Coyote Willow Pole Plantings in Ephemeral Streams of Southwest New Mexico

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Abstract

Pole plantings are a strategy for stabilizing streambanks along perennially flowing watercourses because the high water table adjacent to these streams allows for successful establishment. In the Southwestern United States, however, such live water is uncommon, though high water flow events during the monsoon season can lead to severe erosion. This study tested strategies at the C Bar Ranch in New Mexico for establishing pole plantings of coyote willow (*Salix exigua* Nutt.) to disrupt waterflow and prevent soil loss during high-flow water events.

Introduction

Erosion in the Southwestern United States is an ancient problem. Current erosion issues have been caused by a variety of factors, including overgrazing, 17th-century cattle drives, game trails, and topography. At the C Bar Ranch, located about 35 miles southwest of Silver City, NM, we (the Evans family) have been dealing with all of the above.

We settled into the C Bar Ranch in the mid-2000s. The land was homesteaded in approximately 1880. We learned that the former owner had a long and tumultuous history with the U.S. Department of Agriculture (USDA), Forest Service. The ranch had had a long-standing year-round permit for 275 head of cattle through the USDA Forest Service.

When the prior owner passed away in the mid-1970s at age 98, the USDA Forest Service had been waiting for years to reduce the number of cattle on the permit, and approximately 400 head were removed. Thereafter, the ranch passed through several absentee owners. We inherited a permit for 60 head when we moved to the ranch in 2005 and approached the USDA Forest Service about changing the permit to a winter grazing allotment (August through April). The permit was granted. As a result of the planting projects described in this article to stabilize soil, we have since been able to increase our animal units.

Site Description

The C Bar Ranch is located in the Burro Mountains, near the south end of the Gila National Forest. The land has been historically used as rangeland, with the C Bar Ranch serving as private grazing land and the Gila National Forest serving as a winter grazing range for the registered Angus herd from C Bar Ranch, as well as public recreational land. Firewood is also harvested from this allotment by the public. In addition, hunting permits are sold for mule deer, javelina, and more recently, elk. The elevation range is approximately 5,000 to 7,000 feet. The forest type is primarily pinyon/juniper (defined by the presence of one or more species of pinyon pine [*Pinus* spp.] and juniper [*Juniperus* spp.]). Most of the soils are sandy with volcanic influence.

The climate is temperate. Winter temperatures can dip below 20 °F at night, with an occasional drop below 0 °F. High summer temperatures can range above 90 °F. Records suggest that annual rainfall averages about 16 in, but since moving to the area, we have had more years with precipitation below 10 in than we have had at 16 in or above.

When we first arrived, the ephemeral streambeds had little to no vegetation due to the rapid flow of seasonal floodwaters. The ranch had also been severely overgrazed. The first USDA Forest Service manager we worked with described C Bar Canyon as being so choked with cholla (*Cylindropuntia* spp.) that one could not even ride a horse through it. The Arizona walnut (*Juglans major* [Torr.] A. Heller) and cottonwood (*Populus* spp.) trees had been devoured to their bases, and even the beargrass (*Nolina* spp.) had been

decimated. The water table had dropped to the point where all mature trees had died.

The grass species on the ranch are primarily warm-season species, including blue grama (*Bouteloua gracilis* [Willd. ex Kunth] Lag. ex Griffiths), black grama (*Bouteloua eriopoda* [Torr.] Torr.), sideoats grama (*B. curtipendula* [Michx.] Torr.), hairy grama (*B. hirsute* Lag.), Arizona cottontop (*Digitaria californica* [Benth.] Henr.), green sprangletop (*Leptochloa dubia* [Kunth] Nees), sand dropseed (*Sporobolus cryptandrus* Hitchc.), spike dropseed (*S. contractus* Hitchc.), giant sacaton (*S. wrightii* Munro ex Scribn.), and various lovegrass species (*Eragrostis* spp.). Some patches of cool-season grasses are also present, such as Indian ricegrass (*Achnatherum hymenoides* [Roem. & Schult.] Barkworth) and bottlebrush squirreltail (*Elymus elymoides* [Raf.] Swezey). The shrubs include skunkbush sumac (*Rhus trilobata* Nutt.), manzanita (*Arctostaphylos* spp.), algerita (*Mahonia trifoliolata* [Moric.] Fedde), sotol (*Dasylirion wheeleri* S. Watson), and gray oak (*Quercus grisea* Liebm.). In addition, the site has alligator juniper (*Juniperus deppeana* Steud.), one-seed juniper (*J. monosperma* [Engelm.] Sarg.), cholla, and prickly pear cactus (*Opuntia* spp.). The trees include Gooddings willows (*Salix gooddingii* C.R. Ball), coyote willow (*S. exigua* Nutt.), cottonwood, chokecherry (*Prunus virginiana* L.), netleaf hackberry (*Celtis laevigata* Willd. var. *reticulata* [Torr.] L.D. Benson), Arizona walnut, and a grove of Gambel oak (*Quercus gambelii* Nutt.).

