THE SUCCESSFUL RESTORATION OF COMANCHE CREEK IN NORTHERN NEW MEXICO: INTEGRATING THE WATERSHED'S HYDROLOGICAL, ECOLOGICAL, AND SOCIAL FUNCTIONS

Melanie Lawrence[1]

The restoration of Comanche Creek is a watershed-based and collaborative effort aimed at creating an atmosphere of stewardship with the land. It is holistic in the deepest sense as it incorporates all the functions of the landscape and provides an opportunity for building a lasting relationship between people and land; this partnership leads to improving water quality and restoring fish habitat while healing damage from past land use. The restoration of Comanche Creek can be deemed successful on many different levels including:

- habitat improvement and protection for an imperiled native fish, the Rio Grande Cutthroat Trout (RGCT);
- improved overall water quality;
- learning to manage a watershed in a holistic, integrated fashion;
- providing educational opportunities for the public to learn about the importance of watershed restoration;
- cooperation and collaboration among the Comanche Creek Working Group;
- opportunities for interested stakeholders to participate in restoration activities;
- dissemination of technical information regarding successes and failures including adaptive management techniques and the results from monitoring.

The Comanche Creek restoration project successfully integrates the hydrological, ecological, and social functions of a watershed by involving federal and state agencies, non-governmental organizations (NGOs), and community-based groups to assess, plan, implement, and monitor the project. The goals and objectives of the riparian restoration project include appraising Comanche Creek as to the values it provides to the entire watershed. While the main focus is on providing for and protecting the habitat of the RGCT with attendant emphasis on local water quality, the multiple uses of this watershed are not ignored; livestock grazing, recreation, and hunting are figured into the overall value of this watershed. The collaborative involvement of all these groups with divergent interests in Comanche Creek created the project's most important successes: dialogue and education. The kind of reciprocal learning that is necessary between agencies and the public, and between different users of the area, enhances the stewardship possibilities of these important riparian areas.

The Quivira Coalition, a non-profit organization based out of Santa Fe, N.M. whose purpose is creating a new ranching paradigm, is the keystone organization facilitating this project. Their involvement goes back to 2000 when Quivira was called in to work on a project begun by New Mexico Trout, a fly-fishing group concerned with the loss of habitat for the RGCT, a species found in the cold mountain waters of Comanche Creek. The New Mexico Environment Department (NMED) was also concerned as their Unified Water Assessment showed that the Upper Rio Grande watershed, of which Comanche Creek is a part, is in need of restoration. Quivira coordinated the project starting in 2001 using monies from an EPA 319(h) Program grant to:

- conduct an assessment to identify specific impairment;
- conduct baseline monitoring and mapping activities;
- identify and implement best management practices, and;
- conduct an educational program (White 2008).

According to the Watershed Restoration Action Strategy document prepared by the Quivira Coalition, the goals of the project are to improve the condition of the Comanche Creek watershed to meet current water quality standards and to restore normal hydrologic functions (WRAS 2005). The benefits of attaining these goals include improving the habitat of the RGCT and other native fish and aquatic species, improving habitat for terrestrial wildlife species, enhancing recreational opportunities for local communities and visitors to the area, and providing the foundations for sustainable economic use (WRAS 2005).

SITE DESCRIPTION AND LAND USE HISTORY

Comanche Creek is located in north-central New Mexico in Taos County, and lies within the Sangre de Cristo Mountains. It is a tributary of the Rio Costilla which is located within the Upper Rio Grande watershed (USGS Hydrologic Unit Code 13020101015) and contributes 27,430 acres to the Costilla Watershed (WRAS 2005). The elevation of the headwaters of Comanche Creek is about 10,400 feet and it flows

1 School of Forestry, Northern Arizona University, Flagstaff, Arizona

northward for 11.8 miles to empty into the Rio Costilla at an elevation of 8,940 feet. The creek has ten perennial tributaries along its length and the peak flow of Comanche Creek occurs in May and June due to the higher spring runoff.

