological health of the region and the challenge to the associated lifestyle had resulted in escalating confrontation between disparaging interests, almost to the point of violence. The formation of the Eastern Nevada Landscape Coalition and its broad based support from very different perspectives is the result of an adaptive process seeking solutions based upon the development of trust between parties. It is also the result of several other attempts at consensus targeted on resource management issues including CRM (Coordinated Resource Management). The tri-county weed program is the most recent precursor model to the establishment and success of the ENLC. The key principles to successful consensus building are: (1) Voluntary participation by all parties with different interests, (2) Develop Trust, (3) Jointly develop agreed upon ground rules, (4) Find and

Share the Common Vision, (5) Learn to Work Together, and (6) Focus on the Problems, Not the People. As a result, participating individuals and groups feel they are part of the decisional process affecting their future and the future of the land. This has led to the formation of the Eastern Nevada Landscape Coalition as a group which incorporates the political spectrum and scientific knowledge to work toward positive changes in our natural environment.

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The Philosophy Underlying Restoration: Breaking down the human/nature dichotomy

The history of at least post Columbian North American culture has served to separate humans from the rest of nature ? even in our environmentalism. This mindset is rooted in basic assumptions about the "New World" established by early colonists, philosophers and our economic tradition. Ecological restoration is a way that we can begin to dissolve the false dichotomy that serves to separate humans from nature and will help to lead us to a more sustainable reciprocal relationship with the rest of nature.

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Lessons in Restoration Planning & Design: Agua Caliente Spring and Aquatic Ecosystem, a Case Study

In 1999, Pima County, Arizona initiated the Sonoran Desert Conservation Plan, the primary objective of which was the development of a Habitat Conservation Plan to address constraints of an endangered owl. From there the mission grew to addressing regional habitat loss for over 50 species - many of which are riparian obligate/dependent. The perennial spring and aquatic habitat that exists at the Pima County-owned Agua Caliente Park was seen by the SDCP Science Team as an ideal location for planning an ecosystem restoration project that could support native fish, frogs, snakes, other at-risk wildlife and plant species that were once abundant at the Park and throughout the Tucson basin. Pima County, in conjunction with the Corps of Engineers, RECON, and the Biological Expert Group, developed a range of measures to restore the original cienega and riparian habitat. Scientific expertise was available, tapped and supportive. The Corps of Engineers would bear the majority of the costs for design and implementation. A vocal community contingent spoke out against any changes at all to the park environs. Concerns included change in visual character, mosquitoes, disruption of wildlife and potential intrusiveness of restoration activities. In November of 2002 the park's future came to a crossroads. Whether

some of the ponded areas would be restored to a prehistorically authentic cienega system, or remain a haven for non-native and exotic species was decided. This session will examine the balance of power that exists between citizen input and scientific knowledge in ecosystem restoration efforts.

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Wetland restoration in urbanizing landscapes: implications of changing land use and hydrology

Wetland restoration is challenging and much desired in urbanizing landscapes, where urbanization process has not only reduced wetland cover but also, more importantly, substantially altered the landscape setting, which fundamentally changed the watershed and stream hydrology. This study investigated the effects of changing landscape, as results of urbanization, on stream hydrology and potential flooding regime in a wetland restoration site near Rowlett Creek in Dallas, TX. Analysis of historical steam flow data from a nearby USGS gauging station and associated flooding regimes for the wetland restoration site showed that flooding frequency had increased significantly over the last decades for all levels of floods but more pronounced for the intermediate floods and with greater increase of flooding frequency in the non-growing season. Remote sensing, landscape analysis, and hydrologic modeling were used to examine the land use pattern changes in the Rowlett Creek watershed from early 1970's to mid-1990's, their impact on stream hydrology and flood regime of wetlands, potential effectiveness of wetland restoration strategies, and likely future of the restored wetlands under various urbanization scenarios. Results of this case study prompt reconsiderations of the conceptual basis and effective strategies for wetland restoration in urbanizing landscapes.

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History of the Great Basin, Cumulative Impacts, Livestorck and Weeds

The Great Basin is a vast area reaching west to east from the Sierra-Cascade to the Rocky Mountains and north to south from the Snake-Columbia to the Colorado watersheds. Its unifying characteristic is the internal drainage with no water escaping to the ocean. During the Pleistocene, in synchronization with glacial epochs, lakes formed in the hydrologic basins within the Great Basin. Periodically, during the Holocene, while large herbivore populations expanded and contracted across the Great Basin, they were very sparse in the central Great Basin. The most abundant vertebrate herbivores were species of jackrabbits (Lepus sp.) adapted to relying upon metabolic sources of water. The Holocene vegetation evolved from the much more abundant and biologically effective periods of the glacial epochs. The overstory was dominated by woody

species of sagebrush (Artemisia sp.) with understories dominated by cespitose perennial grasses. Cattle and horses were introduced quite suddenly in the 1870s and 1880s. Concentrations of excessive livestock during the late winter, early spring, summer and fall seasons year after year weakened and killed native perennial grasses. This allowed a biological significant increase in long-lived native shrubs. The native herbaceous void in the understory of shrub communities was eventually filled by exotic, self invasive annual species which formed a seral continuum, including cheatgrass (Bromus tectorum). Cheatgrass increased the chance of ignition, rate of spread, and extended the season of wildfires. This greatly reduced the interval between wildfires, but most importantly in terms of restoration, resulted in significant biological changes in site potential.

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Soil biota considerations: If you build it, will they come?

The goal of ecological restoration is to increase ecosystem structure and function to a state comparable to undisturbed conditions. Soil biota directly affect plant establishment and plant community structure and function, through their roles in nutrient cycling, nutrient uptake, and soil formation. Due to the copious number of species of soil organisms and the difficulty of identifying most of the species, restoration practice often overlooks reintroduction of soil biota, with the assumption that if plants are established, soil biota will readily colonize the site. Unfortunately, we have relatively little knowledge of the effects of disturbance on soil biota, the ability of soil biota to naturally recolonize a site, and the need for restoration practitioners to reintroduce soil biota. Different kinds of disturbance will alter soil habitats in different ways. For example, soil compaction reduces pore size and distribution, altering water movement and eliminating habitat for larger soil biota. While bacteria and fungi readily disperse via wind or water movement, dispersal of a wide number of functional groups may take long enough to warrant soil biota reintroduction. And, if soil chemical and physical properties are not appropriate, even readily-dispersed biota will not establish. In this talk, we summarize the literature on disturbance effects on soil biota, and the potential for natural recolonization of revegetated sites by soil biota that influence plant community sustainability. We make suggestions for both future research directions and for restoration practice, in light of limited knowledge.