Cibecue Watershed Projects: Then, Now, and in the Future

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Abstract.—The White Mountain Apache Tribe has undertaken a watershed analysis and various demonstration projects in the Cibecue watershed in east-central Arizona. The results support an adaptive management strategy to promote ecological health, enhance economic opportunities, and protect cultural values. Some of the problems faced by today's program are similar to those faced by a Cibecue watershed management project in the 1960s overseen by the Bureau of Indian Affairs (BIA). However, the Tribe's current project has a more holistic goal of restoring streams to health through community-based efforts.

Introduction

The White Mountain Apache Tribe Watershed Program has coordinated a watershed management project in Cibecue for the past three years. The Land Operations Division of the BIA coordinated a watershed management project in Cibecue in the early 1960s. Although both projects confronted deteriorated upland conditions, the goals and methods between the two periods are radically different. The current tribal program has a focus on ecological health, particularly for streams and wetlands. The BIA's "vegetation modification program" cited goals of increasing forage production and reducing soil erosion. However, the program was driven by a fundamental motive of increasing water yields for downstream water users. Analysis of current conditions supports the general community belief that most of the management efforts of the 1960s did not generate lasting improvements for Cibecue. When the anticipated water yields failed to materialize, the program ended. The Tribe's and the community's perception of ulterior motives eroded their trust in the BIA's watershed management efforts. Today's tribal program copes with the legacy of these past efforts as it works to restore the health of streams in the watershed.

Watershed Setting

The Cibecue watershed encompasses 750 km^2 (186,000 acres) located entirely within the Fort Apache Indian Reservation. The village of Cibecue lies in the center of the watershed along both sides of Cibecue Creek. Cibecue Creek flows year-round below two major springs several miles north of the community. Flows in the watershed commence in mixed-conifer forest at 2286 m (7,500 feet), pass through ponderosa pine forest, pinyon-juniper woodland, and blue grama grasslands, and finally reach the Salt River within Upper Sonoran desert scrub at 960 m (3,150 feet). This natural diversity makes Cibecue a beautiful and challenge place to work, and it also made Cibecue a prime candidate for experimental watershed treatments in the 1960s (BIA 1960).

Program Goals

The fundamental concern of watershed management programs in both the 1960s and the 1990s is water. In the arid Southwest, water is a keystone resource, and it has determined the viability of civilizations in the Cibecue watershed since prehistoric times. Grasshopper Pueblo, located a few miles west of Cibecue, once supported more people than does Cibecue today, but it ultimately may have been abandoned when local water sources dried up and soil fertility declined due to erosion (Welch 1996).

Both the 1960s and the 1990s programs recognized the need to manage watershed conditions such as soil erosion and vegetative cover to sustain water flows. However, the 1960s program was supported by off-Reservation desires to increase downstream water runoff. Today's program seeks to restore waterbodies to a healthy condition for the lasting benefit of the local community and the larger ecosystem.

BIA Watershed Project: 1960s

The BIA's project was underwritten by the U.S. Government and the State of Arizona with the goal of increasing water runoff to the Salt River valley through "vegetation manipulation" (BIA 1960). The program was tied into the Arizona Watershed Program through funding it received from the Arizona Water Resources Committee. The Arizona Watershed Program was the offspring of the Barr Report, which was commissioned by the Arizona State Land Department and the Salt River Valley Water Users Association to evaluate methods of increasing water yield

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(State of Arizona 1957). The mission of the Cibecue program reflected these origins, as its stated goals included not only improving timber and forage production and reducing soil erosion, but also increasing water yield (BIA 1960).

The BIA's program faced a watershed in poor condition due to several decades of overgrazing that began when the Federal Government issued non-Indian grazing permits well in excess of the land's carrying capacity (White Mountain Apache Tribe vs. US 1987). This overgrazing was a major factor in the widespread encroachment of juniper trees and other woody vegetation into grassland areas. These issues were a major concern to the Tribe and the BIA because of the associated declines in forage production and soil erosion. However, they were also a concern to downstream water users who feared a decline in water yields (State of Arizona 1957).