The entire length of Comanche Creek falls within the Valle Vidal Management Unit of the Carson National Forest and is administered by the Questa Ranger District. The Valle Vidal, consisting of over 100,000 acres of land, has a unique history as it was donated to the USDA Forest Service by Pennzoil in 1982 (WRAS 2005). Originally a Spanish land grant, the Valle Vidal (Valley of Life) has been used heavily for grazing, mining, and logging and these activities have left the uplands of Comanche Creek, and its tributaries in a "highly degraded state" (White 2008).

Minimal management of grazing by sheep and cattle seriously denuded the area until the transfer of the property to the USFS in the early 80s. The USFS stopped all grazing for two years and starting in 1984 allowed the Valle Vidal Grazing Association to stock the allotment with a conservative number of cattle only. This herd is managed by a rider who is tasked with keeping the cattle from loitering in the creek bottoms and moving the herd from pasture to pasture throughout the grazing season.

Past logging practices also contributed to the degradation of Comanche Creek, not only by the level of timber removal but by the methods in which the trees were removed. 'Jammer' logging, using a cable and winch system to skid logs uphill to a landing site, resulted in the construction of a new road every 150 feet up many hillsides and these road networks contributed significantly to the erosion in the area (emphasis in original WRAS 2005). Placer mining for gold from the 1870s until late in the1800s along La Belle Creek, a tributary of Comanche Creek, that involved diversion of the stream from its original channel, is also thought to have contributed to the present condition of the creek. All of these past land use practices combined with current recreational uses serve to contribute to a pressing need for restoration in the Comanche Creek watershed.

NEED AND PURPOSE OF RESTORATION

The legacy of historical over-use of Comanche Creek is evident in:

- eroded stream banks;
- poor hydrological functioning which contributed to high sediment loads in the creek;
- poorly designed and maintained roads that contributed to sediment loads;
- overgrazing by cattle and elk that prevented the growth of beneficial plants such as willow and cottonwoods (White 2008).

The sum total of these 'wounds' can be seen in the imperilment of the RGCT and reduced water quality in Comanche Creek. The USFS, as the resource manager of this area, is involved in both the protection of the aquatic species and the necessary conditions for its survival. The Forest Service's Watershed Conservation Practices Handbook, Chapter 10, "Management Measures and Design Criteria" states that although aquatic ecosystems make up only 5% of forest lands almost half of the imperiled species are aquatic dependent so there is the recognition of the importance of watershed management and restoration (Forest Service Handbook 2509.25).

On a general level the USFS is also concerned with meeting forest-wide management goals aimed at the watershed including, but not limited to:
maintaining and protecting a riparian buffer;

- sediment abatement;
- proper placement of recreational trails;
- minimal impact grazing strategies;
- quantified habitat monitoring, and;
- development of in-stream/riparian restoration projects (Carson National Forest website)

Developing a specific plan to deal with the RGCT is important to the Carson National Forest, where Comanche Creek is located, as it uses the RGCT as a management indicator species.

COMANCHE CREEK RESTORATION PROJECT

Many factors coalesced in creating the need for a watershed-level restoration project in the Comanche Creek area. The impetus for the project, according to the Comanche Creek website, came from the management goals of several state and federal agencies such as NMED, New Mexico Department of Game and Fish (NMDGF), USFS, and the U.S. Fish and Wildlife Service (USFWS) concerning water quality and the status of the RGCT.

Water Quality

An important reason for the restoration of Comanche Creek comes from the requirements of the New Mexico Environment Department (NMED). As mandated by the Clean Water Action Plan, a federal program aimed at assisting the individual states in identifying and prioritizing watersheds with regards to water quality concerns, NMED conducted an assessment of all of New Mexico's watersheds. This 1998 assessment revealed that 21 of 83 watersheds were in need of restoration and so were designated Category 1. Comanche Creek is a sub-

watershed within a Category 1 watershed – the Upper Rio Grande. New Mexico's Surface Water Quality Bureau is tasked with determining Total Daily Maximum Load (TDML) which is "the total quantity of pollutants (from all sources – point, non-point, and natural) that may be allowed into waters without exceeding applicable water standards" (cleanwater.gov website). Comanche Creek exceeded the standards for temperature when monitored in 2001 and 2002; also the standards for aluminum and stream bottom deposits have been exceeded in the same time periods. More recent monitoring reveals an upward trend in the latter but as so many of the contributing factors that result in high frequency of small particle size classes in substrate analysis are resolved, the occurrence of turbidity and fine sediment deposition is likely to continue (WRAS 2005).

