Grasslands Not Badlands:
Arid Grassland Restoration in Big Bend National Park

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The Northern Rosillos Mountains are named for their reddish color, which is most apparent during sunrise and sunset. The restoration site is located north of these mountains.

Arid Grasslands in Big Bend

When one thinks of the Big Bend region, images of vast open areas, dramatic mountains, and desert adapted plants like cactus come to mind. Many people don't realize however, that grasslands are also a part of the landscape. These arid grasslands are a patchwork across the park, dominated by bunchgrasses, shrubs, and succulents. Chihuahuan desert grasslands are important in maintaining ecological processes like water and nutrient cycling, stabilizing soil, and preserving biodiversity. The abundance of nutritious grasses provides a home and feeding ground for much of the park's wildlife.

Sotol grasslands, dominated by grama grasses and succulent plants, form a belt around the Chisos Mountains.

Big Bend National Park manages one of the largest protected areas of arid grasslands in the entire Chihuahuan desert ecosystem. In 1989 native grassland habitat within the park was augmented by the generous donation of 67,125 acres from the Harte family. Located north of the Rosillos Mountains, this historic rangeland had been impacted and altered in the early 20th century, prior to the Harte's purchase of the land in 1958. Although the damaged land proved to be economically unviable for ranching, it retained scenic and biological values. In spite of its protected status within national park boundaries, however, the trend towards decline and loss of native grasslands continued from 1989 to 2000. In that year NPS staff began an ecological restoration project to slow, and perhaps arrest, the cycle of decline.

Harte Ranch: Past and Present

No one knows for sure what Harte Ranch looked like prior to the ranching era. We can only guess by historical accounts. As in other arid lands with a shallow slope, runoff probably deposited organic matter in bands where nutritious grasses such as cane bluestem, pappusgrass, and vine mesquite grew. The intervening spaces of bare ground was protected by biological crusts, a layer on the soil surface containing soil particles that are bound together by living elements such as lichen, mosses, and cyanobacteria. These crusts are important because they encourage water infiltration, seed germination, stabilize soils, and fix nitrogen--the building block of all life. However, climatic factors and land use over the past century have changed the natural processes in these lands, resulting in their devastation.

Biological soil crust at Harte Ranch.

Soils vary from region to region--at Harte Ranch the soils are fertile but fragile and particularly sensitive to disturbance. Soil erosion most likely began with El Nino winters in the late 1800s and early 1900s, and was aggravated by the loss of grass cover due to the building of water holding and diversion structures that altered surfaced water flow, and subsequent grazing of the land. It is estimated that between 1996 and 2002 Harte Ranch lost a foot of soil surface. The results have been an ever widening system of gullies and accelerated soil erosion that is altering and diminishing grassland habitat located within the entire watershed.

Soil erosion at Harte Ranch has resulted in tracts of land where even the hardiest plants like creosote cannot survive.

Gullies and Climatic Factors

Gullies are a common feature of arid Southwestern landscapes; they are channels that have been cut into the soil by moving water, and were probably widened and deepened by cycles of wet and dry periods that began in the late 1880s and lasted through the mid 1990s. Unusually heavy rainfalls associated with El Nino that cause flooding serve to widen and deepen these gullies. When followed by periods of extreme dryness the water table in the ground drops, reducing vegetation cover, and making soil even more susceptible to erosion. These climatic patterns have played a role in forming gullies in many areas of the southwest, and could be a contributor to the expansion of gullies at Harte Ranch. With each major rainstorm topsoil is washed into gullies, and is then deposited throughout the watershed and eventually into the river. These sediment loads have a high salt content, and threaten recovering grasslands downstream by changing the chemistry of the river.

A mesquite tree growing near a gully at Harte Ranch. Accelerated soil erosion has exposed the roots of the tree.

Water Retaining Structures and Grazing

The building of water retaining structures prior to the establishment of the park and subsequent grazing of the land have resulted in a loss of vegetative cover, and set the stage for destructive soil erosion. Over 140 water retaining structures, such as stock ponds and diversion, have been mapped at Harte Ranch. These structures have changed the way the water naturally flows across the land by channeling water, giving it more erosive force in certain areas, and depriving other areas of vital irrigation, resulting in loss of vegetative cover. With no protective cover, raindrops hit the exposed soil and drive the finest grains into the pore spaces between the larger grains. Once impacted, the concentration of fine grains, seals the surface, and creates a physical crust; a thin layer of the soil surface that restricts water infiltration and air movement in the soil, limiting vegetation growth. With infiltration severely reduced, water runs off the surface and carries soil into gully systems.

A large man-made diversion at Harte Ranch. Structures like this have altered the natural drainage patterns of the land.

The Effects of Soil Erosion

Soil loss has drastically altered the grasslands community. Shrubs like creosote and mesquite now dominate the landscape with only a smattering of tobosa grass in between. The shrubs are left in an unhealthy condition as soil loss exposes the plant's base, including roots, leaving the plant on a pedestal of soil.

Degradation of these areas has resulted in reduced habitat for animals. Pronghorn and bighorn sheep, once commonly found in this area, have become a rare sighting, and migrating birds that are reliant on these grasslands are being displaced. Disturbed areas are easily colonized by exotic plants and animals, which further displace the native species of the area. Without action, it is thought that 20-30 thousand acres of potential native grassland habitat would be lost as the area eventually erodes into a huge gully system.