The BIA conducted a number of activities that are essential to any sound watershed management program, including an intensive soil survey and construction of many miles of new fence to manage livestock (BIA 1964). They also worked with the livestock associations to modify range management practices. However, the main focus of the program was on dramatic vegetation "modifications" to alter the water cycle of the rangelands. The program employed aggressive treatments that including clearing vegetation with heavy chains pulled by bulldozers, chemical eradication of junipers and beargrass, and reseeding with grasses, most of which were exotic species (Robinson 1966). Another major element of the project was "phreatophyte control," the poisoning and girdling of cottonwood trees along riparian areas. Touted as a pioneering endeavor (BIA 1964), this task proved to be the most controversial and the most destructive in the eyes of the community.

Although the BIA reports claim that hundreds of meetings were held concerning the project, community members assert that the purpose, consequences, and risks of tasks such as the cottonwood eradication were never explained to them. After the cottonwood eradication got underway, community response was decidedly hostile and several tribal members quit the project (Basso 1970). The newly-established tribal Recreation Enterprise voiced concerns about potential impacts to tourism, so some areas were apparently spared. Today residents point to the cottonwood eradication as a major factor in the unraveling of Cibecue and other creeks.

Tribal Watershed Project: 1990s

The period between the mid-1960s and the mid-1990s saw the Tribe dramatically increase its control and sophistication in all its affairs, and especially in natural resource management. Unfortunately, many of the Reservation's streams and watersheds, including Cibecue, continued to deteriorate. To address this challenge, the Tribe established a Watershed Program in 1994 with a mission of protecting and restoring water quality and stream health. In 1996, the Tribe's initiated a community-based effort to promote the health of the Cibecue watershed. Through a competitive process, the US Environmental Protection Agency selected the Tribe as one of four tribes nationwide to conduct pilot projects for developing an appropriate Watershed Analysis and Management (WAM) approach for Indian country (Pacific Watershed Institute 1999). Specific goals of the Tribe's project included:

- compiling existing information about watershed and riparian conditions in a format that can be used to plan future land management activities;
- addressing questions and places of greatest concern to the community;
- identifying priority areas for restoration and other forms of special management;
- training tribal members from Cibecue in watershed assessment and restoration techniques;
- providing a forum for discussion of watershed management issues among community members, local students, resource managers, and tribal leaders; and,
- collecting new field data at several sites in the watershed to evaluate current conditions and better understand important processes in the watershed; andimplementing demonstration restoration projects at sites important to the community.

Advantages of Watershed Analysis and Management Approach

The WAM framework provided a shell for the larger Cibecue restoration project. The WAM process is an ecological-based approach to assessing watershed conditions and processes (Pacific Watershed Institute 1999). This approach was well-suited to the Tribe's needs because it focused on streams, it provided systematic methods to collect and organize information, and it could be modified to meet local needs. The project is discussed in detail below to explain the choices and findings of this approach, and especially to highlight efforts to engage the local community.

Methods

We relied on several methods to collect information for the watershed analysis. We analyzed aerial photos and videography to identify areas of erosion. We collected field data on riparian vegetation, channel morphology,

and water quality. Students from the local high school helped the project manager collect stream data and conduct interviews with residents to identify community concerns. We worked with various other programs to implement demonstration projects that are discussed in the results section below.

Critical Questions

The WAM methodology seeks to answer "critical questions" about the watershed (PWI 1999). We had four major questions to address:

- What are reference conditions for streams in the Cibecue Watershed?
- How have streams and uplands changed in recent decades?
- How have changes in functional processes (such as sediment transport and vegetation growth) affected beneficial uses in Cibecue?
- What concerns do the residents of Cibecue have for the watershed?