Rio Grande Cutthroat Trout

The range of this subspecies of trout includes the headwaters of the Rio Grande River so the management area encompasses two U.S. states and many regional, state, federal, and tribal governmental agencies. The Management Plans and Conservation Strategies for the RGCT sprang out of the 2003 multi-party agreement between NMDGF, Colorado Department of Wildlife, USFWS (Regions 2 & 3), National Park Service, Bureau of Land Management, USFS Regions 2& 3), and the Jicarilla Apache Nation, assuring the "long term persistence of RGCT subspecies within its historic range" (Comanche Creek website).

NMDGF has an obvious interest in restoration of the RGCT as it has the authority and responsibility for the management that arises from sport fishing, stocking, and elk management but cannot regulate water use, dam construction, grazing, mining, timber harvest, or construction/maintenance of roads and trails where those species reside (Comanche Creek website). It is imperative for NMDGF to work with the other state and federal agencies in its quest to protect and restore the habitat of the imperiled RGCT as well as manage for other aquatic and terrestrial species important to the ecological health of the area.

Quivira Coalition Involvement

This NGO sought to begin achieving the long-term goals of restoring Comanche Creek and its tributaries by:

- improving water quality (temperature and sediment TMDLs);
- improving the overall hydrological function;
- restoring the conditions for healthy riparian habitat for aquatic and terrestrial species;
- creating the foundation for sustainable economic use;
- recreational opportunities (White 2008).

Since the administrative structures are already in place, the Quivira Coalition believes that the likelihood for success is high. Comanche Creek is entirely within the Valle Vidal Management Unit of the Carson National Forest and is protected from future development, logging, and mining, and the goals for restoration are completely within the management objectives of the Forest. From a socio-ecological perspective the view is also optimistic; there is an active and collaborative stakeholder group in place, and all ecological trends and habitat indicators are in a positive direction.

RESTORATION PRACTICES

After Quivira completed baseline assessments and mapping, and created photo points for future reference, a three-pronged strategy was developed to address the raw streambanks, bad roads, and hungry animals that the group identified as being the culprits in the degradation of Comanche Creek watershed (White 2008). Professional restorationists, adept at viewing the watershed in a holistic fashion and creating effective natural channel treatments, worked with volunteer groups under the direction of the Quivira Coalition to construct upland and in-stream treatments, repair and install exclosures, and revegetate streambanks. All of these treatments are aimed at improving water quality and habitat for the RGCT but also result in overall healthier watershed conditions through using (and contributing to) Best Management Practices (BMPs) employed by the USFS and other agencies.

Upland Erosion Control

Treatments consisted of constructing one rock dams, rock baffles, rock bowls, worm ditches, and headcut control structures installed along side drainages to slow the movement of water, collect soil, nourish vegetation, and prevent sediment from entering the creek (WRAS 2005). Drifter fences were erected in some upland sites to keep cattle and elk from trailing down the drainages causing erosion. In addition, over eight miles of roads were closed or rehabilitated for erosion control purposes (when it took possession of the Valle Vidal the USFS closed more than 300 miles of roads); treatments included culvert improvement or removal, and stabilization of roadways with rolling dips and waterbars to harvest water from roadways and to lessen sediment load to streams (WRAS 2008). Heavy equipment was only used to create low-water crossings.

