Restoration of Soldier Spring

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Abstract.—Various restoration techniques were employed to restore an ecologically and culturally important stream on the Fort Apache Indian Reservation. The methods were specially developed to address the unique character of this water body. The results show promise for restoring steep gradient riparian ecosystems.

Introduction

Soldier Spring emerges from a basalt hillside to form a perennial stream in the White Mountains of Arizona. The spring holds special importance to the White Mountain Apache people. The spring harbors plants and wildlife endemic to the White Mountains, including a genetically pure population of Apache trout (*Oncorhynchus apache*).

Assessments by staff from the Tribal Watershed Program and the US Fish and Wildlife Service Arizona Fishery Resources Office (AZFRO) determined that the stream and its fauna were threatened by downcutting and bank erosion. This finding led to a restoration effort to stabilize the channel and reestablish native wetland vegetation. We employed a combination of grazing exclusion, rock sill construction, transplanting, and reseeding.

Assessment of Conditions

Historical Evidence

Soldier Spring has changed dramatically over the past hundred years. An account from a tribal biologist describes Soldier Spring as being lush and marshy in the 1980s (Joe Jojola, pers. communication). Today the main channel is severely downcut along the reach just a short distance below the spring. An Apache legend recalls that willow trees once grew at the spring. We found a single Bebb willow (*Salix bebbiana*) on a steep bank along the creek.

Our effort to restore Soldier Spring apparently was not the first. A notched log weir remains intact below the spring, and two logs from another have been dislodged and now rest along the stream bank downstream. We do not know exactly when these structures were built, but most likely it was in the 1980s after the native trout were identified in the stream.

Feral horses, maverick cattle, and elk all have contributed to the degradation of Soldier Spring. The spring is one of the few water sources in a relatively dry area that has large populations of all three ungulate species. Its remote location posed a challenge to managing animals at this site.

Conditions Prior to Restoration

Staff from the Tribal Watershed and Fisheries Programs and the AZFRO jointly examined conditions at the site in 1996. We conducted a streambank vegetation survey that revealed a very diverse plant community due to the presence of both native and exotic species and the variability of soils from wet to relatively dry. The channel was downcut along most reaches. The channel averages a steep 2.7% slope (unpublished data, 1999) that poses a challenge to restoration efforts. Using the Rosgen classification system (Rosgen 1996), we concluded that the channel had downcut from a B-type step-pool channel into an entrenched G-type gully. Many of the streambanks were bare, and the soft soils easily eroded into the channel.

Returning to the site in 1998, we found that the downcutting had worsened. Vegetative cover along the downcut channel was low. Much of the reach was bare along the steepened banks and on benches adjacent to the channel. Several native wetland plants still grew in the channel, including buttercups (*Ranunculus aquatilis and R. hydrocharoides*), rushes (*Juncus* sp.) spikerush (*Eleocharis* sp.) and sedges (*Carex* sp.). More mesic, invasive species such as Kentucky bluegrass (*Poa pratensis*) and clovers (*Trifolium repens* and *T. pratense*) were abundant along the channel. Since we knew from historical evidence that the spring once was a lush wetland, it was sad to see it in such poor condition.

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Restoration Activities

After field visits in 1998 demonstrated that downcutting was worsening, the Tribal staff worked with AZFRO to initiate restoration using funds for fisheries habitat improvements. To arrest the degradation, we began constructing rock check dams in the steeper reaches. Participants in the Tribe's Summer Ecological Youth Camp constructed thirty rock check dams along the stream using rocks rolled from the slopes adjacent to the channel. In July and August of 1998, we constructed an 8-foot tall solar-powered electric fence to exclude all ungulates.

In 1999, we received additional funding support from the US Forest Service Rocky Mountain Research Station (RMRS). We planned to expand on the rock check-dams by creating large rock riffle structures designed by Alvin Medina of the RMRS. Once again, participants at the Ecological Youth Camp, including tribal members from Whiteriver and guests from Heritage Middle School in Chino Valley, conducted the work alongside staff from the Tribe and RMRS. In addition to using boulders and cobbles from the slopes, the riffles incorporated some gravel, soil, and plant materials in a specially arranged mixture. The riffles enhanced the pool habitats along the reach, slowed the water flow, and raised the water higher along the banks. The campers also transplanted sedge sod (mostly *Carex utriculata* and *Carex nebrascensis*) harvested from nearby restoration sites. The stream banks are being reseeded with native wetland species.

Results

The construction of the electric fence dramatically changed conditions at the site. The elimination of ungulate grazing and trampling has promoted plant growth.

Now, the plants are able to flower and seed more readily, helping us to identify the unusual diversity of this site.

The small rock check dams initially constructed at the site appeared to stop further degradation and promoted growth of extensive beds of water buttercup (*Ranunculus aquatilis*). We did not expect these check dams to withstand a strong flood; however, the most recently constructed rock riffles should last a very long time. Working in concert with the reestablishment of native wetland plants, the riffles should reestablish functional processes such as trapping sediments and forming banks. The deepening of pools along the reach and protection of rock substrates in the channel will enhance habitat for the native trout in this system. We are continuing to monitor and modify the riffles to respond to changes in the system.

Conclusion

Soldier Spring was an excellent site for restoration activities due to its biological diversity and significance to the community. A combination of ungulate impacts had propelled channel degradation that jeopardized its long-term health. Because its location made it difficult to actively manage animals, tall electric fence was the best choice for protecting this area. Fencing alone would not have been sufficient to restore this wetland due to the severely entrenched condition of the channel and the loss of habitat for native aquatic graminoids. The riffle structures appear well-suited to reestablishing a stable channel geomorphology. They should last longer and better promote stream functions than the log structures that were tried previously.

This project has promoted many values. Beyond conserving endemic fish and plant species, this restoration work has engaged young people in protecting an important water source. In this way, the site has continued to serve a role as a place of teaching. Through this restoration work, we have helped to return some of the favors that the spring has given the people.

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Literature Cited

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