

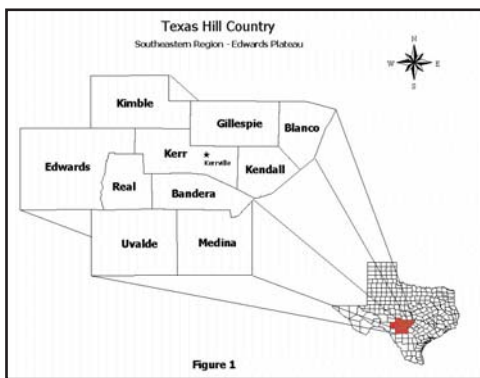
Grassland and Woodland Restoration in the Texas Hill Country

Mark L. Duff and Susan M. Sander
Texas Forest Service

This brochure outlines the factors that have impacted the Hill Country ecosystem, and offers strategies that can lead to its restoration.

THE HILL COUNTRY

The Edwards Plateau, one of ten distinct ecological regions, covers nearly 23,000 square miles in central Texas. The Hill Country lies in the southeastern part of this region and includes all or portions of ten counties (roughly 4,500 square miles). The City of Kerrville in Kerr County is located near the geographic center of the Hill Country area.



The Hill Country is characterized by limestone hills covered by shallow, alkaline soils, broad open divides and deep canyons. Elevation ranges from 1,300 to 3,000 feet above sea level. The headwaters of ten river systems begin in this area due to the numerous seeps and springs. The steep canyons and karst caves are habitat to many species of endemic as well as rare plants and animals. Although nearly all the plant and animal species originally documented in the Hill Country region 200 years ago are still present, changes have occurred in their abundance and range, resulting in several federally-listed threatened and endangered species.

The Hill Country's climate features relatively dry summers with mild winters. The annual rainfall averages 31 inches, yet drought conditions are often common during the growing season. Many plant species share characteristics with plants of the Chihuahuan Desert of west Texas and northern Mexico. Still, the pleasant climate and rugged scenery (spring wild flowers, oak motts and open spaces) attract visitors as well as retirees. The increased trend to divide ranchland into homesites along with changes in land use has impacted the ecological functions of the grassland and woodland ecosystems.



Ecosystem Factors

Botanically, the climax vegetative type of the Edwards Plateau is classified as a "live oak–Ashe juniper park." Prior to settlement in the mid-1800s, the floral composition of the Hill Country was roughly 60% mid- and tall-grass savannahs and 40% relatively closed Ashe juniper-hardwood forests or woodlands. The early explorers also noted extensive "cedar brakes" (dense stands of *Juniperus ashei*) on the steep, rocky slopes, while towering baldcypress (*Taxodium distichum*) lined the banks of perennial creeks and rivers.

The vegetation of an area reflects the unique combination of soil conditions, elevation (slope and aspect), climate, and disturbance. Following a major disturbance (i.e. fires, floods, drought, even grazing/plowing), bare ground will be first colonized by short-lived annual forbs (weeds) and grasses followed by perennials, then woody species, such as shrubs and trees will appear and slowly displace the open areas. Over time, with and without periodic disturbances, a grassland will develop into a climax woodland through the process of plant succession. Land stewardship is managing (arresting) the vegetation at some point during its natural "succession" process as nature does not stand still.

Prior to settlement, the native grasslands that dominated the open uplands of the Hill Country were maintained by fires (caused by lightning strikes or set by Native Americans), and periodic but intensive grazing by large herds of migrating bison and antelope. With the settlement of the region in the mid- to late 1800s, the bison herds were largely exterminated. In addition, early European settlers sought to suppress wild fires.

The introduction of barbed-wire fencing prevented free range of livestock (cattle, goats, sheep, horses, and more recently, exotic ungulates). Once confined, the animals grazed an area year-round (unlike the roaming wild herds of bison), and thus, greatly reduced the fuel needed for wildfires. In those early years, the concepts of carrying-capacity and pasture-rotation were not understood, and therefore, not practiced.