Past and Current Erosion at the Ranch

In 1862, the Homestead Act was passed, offering any adventurous American citizen title to 160 acres of land if they could "prove up," that is, make it habitable within 5 years. This act was drafted by residents of the Eastern United States who did not realize that 160 acres may only support a quarter of a cow in the southwestern part of the country, which was hardly enough for a family to survive.

When the homesteaders came to the area, the canyons were referred to as a "ciénaga," which is a Spanish word for swamp (i.e., wetland). In the monsoon season, the washes would flood bank-to-bank, or canyon wall to canyon wall, thus wiping out the crops planted by the settlers. To control the flow, the settlers built dikes in various places to send the water flow to one side of the canyon or the other, thereby diverting it around their crops. Presumably, they also harvested water at some point. The hand-dug well located at the homestead near the upper end of our part of Walking X Canyon was only 12 to 15 ft deep. The homestead remnants and historical accounts tell us that 2,000 people lived in this small watershed at one point. There was even a school built in the early part of the 20th century. When the homesteaders left, they took their lumber and all the material that held their homes together, but the dikes remained and continued doing exactly what they had been intended to do.

When we moved to C Bar Ranch, the most egregious example of past dike construction was found in Walking X Canyon where remnants of the dikes could be seen, along with huge gorges formed along the rock walls of the canyon. The "farmland" in the middle was full of Russian thistle (*Salsola* spp.). Along the side of the gorge was a vein of black, anaerobic soil. At the upper end of the canyon this vein was about 2 ft below the accumulated flood detritus, and about 1 mile down canyon the vein was about 8 ft below the silt.

As we explored Walking X Canyon over to the neighboring Prevost Ranch, we found that the ciénaga water rose and fell depending on the bedrock structures underlying the washes, portions of which were a beautiful, braided channel. Not far below that was a flood plain filled with Bermuda grass and a massive head cut (an erosional feature in stream geomorphology indicative of unstable and expanding drainage). We monitored that head cut through several flow cycles and observed that it migrated 50 ft up the channel after a single, gentle 2-in rain event.

Pole-Planting Projects

Dryland restoration can be challenging and require various techniques (Bainbridge 2007). Given the periodic precipitation events on the ranch, we were concerned that further head-cut migration would endanger the entire ciénaga. So, we partnered with the absentee owners of the Prevost Ranch and the U.S. Fish and Wildlife Service's Partners for Wildlife program to reestablish the stream meander and reintroduce native vegetation to the area.

A common vision is to seed native species to reestablish cool-season grasses and other native plants. The reality in our area is, however, that seeding requires

Figure 1. Augers were used to create planting holes that were deep enough for the coyote willow poles. (Photo by Erin Evans, 2012)

such precise conditions to succeed that it has a high probability of failing. We have had more success with planting container-grown plants. We have learned that the plants need to be grown in a container that is at least the size of a 4-in wide by 12-in deep Treepot™ (Stuewe and Sons, Inc, Tangent, OR) and must be irrigated after planting until they are established. Thus, our focus was on planting poles based on research showing successes with this approach in New Mexico (Dreesen and Fenchel 2014).

Coyote willow poles were at least 8-ft long and had an approximately 1-in diameter (but not less than 0.75-in or more than 1.25-in) with all the upper growth cut off. We drilled the planting holes 6 ft deep with either a handheld auger or a tractor-mounted auger (figure 1), depending on site accessibility. Planting was done in January and February, before the coyote willow broke bud. We planted the poles as deep as we could get them in the holes, leaving 12 to 15 in aboveground (figure 2).