Technical Support Team

The full-time Project Manager, a tribal member originally from Cibecue, worked with the Watershed Planner to conduct the analysis. Tribal and BIA Geographic Information Systems specialists prepared maps for the analysis. The Tribal Hydrologist and Tribal Fisheries Biologist provided technical assistance for particular modules. Staff from the Rocky Mountain Research Station in Flagstaff provided reviews and other technical assistance.

Modules

The heart of the WAM approach is a series of modules to investigate particular resource concerns and then integrate them through a final module called synthesis. We focused on the following modules:

Community Concerns

For this module, the Project Manager conducted dozens of interviews with residents. He was assisted by high school students as part of a school project.

Vegetation

We conducted vegetation surveys at several sites in the watershed. We identified key wetland species in the watershed and in adjacent watersheds. We compared densities of these plants with reference areas and old photos.

Channel Morphology

We relied on the Rosgen channel classification system and assessment methodology (Rosgen 1996). We did pebble counts and cross-sections as well as channel typing to identify unstable areas.

Water Quality

We compiled existing water quality data and collected new samples for fecal coliform, turbidity, temperature and phosphorous.

Cultural Concerns

We conducted interviews and site visits with cultural advisors, including members of the Tribe's Cultural Advisory Board. We identified plants of particular concern and examined relationships of the plants to watershed conditions.

Erosion

We referred to the soil survey in identifying high hazard areas. We analyzed aerial photos and conducted field investigations to identify erosion source areas. We looked for features such as gullies, landslides, and alluvial fans and then correlated these features with soil types.

Synthesis

Through synthesis we connected processes in the uplands and the riparian areas. The challenge lay less in understanding these relationships than in trying to compare the relative importance of different factors. Although our level of analysis was not detailed enough to quantify conditions throughout the watershed, the results are sufficient to plan restoration activities.

Results of the Watershed Analysis Project

The project has resulted in an analysis of watershed conditions that highlights various indicators of degradation. The analysis has identified opportunities for restoration, some of which have become demonstration projects. We have engaged the community in watershed restoration activities by establishing an Adopt-a-Watershed Program with the local school, coordinating projects with various tribal programs at the local level, and training community members in watershed assessments and restoration. Finally, we have a database of information that will guide future projects.

Indicators of Degradation

The analysis confirmed the general community perception that the riparian ecosystems of Cibecue Creek were well below their potential condition. We examined vegetation, hydro-geomorphology, and soil conditions to identify the extent of degradation.

Vegetation

Native wetland graminoids (sedges, rushes, cattails, bulrushes, reeds, etc.) are no longer dominant along much of Cibecue Creek. These plants were formerly abundant throughout the perennial reaches, according to literature (Buskirk 1954), interviews, and old photos. For example, advisors reported that cattails and reeds were common along the reach passing through town. People reportedly used to gather cattails along the stream above the community. Photos from a 1965 *Arizona Highways* article depict a stream lined with lush graminoids. Today many reaches have an impoverished herbaceous understory.

Hydro-Geomorphology

Cibecue Creek has been disrupted by a variety of impacts to the channel. The main stem of the creek appears to be adjusting to elevated sediment loads from gullies, roads, and burned areas in the uplands. Channels in the community area tend to be wide, shallow, and relatively straight. In-stream bars and braiding are signs of aggradation in these reaches.

Soils

Aside from the floodplain terraces, riparian soils along the creek show little development owing to the continual shifting of channel substrates. The substrates adjacent to the stream are dominated by cobbles and gravels, but clays and sands accumulate in some areas. Soil organic matter in these deposits promotes the growth of lush vegetation. These findings show that we need to retain fine sediments in the riparian areas to restore herbaceous vegetation.