Over time, rangelands became overgrazed. Without the intensive root system of native grasses to anchor the soil, heavy rains eroded the shallow topsoil, especially on the slopes. This shift in soil conditions favored “pioneer” annual weeds (mostly non-native species) to colonize large areas.

During the 1940s and 1950s, the introduction of non-native (exotic) grasses, (e.g. Johnson grass, King Ranch “KR” bluestem, coastal bermuda) for forage created monocultures that outcompeted the more palatable and nutritious native grasses and forbs. This situation is difficult to reverse as these plants have escaped cultivation.. The severe, prolonged drought of the mid-1950s added to the decline of range conditions.

The land-use practices of the past 150 years have resulted in four major forest health issues: the encroachment of Ashe Juniper (cedar); the proliferation of oak wilt disease, the lack of regeneration of hardwood species, and the invasion of non-native species.

Ashe juniper, locally called cedar or mountain cedar, is a native, woody species naturally kept in balance by fire which kills sprouts and even young trees. Hence, this species, like many native hardwoods, was restricted to areas that burned infrequently, e.g., rocky slopes, hill-tops, and the cooler, more moist canyons. Ashe juniper is highly adapted to the Hill Country, hence current land conditions have fostered its encroachment. To manage effectively, one needs to understand its biology.

The male trees produce clouds of air-dispersed pollen during winter. Female trees produce abundant blue “berries” (fleshy cones) consumed by birds and wildlife that deposit seeds in new areas. The spiny needles on young sprouts guard against browsers, and due to the high oil content nothing eats it as a first choice. Removing mature trees reduces the competition, and thereby, fosters a growth spurt among the sprouts that although only six inches high may be 6 to 8 years old.

As the tree’s dense canopy shades out grasses and forbs, pastures degrade in food value for livestock and wildlife. Dense cedar-brakes also out-compete more desirable trees (including live oaks), hindering hardwood regeneration. During prolonged droughts, the oil-laden cedars become heavy fuel loads creating a fire hazard. Crown fires throw off sparks that can ignite new areas, making control difficult.

Local water resources can be impacted by dense cedar. Since Ashe juniper is evergreen and has a much greater leaf surface area than most trees of the same size, water loss through evapotranspiration (via direct surface loss and transpiration) can take place year-round.

In addition, due to the scaled needles, ashe junipers intercept 37% of a rainfall in their leafy canopy, while the litter intercepts 43%. More than half of the rainfall events are under one inch, hence, the needles hold on to raindrops; which are lost to evaporation once the sun shines. Without soil infiltration, groundwater is not recharged which means that spring flow, and in turn, creek and river flow are also reduced. Conversely, Ashe juniper cover on slopes protects the ground during heavy downpours, as the canopy softens the impact of



rain pounding the soil.

When left unmanaged or overgrazed, grasslands tend to develop into an Ashe juniper monoculture at the expense of plant diversity, and in time, animal diversity. Control of Ashe juniper is done by ax, chainsaw, hydraulic clippers and bulldozers – methods that are both costly and labor intensive. Unless all leafy branches are removed, the tree can resprout; and as long as grass cover remains short, berries can sprout. Hence, control requires an on-going maintenance strategy.

Live oaks have also become more densely populated throughout the Hill Country. Unlike Ashe juniper, live oaks are desirable landscape trees for homesites in the Hill Country. During summer, oaks provide valuable shade for livestock; acorns are important food for wildlife in the fall, and the branches provide shelter and winter browse, particularly for deer.

In the past, live oaks were often found stunted among Ashe junipers on hillsides, or in scattered motts among the “sea” of grass. A mott is a group of live oaks that share an interconnected root system. New live oaks most often sprout from the existing root system of a large tree. When ground fires periodically swept through the grasslands, enough heat was generated to kill off many of these tender young oak sprouts without creating a canopy fire that destroyed larger trees. Thus, fire prevented the encroachment of live oaks into the surrounding grassland.



Without periodic fires, the root sprouts grow into dense stands of young oak trees that are essentially one organism, or clones due to their grafted roots.