Our first planting efforts (2010 and 2011) were on the Prevost Ranch with coyote willow poles sourced from a grove in C Bar Canyon. One site was in floodplain soil and the other was in sand. Each planting hole was drilled and had water in the bottom. Because we stuck the poles into wet ground, we anticipated great success. Both sites were adjacent to stream meanders, so wetland conditions appeared to be appropriate for the poles to thrive. Nonetheless, every pole planted in the floodplain soil died. More than half of those planted on the sand bank survived. Still, it was disappointing because we had envisioned poles in the floodplain soil to deflect water back into the meander. We believe the soil may have caused rotting or anaerobic conditions that did not allow proper root development. Based on these results, we concluded that it is critical to backfill with sand rather than soil.

Figure 2. Coyote willow poles were planted as deeply as possible, leaving just the top 12 to 15 inches aboveground. (Photos by Erin Evans, 2012)

For the second planting (2012), we revised the planting methods and site selection. We chose two locations near each other that had similar water table heights and waterflow rates during precipitation events. The locations were about 2 miles upstream from the first planting. A neighbor routinely overgrazes their land, resulting in significant flood waters from their side of the fence into our main channel when there is a heavy rain. A rock wall on one side of the canyon deflects the water to the opposite floodplain bank, rapidly eroding the streambank. We planted coyote willow poles along the most vulnerable area of the bank. Pole characteristics and source were the same as the first planting. After a few years, the bank is very stable, the willows are large, and the grass has grown as well (figure 3).

We continued the same planting strategy in an adjacent area in 2013 by planting poles in diagonal rows across the same channel. The first year after planting, the poles were buried by sediment from a flood event. Two years later, however, the poles emerged from the sand and are now armoring the wash adjacent to the previous planting (figure 4).

We have initiated similar experimental plots on the Gila National Forest, several of which have failed due to both elk predation and flooding. One notable success is in a wash with significant erosion potential. In 2017, we began planting at the top of this area which had a shallow sand base sitting on bedrock. Some pole mortality occurred in this upper area. Further downstream were varying depths of bedrock, which influenced where we planted the poles. When we got to an area where we could drill at least 4 ft deep, we planted the poles about 6 ft apart. In every case, there was water in the hole, but we were working in sandy sediments. We fenced this area to prevent elk predation, installing the fence high enough above the wash surface so flood water would not destroy it. After 5 years, the planting is doing well (figure 5).

The pole plantings on the C Bar Ranch and surrounding areas were not placed in riparian areas as

Figure 3. Coyote willows planted in 2012 armor a bank at the top of Walking X Canyon. Four years later, erosion has been mitigated, grass has been reestablished on the bank, and the willows have put out numerous suckers. (Photo by Erin Evans, 2016)

Figure 4. Diagonal rows were planted adjacent to the armored bank in 2013 but were covered by sediment after a major flood event. Two years later, however, the planted coyote willows had emerged from the sand. (Photo by Erin Evans, 2016)

Figure 5. These coyote willow poles were installed on the Gila National Forest in 2017. Three years later, the suckers can be seen along with the protective fencing installed to guard against herbivory. (Photo by Erin Evans, 2020)

usually done for such projects. The conventional technique is to place the bottom end of the pole in persistent groundwater and backfill with soil from the augured hole. At our sites, however, the pole plantings had no adjacent live water. We relied on damp sand to establish the plants, knowing that any water flow would be seasonal, if at all. To prevent losses due to elk herbivory, we used concrete reinforcing wire installed 12- to 18-in above the wash surface, so that any debris carried by floodwater would pass through or deposit in the planting area. While we are using the plantings to slow and distribute the flow of water, a side benefit is the deposition of organic material in the sand washes, which then enables the establishment of grasses and shrubs to further stabilize the streambed.

Conclusions

The pole-planting method described in this article has proven to be an effective strategy for mitigating erosion in sandy arroyos in the Southwest. Landowners can apply this technique without a large investment in equipment or materials. We plan to continue implementing this process in various target areas throughout our allotment on the Gila National Forest and on the C Bar Ranch private land.

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