Exposed roots of an allthorn bush at Harte Ranch.

The Lark Bunting is a winter resident of the park and makes its home in the grasslands of Big Bend.

Early Grasslands Restoration

After the establishment of the park in 1944 it was hoped that the grasslands would recover. The grasslands in the Chisos foothills began recovering within a number of years, but the hotter and drier lowlands were not as quick to recover. In the 1950's the NPS along with the Soil Conservation Service attempted to restore the grasslands at Tornillo Flat, located south of Harte Ranch. They built structures at the bottoms of gullies to prevent further erosion, and contoured and pitted the land, adding native grass seeds to increase grass cover. It is hard to judge the success of the SCS effort because little is known about original project goals. Surveys of the area indicate mixed results; grass continues to grow in the pits, but overall vegetation cover has not increased, and unfortunately soil erosion continues today in the Tornillo Flats area. It was realized that restoration of grassland ecosystems is more complex than originally thought.

The Soil Conservation Service restoring the grassland at Tornillo Flats in the 1950s.

Grasslands Not Badlands: Current Restoration Efforts

The current restoration effort began in 2000 at Harte Ranch with the goal of mitigating soil erosion by restoring the natural drainage patterns to the land. After the land was assessed, park staff used knowledge gained from previous restoration activities to test new methods over a two year period. Similar methods used by the Soil Conservation Service, like pitting, were attempted with little success. Planting evolved from small treatments of live plants to a mixture of seeds, mulch, and a glue-like substance that is sprayed on by a machine, which allowed workers to treat larger areas. Once planted the area was covered with brush, which aids in seed germination and soil protection.

NPS staff tried micropits in an attempt to restore hydrologic function. These pits filled in after several rains.

A total of 325 acres of the most severely eroded areas were targeted for restoration. Strips that will be planted with native grass and forb seeds are plotted to mimic the natural vegetation pattern of the land. After the strips have been plotted, loads of brush are staged along the strips. The brush is collected from other park projects such as exotic plant removal and fuel reduction activities.

Aerial view of a restoration site at Harte Ranch.
Grasses and forbs are planted on level contours to catch water.

A vegetation strip that has just be tilled.

Once the brush is staged it is time to till the soil. A disc plow is used to till strips that are 8 feet wide and up to 500 feet in length, and are arranged along level contours. This arrangement allows the strips to interest water runoff and increases infiltration. The tilling breaks up the physical crust and allows roots and water to penetrate the soil.

A vegetation strip that has just been planted; hydromulcher pictured in background.

Immediately following plowing the strips are planted with a mixture of mulch, seed, tackifier, and water sprayed from a gas powered hydromulcher. The mulch aids in seed growth and the tackifier, a glue that binds the seeds and mulch to the soil, prevents wind and animals from carrying the seeds away. A non-toxic dye that eventually fades allows workers to see where they have planted.

The vegetation strips mimic the natural patterns of shrubs and grasses in arid grasslands; they slow the overland flow of rain water, and act as a sink for the water to penetrate into the soil, rather than run off into gully systems.

A completed vegetation strip.

Once the strips are planted they are covered with brush and left to await the rains. The brush is critical to the success of the grass. It slows the velocity of rain drops and decreases further soil erosion. Most importantly, the brush shades the seeds and lowers soil temperatures, providing the necessary environment for the successful establishment of grasses.

The Results

Environmental restoration is not a perfect science—complex ecosystem processes that have developed over millions of years cannot be mimicked by humans. Potential recovery will require years, and with the project still in early stage, success cannot be completely determined.. Thus far the results have been positive. The grasses are growing year after year and the overland flow of water has slowed. In some areas grass is even beginning to grow outside the planted strips. It's possible that the restoration project could serve to protect grasslands down slope, and that the grasslands at Harte Ranch could eventually re-establish themselves, but only time will tell. Despite knowledge gained and successful treatments, restoration can never take the place of undamaged lands. Protection is the best way to keep our environment healthy and diverse.

Grasses are growing each year with the spring and summer rains. Here grass has even begun to grow outside of planted areas.

Get Involved

Protecting and rehabilitating land isn't always an easy task, especially when it comes to environmental restoration projects that are large in scale and labor intensive. Volunteers play an important role in accomplishing these projects. Thus far 316 acres of grassland have been restored with the valuable help of project volunteers.

Volunteers from the Jefferson Community School in Port Townsend, Washington take a break at the worksite.

One of the biggest contributors to the project has been the Sierra Club, who perform service projects on a yearly basis in the park. In March 2009 they helped restore 50 acres.

The Sierra Club.

In the fall and winter season of 2008-2009, 142 volunteers contributed over 2,000 hours of their time, helping park staff to treat 191 acres in just a six month span. Volunteer groups varied in background and age. Our youngest volunteer was 11 and the oldest 80. Volunteers gain work experience in the resource management and restoration field, have a chance to work in areas of the park that many visitors don't get a chance to go to, and help keep our public lands in a healthy condition.

The Earth Corps, based out of Austin Texas, helped remove exotic vegetation from riparian areas in the park.
The brush was used to shade grass seeds at the restoration site.

For more information about volunteering in the park visit the "support your park" section of the website, or contact the park volunteer coordinator at (432) 477-1196.