The increased density of live oaks, as well as the propensity of live oaks to form root grafts and grow in interconnected motts, created conditions that facilitated the current oak wilt epidemic. Oak wilt is a vascular disease that can infect all oak species. Spores of the oak wilt fungus (*Ceratocystis fagacearum*) are carried by tiny sap beetles from fungal mats formed in diseased Spanish (red) and blackjack oaks to open wounds in other oaks. Since the 1970s, oak wilt has killed millions of live oaks and Spanish oaks across central Texas resulting in millions of dollars of lost property values. To date, oak wilt has been found in 63 counties of Texas. Prevention and property maintenance is the best defense.

Animal Impacts

Historically this region’s woodlands naturally occurred in protected canyons. Woodland health has been severely impacted by the white-tailed deer population, now at an all-time high due to an increase in habitat cover (cedar brakes, oak motts and home landscapes), along with the creation of more surface water sources (i.e., stock ponds). The loss of biological controls (eradication of the screw worm parasite in the 1950s) and a reduction of predators (i.e., mountain lion, coyotes, and wolves) have not been offset by hunters who tend to take bucks versus does. It is now common to have a ratio of one buck to three does with an average density of one deer to six acres. Ideally, the goal for wildlife managers would be a ratio of two does per buck, and a density of one deer to every 8-35 acres (under good range conditions).

In addition to deer, there has been an increase in the stocking rates of other browsers, e.g., goats and exotic ungulates. These animals tend to eat similar vegetation, most often consuming forbs first then switching to woody species. (Despite the number of browsers found in central Texas, Ashe juniper (cedar) is not a preferred food.)

Due to the competition, deer are forced to browse woody plants, their winter staple, during the summer growing season. It is common to see a four to five-foot high "browse line," indicating that understory woody species (i.e. replacement seedlings or root sprouts) have been eliminated. Predictably, as browsers consume foliage and seedlings, only mature, over-story trees survive. The result is a non-sustainable, mature woodland. Consequently, as older trees die, there is no replacement, and future seed sources are also threatened.



Presently, Hill Country woodlands show an alarming lack of regeneration for many unique species: Texas madrone (*Arbutus xalapensis*), blackjack oak (*Quercus marilandica*), chinquapin oak (*Q. muhlenbergii*), Lacey oak (*Q. laceyi*), post oak (*Q. stellata*), Spanish oak (*Q. buckleyi*), big-toothed maple (*Acer grandidentatum*) and escarpment blackcherry (*Prunus serotina var. eximia*). Rare species, such as Sycamore-leaf Snowbell (*S. platanifolia*), Texas mock-orange (*Philadelphus texensis coryanus*),



and canyon mock-orange (*P. ernestii*) and Texas snowbells (*Styrax texana*), a federally-listed endangered species, have been reduced to remnant populations on steep bluff walls, places not easily reached by browsers.

Without hardwood regeneration and periodic fires, Ashe juniper will develop into dense stands in both grasslands and canyons. As the cedar brakes mature and die, the fire hazard increases.

THE HUMAN FACTOR

Like many other rural areas, Hill Country communities have been moving away from agriculture. Working ranches have diminished in size and number. Due to inheritance taxes and low profits, ranchers turn to subdividing their land, often into 3 to 5-acre homesites. The fragmentation rate in the Hill Country can run as high as 25%. During the past 50 years, the area's population increased by 228% (almost triple the growth rate for the United States).

Dividing a 100-acre ranch into 5-acre parcels can easily result in 20 different land-use goals and management philosophies. Smaller parcels not only fragment wildlife habitats, but also prohibit the use of certain management strategies such as prescribed burns that are important to the restoration of grassland health. In addition, home landscaping becomes the source of new introductions of non-native plants (Chinese tallow, Japanese ligustrum, nandina and Chinaberry). In the last 150 years, more than sixty non-native plant species have escaped into the ecosystem. When naturalized they compete with native species and can also lower wildlife food values.