Identification of Restoration Opportunities

The guiding principle for restoration of the Cibecue watershed is to reduce sediment flow from the uplands while promoting the ability of the riparian ecosystems to process that sediment into stable streambanks and productive wetland soils. Numerous opportunities to benefit the Cibecue watershed were identified and explored through the analysis. Some of the highlights include:

- Road closures in the upper watershed, since several minor roads appear to be significant contributors of sediment.
- Irrigation diversions, since some diversions are a significant impact to the main channel by disrupting sediment transport and altering channel morphology.
- Grazing impacts, since continuous grazing, particularly by horses, was the most widespread problem affecting both streams and uplands.
- Unstable channel conditions, since channels exhibit aggradation and bank erosion.

Demonstration Projects

We conducted a number of projects to evaluate potential for restoring watershed health. Successful projects serve as showcases to the community and tribal leaders. By identifying complications in these pilot projects, we can design better, larger-scale efforts in the future.

Cibecue Bridge Projects

With direction from our program, the BIA Branch of Roads used heavy equipment to clear two bridge areas of accumulated sediments and redirect the channel through the bridge. Members of the local livestock association built a fence around the upper bridge site to protect the rich wetlands at the site. The Project Manager supervised a crew of high school students in transplanting, reseeding, and thinning the bridge area. The response of vegetation has been acclaimed by community members, some of whom are now gathering plants from the site for their use.

White Springs

This important spring had been devastated following the White Springs fire of 1996. Tribal Council members arranged to close roads leading to this spring. We hired members of the local livestock association to build a fence around the area. Restricting access by animals and vehicles has dramatically improved the appearance of the spring area. We constructed large rock riffle structures to prevent further downcutting and to raise the water level in the downcut reach. The structures have stopped the downcutting and promoted rapid recovery of vegetation at the site.

Little Springs

This wetland was fenced by members of the local livestock association to establish a botanical refuge area that now serves as a source of transplant materials.

Stockman's Diversion

This irrigation diversion had been moved many times in the past several decades in response to the shifting channel. For our project, the channel was relocated to its original position, and the diversion was reconstructed as a much wider and more natural riffle feature. Access to the diversion was restricted with fencing. The diversion has been replanted with cattails (*Typha latifolia*) and has thus far survived several heavy floods.

Adopt-a-Watershed Program

The Cibecue School has made Cibecue watershed an outdoor learning laboratory for its high school science curriculum. The first graduates of the high school had the opportunity to learn about their watershed and how to restore different areas within it. The Adopt-A-Watershed program led to an exchange with Nueva Vista High School in Concord, California.

Students from the partner school in California first visited Cibecue to help with the White Springs restoration project. Then the Cibecue students flew to California, where they learned to care for monarch butterflies. Following that trip, the Cibecue School established a garden area to attract butterflies.

Several students from the Cibecue School have made presentations based on their involvement with the Adopt-a-Watershed program. Students held a community meeting to present results of their assessment activities and proposals for restoration projects. Two students also made presentations at a salmonid restoration conference in California.

Cross-Program Interactions

Although most of the assessment work was done by Watershed Program staff, numerous entities took the lead on demonstration projects. Members of Cibecue Livestock Association built sturdy fences at the restoration sites. The BIA Roads Department and Cibecue Land Operations irrigation crew used their heavy equipment to modify the channels.

Tribal and BIA forestry programs implemented a woodland thinning demonstration project that was studied by project staff and high school students. An intern from the tribal fisheries program sampled fish populations with assistance from the project supervisor and high school students. We assisted the Tribal Wildlife and Outdoor Recreation Division training tribal guides, including two residents of Cibecue, to lead nature tours into lower Cibecue Canyon The Grasshopper and Cibecue Livestock Associations and Tribal Range Program rounded up maverick animals to improve range conditions. BIA Fire Management conducted one of the first low-elevation prescribed burns in many years. In reviewing the burn proposal, members of the Tribal Cultural Advisory Board reflected on the tradition of burning such areas to improve conditions for livestock. All these cooperative efforts involved local residents in promoting the health of the watershed.