In-stream Controls

Previous treatments, such as revetments installed by the Forest Service in the 80s that had failed to slow bank erosion, were removed. Post vanes were installed "at strategic locations to direct stream flow left or right, away from eroding banks to reduce sediment production and promote streambank vegetative growth" (WRAS 2005). These areas with post vanes had rock placed behind the vanes and vegetation such as sedge 'mats' and willow cuttings (a minimum of two species taken from exclosures) were planted to catch sediment and induce the stream to aggregate rather than erode. Baffles, more aggressive than vanes, were also installed in a few strategic locations.

Wildlife mini-exclosures were installed or repaired to provide protection for the riparian vegetation needed for bank stability, aquatic habitat, and cooling of stream water. These mini-exclosures, based on evidence that elk are hesitant to jump into small fenced areas, have proven to work at protecting the woody vegetation in several locations along a stream reach. This alternative provides more opportunities for natural germination and/or places from which to gather cuttings (CC Final Report 2008).

MONITORING

Monitoring, according to one of the watershed restoration practitioners integral to the Comanche Creek project, "is not research; it's a tool of management" (Zeedyk 2004). He goes onfurther to state that "it can be simple but never casual" and it must be deliberate, disciplined, scheduled, and consistent (Zeedyk 2004). According to Jeffrey Kershner (1997) in "Monitoring and Adaptive Management" (Chapter 8 in Watershed Restoration: Principles and Practices), to be effective in generating feedback useful for adaptive management, monitoring must have procedures developed in advance to discern the effects and differences associated with the project's implementation, effectiveness (including changes in trend), and validation of the assumptions behind the effectiveness monitoring (geared more to a research focus).

The protocols used by Quivira for monitoring the restoration efforts on Comanche Creek and laid out in the Project Quality Assessment Plan include using the RMRS Technical Reference Guide "Monitoring the Vegetation Response in Riparian Areas," (known as the 'greenline monitoring') and the USDA Jornada Experimental Rangeland Monitoring Protocol for determining stability of the Comanche Creek uplands as to grazing impacts and erosion from roads. Vegetation changes are interpreted by using permanent photo points, line-point intercepts for cover and composition, and gap intercepts for determining spaces between plants.

Geomorphic changes are tracked using Rosgen Level II 'hubs' (cross sections arising from the same central point). This monitoring detects changes in bank location and shape due to installation of vanes and other treatments. Water quality is determined using Quality Assurance Project Plan for the NMED's Water Quality Management Program that involves measuring stream bottom deposits, turbidity, temperature, and stream flow (WRAS 2005). All treatment areas include permanent photo points using GPS coordinates for identification and to document changes over time. GIS maps assist in visually assessing the watershed and in treatment/structure location.

RGCT population and habitat are being monitored separately but both are being performed by Trout Unlimited – Truchas Chapter. The focus is on measuring three variables: (1) channel cross section; (2) stream bottom deposits; and (3) bank erosion (WRAS 2005).

ACCOMPLISHMENTS – HYDROLOGICAL, ECOLOGICAL, AND SOCIAL

Hydrological /Technical

Included in this category are improvements in the hydrological functions of the watershed. From the Final Report on the Comanche Creek Restoration Project, the Quivira Coalition claims to have accomplished the following:

- building 130 in-stream structures;
- treatment of 35,000 feet of channel sites;
- construction of 50 elk mini-exclosures to protect 200 feet of stream bank;
- treatment of seven eroding upland sites with 75 structures, and ;
- extensive treatment of eight miles of administrative and closed roads with 150 water-harvesting BMPs (Comanche Creek Watershed Restoration Project 2008).

Additionally, the technological accomplishments include a better understanding and knowledge of how to achieve agency-required BMPs, better techniques for construction and installation of mini-exclosures, and other adaptive management strategies to restore the hydrological functioning of a second-order stream.

Ecological

The Comanche Creek restoration project is still too new to judge whether the ecological goals are being met. These goals include improved water quality and RGCT habitat so as to restore a healthy cold-water fishery. Aquatic and terrestrial creatures will benefit from the improved conditions as willows, alders, and at the lower

elevations, cottonwoods, regenerate. Cooler water temperatures from improved water flow and the shade provided by streambank vegetation should also improve RGCT habitat; the lower levels of sedimentation should contribute to better spawning habitat for trout.