RESTORATION OPPORTUNITIES

Typically, a Hill Country landowner owns 10-100 acres often with a primary or secondary home. Usually, residential and recreational uses (hunting and leisure) are the primary objectives, with a desire to maintain a lower tax status under "open space" with agriculture evaluation.

Fortunately, landowners are interested in good land stewardship, which entails the sustainable management of grass, forbs, trees, soil and water resources in balance with wildlife and livestock needs. To achieve specific landowner goals, a conservation or stewardship plan can be designed for individual properties. Natural resource management professionals assist landowners in identifying and attaining specific woodland and range management and restoration objectives. Various options are outlined here.

A landowner may decide to restore grasslands and/or native hardwood forests. This is possible on many sites as hardwoods generally grow on steep rocky slopes, in canyons or along creeks, while grasses better occupy valleys and lowlands with deeper soils, or upland divides.

To maintain an agricultural evaluation for *ad valorem* taxes one can now manage for wildlife species (deer, turkey, quail, dove, even songbirds) instead of livestock. A wildlife management plan is designed for the property and determination is made through the local county tax appraisal office. Most landowners seek a combination of objectives that will assure the sustainability of various natural resources and work to manage their property holistically.

Grassland restoration often includes a combination of practices such as reseeding native grasses, grazing management, brush control and prescribed fire (where practical). Reintroducing native grasses (e.g., big bluestem, little bluestem, Indian grass and switch grass) can provide good to excellent livestock forage. Grazing management includes stocking pastures at or below carrying capacity and the practice of high-density/ low-frequency rotational grazing systems. Brush control for second-growth Ashe juniper, prickly pear and mesquite involves a combination of herbicide sprays, clearing or sculpting by hand cutting or mechanical means (bulldozers, shredders or hydraulic clippers), and prescribed burns. The latter can be used to prepare sites for seeding, improve wildlife habitat (including endangered species), dispose of woody debris, control weeds and woody species, as well as improve forage for grazing. Through local prescribed-fire co-operatives, several adjacent landowners can collectively burn much larger parcels of land. Contact your local agent from the Natural Resource Conservation Service or County Cooperative Extension for details.

Native hardwood forest restoration techniques include management of oak wilt through prevention and control methods; release of established trees from Ashe juniper competition by thinning; reintroduction of locally-grown native hardwoods; protection of newly planted trees and naturally regenerated seedlings from animal damage with appropriate fencing; reduction of deer and exotic animals; monitoring and control of non-native species that are becoming invasive.

☛ To prevent oak wilt, immediately paint all wounds and pruning cuts on all oak trees; eliminate or girdle infected red oaks (to prevent fungal mat and spore production); do not use or store unseasoned, diseased Spanish or blackjack oak firewood; and treat specific live oaks with Alamo™ fungicide. Methods to control oak wilt spread are generally limited to deep-trenching (below root zone) 100 feet in front of expanding oak wilt centers to sever common root systems.

Since new outbreaks of oak wilt are common (especially in areas with high numbers of diseased red oaks), control measures may only be temporary.

☛ Before clearing Ashe juniper carefully survey beneath canopy for sprouts of hardwood species. Ashe juniper, agarita and other thorny species act as nursery plants by protecting tender sprouts from browsers (note the red oak and madrone sprouts in picture). Clear-cutting can destroy



this potential hardwood replacement. Selective cutting of overhead competing branches releases the desired hardwoods and allows them to grow to mature height. Also, more mature hardwoods that have grown up in dense cedar brakes are often protected from buffeting winds and sun. Releasing them may increase their exposure to sun scald and wind damage. Hence, it may be more beneficial to do cedar removal in stages to protect existing hardwoods.

☛ Long-term management should include enrichment plantings with a variety of native hardwoods, particularly oak trees resistant to oak wilt, and other species tolerant of drought conditions and high alkaline soils.

Forests with a diversity of tree species and ages are less likely to suffer from insect and disease epidemics than monocultures. Since insects and diseases are generally host specific, when they occur in a diverse woodland, their impact is often less destructive. Greater plant diversity also provides for more varied wildlife habitats and natural food sources.