Training Tribal Members

A top priority of the project was to train tribal members in assessing and restoring watershed health so that future generations would understand the history and methods of the program. This training provided useful and interesting work for many young Cibecue residents. The Project Manager received many days of intensive, hands-on training in assessment and restoration activities. As a result, he is able to make recommendations to other tribal land management entities and to design restoration projects. High school students were trained in assessment methods and had the opportunities to explore challenges facing the watershed. As a result, they were able to better understanding how activities need to be changed within the community. For example, many students discussed the importance of managing horses in the community to protect their streams.

Database

A major feature of the WAM approach is its capacity to organize information from a variety of sources. We found that old photos from the *Arizona Highways* magazine were particularly valuable in visualizing past conditions. Aerial photos served to identify sediment source areas. By examining maps, working with cultural advisors and other community members, and consulting with resource managers, we identified wetland habitats in the watershed.

Community Interactions

Despite the general interest of the community in watershed issues, we found that community meetings did not yield a strong turnout. Radio presentations by the Project

Manager and Council members were a more effective way to get information to the community. Several field trips with the Tribal Council, resource managers, and school teachers were helpful in drawing attention to the watershed issues and restoration efforts. For example, teacher aides visiting White Springs reacted very positively to the work that had been done there. The most reliable method of interaction with community members was personal communications by the Project Manager.

Future Plans

We have planned several demonstration projects in the watershed, including a large restoration project on the creek at the north end of the community. We plan to realign the channel along a stable morphology, remove excess woody vegetation, slope-eroded streambanks, and promote growth of herbaceous wetland species. Local landowners are being consulted on the design of the project. At Martinez Ranch, we are fencing an important spring area from ungulates and plugging gullies to reduce erosion. We will continue to monitor restoration and new management activities (burning, thinning plots, reseeding, gully control projects) to see how areas respond to treatments. We will then return to the watershed analysis to evaluate restoration capabilities and appropriate techniques for different sites.

Currently, the Cibecue Watershed Project is funded through a grant from the Tribe's own Land Restoration Fund. The Tribe established this permanent fund using a portion of its settlement against the Federal Government for mismanagement, including the overgrazing of tribal rangelands. The Tribe is enlisting additional funding sources in its efforts to reverse the process of degradation, but any funds must be fully compatible with the Tribe's goals for managing its watersheds.

Conclusions

The watershed management programs of the 1960s and the 1990s both had to confront degraded range conditions stemming from over grazing under the non-Indian permit system administered by the Federal Government. The program of the 1960s viewed the problem of watershed degradation as a need to increase economic returns from the land and to increase water yields. Thus, the health of the land tended to be valued as an instrument rather than as an end. This approach was not consistent with traditional cultural norms, as evidenced by the hostility of many community members towards various aspects of the program. Because the BIA's program depended on promoting the needs of downstream water users, it failed to provide lasting benefits and instead engendered distrust among the community. While the land managers initially may have sought a "win-win" solution for the local community and downstream users, they sacrificed local concerns, such as preservation of cottonwood trees, to satisfy the downstream interests.

Changes in societal values have moved watershed management away from large-scale vegetation manipulation to increase water yield (Ffolliot et al. 1998), and more towards restoration to sustain ecological functions and biodiversity. However, the experience of Cibecue teaches us that in addition to changing goals, we must follow processes that empower land-based communities in sustainably managing their watersheds.

Today, the Tribe's Watershed Program works to help tribal communities achieve their goal of healthy streams. Today's tribal program recognizes that economic progress, community development, ecological restoration, and environmental education are interconnected. Promoting the functions and stability of the watersheds will serve to sustain the economy and culture of the communities that live within them. Location, a long history, economic uses and cultural ties makes Cibecue an outstanding example of such a "watershed community" in which the people, the land, and the streams are linked inextricably. The Tribe's watershed analysis project in Cibecue was conducted with these connections firmly in mind, and future watershed management activities must continue to promote this unique association.

Acknowledgments

The author wishes to thank Malchus Baker, USDA Forest Service, and Aregai Tecle, Northern Arizona University, for their technical reviews of this paper.

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