Bill Zeedyk, the primary restorationist for the Comanche Creek project, explains in his booklet about erosion control how important it is to help the soil retain more water; its sponge-like ability to absorb and slowly release moisture is the most important function soil performs. Water infiltrating the soil allows microorganisms to flourish and encourages dormant seeds to germinate. So the ecological effects from this restoration project should be apparent as many other species of plants and animals benefit - from beaver to songbirds to wildflowers - from a restored watershed.

Social

Collaborative stewardship must rank as one of the most impressive achievements for the Quivira Coalition and the Comanche Creek Working Group as more than 19 stakeholder organizations – from small, local, informal groups to large, well-known, national groups – are involved.

The main goals for Quivira are the transfer of technological knowledge to other watershed groups as well as the dissemination of the knowledge gained from monitoring. Public outreach includes workshops on restoration and erosion control and how to involve the public in restoration activities. Another form of dissemination of knowledge gained from their activities is the publication of three booklets. Published in collaboration with several authors and organizations and dealing with restoration techniques and erosion control are: An Introduction to Induced Meandering, 2004, An Introduction to Erosion Control, also in 2004, and A Good Road Lies Easy on the Land: Water Harvesting from Low-Standard Rural Roads, 2006. Each of these booklets is free to the public and the information is available online. All of the reports, including GIS maps and photos, from the Comanche Creek restoration project are also available online at comanchecreek.org.

CONCLUSIONS

The need for watershed-based restoration and holistic ecosystem management of public land has been apparent to government agencies for some time now but the push to become partners in stewardship projects has been thwarted, at times, by institutional culture. Turf wars, power struggles, and the inability to relinquish the image of being the 'experts' in decision-making coupled with legal constraints regarding the sharing of responsibilities continues to stymie some collaborative efforts. Other impediments include overworked, underfunded resource management agencies; one person stationed in the Carson National Forest's Questa Ranger District (wishing to remain anonymous) stated that the extra burden placed on the limited staff by the Quivira-related restoration project was unwelcome.

Regardless of the challenges, concern for the declining health of riparian areas is "shared today by a much broader spectrum of interest groups including land and water resource managers, legislators and litigators, educators, and environmentalists" and these interested stakeholders seek "a better understanding of the dynamics, functions, uses, and the restoration of degraded riparian areas" (Neary et al 2004). Identifying opportunities to develop partnerships to improve water quality, restore fish habitat, and heal the damage from past land use practices in an age of reduced budgets for land management agencies is imperative.

In "Changing Roles and Responsibilities for Federal Land Management Agencies" (Chapter 9 in Watershed Restoration: Principles and Practices), the authors point out that it is no longer sufficient to use "gabions (stone-filled wire baskets) or riprap (a collection of large rocks) to artificially support degraded stream habitats" in addressing the effects of degradation; the root causes must be identified. More importantly they make the case for collaborative stewardship as a means for prioritizing watersheds that "merit special protection due to their ecological and social importance or that offer a good potential for recovery" (Dombeck et al 1997). Organizations such as the Quivira Coalition fill the need as facilitators for the stewardship activities that create effective public-private partnerships for watershed restoration such as the project on Comanche Creek.

Courtney White, one of the founders of the Quivira Coalition more than ten years ago and current Executive Director, believes the human element is mandatory in restoration of Comanche Creek and its ability to "renew, heal, reaffirm, nurture, rekindle, revitalize, repair, revive, mend, soothe, rebuild, fix, regenerate, and reinvigorate" (White 2008). The dialogue that exists between stakeholder groups and resource management agencies is necessary for the process of restoration and it is akin to the movement "to reconnect people to nature meaningfully and adaptively" which results in the possibility of redemption for the wounds we have inflicted to our ecosystems (White 2008). Stewardship partnerships bridge the socio-ecological gap between restoration and redemption bringing another dimension to holistic ecosystem management.

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