☛ Fence cages allow individual hardwood regeneration or planted trees to grow beyond reach of browsing animals and livestock damage. Later, cages can be removed and reused. The installation of high fence exclosures around larger areas with desirable mature trees can protect sprouting seeds from the natural seed “rain” to promote regeneration. Such exclosures serve as “genetic seedbanks.” Within a few years wildlife, wind and water will scatter seeds to new locations.

Fences can also be used to exclude livestock to protect water quality of springs and riparian zones while preventing soil erosion on the banks. In other cases, fences can be used to protect critical habitat of endangered plant species, as well as to protect feeding and breeding areas of the endangered black-capped vireo (which nests within three feet of the ground) in addition to ground nesting songbirds, turkey and quail.



☛ To maintain a healthy woodland, the number of browsing animals needs to be proportionate to the food source. Often the small size of property prohibits such techniques as hunting and trapping (which is stressful to the animal). High fencing is expensive and can restrict the movement of other species as well. It is often difficult to balance the desire to see deer up close with that of their impact.

☛ Control of non-native species has become a pressing issue in the past decade as more and more species are escaping the home landscape and finding their way into the ecosystem. State and federal departments



now wrestle with aliens in the natural areas as part of their management strategies. The role of good stewardship is to consider the impacts when introducing a new species into the environment. Today Chinese tallow is beginning to show up in the major drainages of Kerr County. Due to the topography of the land, the seeds are spread not only by birds but also by run-off. Know your plant's reproduction habits — berry producing species tend to attract birds, although it is unknown at this time if the berries are actually providing real nutritional value. Some species, such as Chinaberry, produce a dense canopy that reduces sunlight for other lower species.

Chinese tallow produces a chemical compound that inhibits the growth of neighboring plants. Since both produce thousands of seeds, without natural

biological controls (i.e. pests), they can quickly overwhelm an ecosystem. Such strategies give the non-native plant an advantage over the native species and over time will replace them in the environment.

***In summary, clearly defined goals and objectives are essential for any management.
An inventory of your land's resources is a good starting point.***

CONSERVATION OPTIONS

Landowners can use leases, mutual covenants, conservation easements, or “transfer of development rights” as strategies to preserve the natural resources of their property for future generations. Such options are outlined in the booklet, "*Conservation Easements, A Guide for Texas Landowners*," available from Texas Department of Parks and Wildlife. A PDF document is also available from the TPWD web-site (see below for address). Clearly defined goals and objectives are essential for effective resource management.

LANDOWNER ASSISTANCE RESOURCES

While site specific recommendations are beyond the scope of this brochure, the following university, state and federal agencies serve the Hill Country region and offer landowners assistance and technical guidance, free of charge. Contact their local office or websites for details about their particular programs.

- *Natural Resources Conservation Service* of USDA
<www.tx.nrcs.usda.gov> Hill Country is in the “San Angelo zone”
White page listing is under
“United States Government Offices: Agriculture, Dept. of Consolidated Farm Service Agency.”
Kerr-Bandera office is located in Kerrville: (830) 896-4911
- *Texas Cooperative Extension* (County Extension Agent) A branch of the Texas A& M University System
Most brochures are available as PDF through their web-site:
<<http://TEXnat.tamu.edu>>. To reach county web-site, type the county in the blank <____-Tx.tamu.edu>.
- *Texas Forest Service* A branch of the Texas A& M University System
<<http://texasforests-service.tamu.edu>> * consolidated Oak Wilt web-site: <www.texasoakwilt.org>
Two offices serve the Hill Country counties:
Kerrville (830) 257-7744 (Bandera, Edwards, Kendall, Kerr, Kimble, Menard, Real)
Johnson City (830) 868-7949 (Blanco, Gillespie, Hays, Llano, Mason)
- *Texas Parks & Wildlife Department* <www.tpwd.state.tx.us/>
Regional office in Kerrville: (830) 896-2500