USA: New Mexico: Reintroducing Beavers to Facilitate Riparian Restoration on the Zuni Reservation

Overview

The Zuni Watershed in west-central New Mexico has been subject to acute and continuing processes of degradation since the arrival of European settlers in the nineteenth century. A lawsuit brought against the federal government in response to gross mismanagement of local environmental resources resulted in the inception of the Zuni Conservation Project in late 1991. Planned and implemented by the Tribe's Fish and Wildlife Department, this unique program of watershed restoration and riparian conservation has been rooted in traditional Zuni cultural values, as plans have been developed in consultation with tribal elders, religious leaders and local landowners. The project has attempted to strike a balance between traditional water control features, employing hand labor and natural materials wherever possible, and watershed-level interventions facilitated through a series of geomorphic study stations and geographic information systems. In addition to such riparian restoration methodologies as eliminating invasive species (i.e. Tamarix pentandra), reshaping channelized watercourses, excluding sensitive areas from grazing and conducting revegetation with native species, the project has also reintroduced approximately 23 beavers to sites with impaired hydrologic flow regimes. These new recruits have quickly demonstrated their capacity to dramatically alter ecosystem dynamics, as they have immediately begun building dams and provoking favorable hydrologic changes. Areas with transplanted beavers have seen an increase in available surface and subsurface water, reduced sedimentation, fewer invasive tamarisk trees and marked improvement in the quality of adjacent riparian habitats. It is hoped that by affecting these kinds of structural changes, the beavers will ultimately help encourage the natural regeneration of much of the watershed.

Quick Facts

Project Location:
Zuni Reservation, NM, USA, 35.047136, -108.71257909999997

Geographic Region:
North America

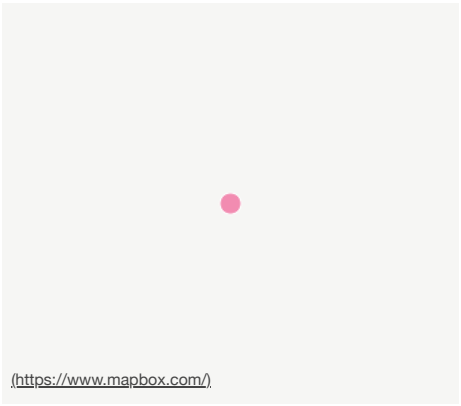
Country or Territory:
United States of America

Biome:
Freshwater

Ecosystem:
Freshwater Ponds & Lakes

Organization Type:
Governmental Body

Location



TIMEFRAME

Project Stage:
Implementation

Start Date:
1998-01-08

End Date:
2009-01-08

DEFINING THE PROBLEM

Primary Causes of Degradation

Agriculture & Livestock, Invasive Species (native or non-native pests, pathogens or plants), Urbanization, Transportation & Industry

Degradation Description

Beginning with European settlement in the nineteenth century, riparian ecosystems in the Zuni Watershed have undergone a series of dramatic changes. Extensive logging and overgrazing in the late 1800s and early-to-mid 1900s severely degraded the watershed, resulting in a decline in vegetative cover that increased surface erosion, gullying, headcutting, wide discharge fluctuations and loss of water in the system. The most significant causes of degradation in more recent times are:

–Man-made dams–
Man-made dams have changed the hydraulics of rivers and streams, making many formerly perennial watercourses semi-perennial or ephemeral. Water stored in large lakes and reservoirs, while locally raising the water table and making water available at a few sites, reduces the availability of water in other reaches of a stream by increasing evaporation from surface water, which in this part of the US reaches 54 in (137 cm) per year (Kohler and others, 1959). It also ultimately reduces the total amount of water in the system. The approximate surface area of the nine major and several minor reservoirs on the Zuni Reservation is 1,546 acres, which translates to more than 6,900 acre free (2.25 x 10-8 gallons, or 8.51 x 10-8 liters) per year of water (Orr, 1987). In addition, many reservoirs in this area create a “sediment deficit” in their downstream watercourses. Where formerly sediment-rich river water would travel a stream, depositing and picking up sediment as it went (depending on factors such as stream velocity and channel shape), the below-dam reach of stream carries little sediment and, having nothing to deposit, can only pick up sediment–a process that can severely erode the reaches of a stream immediately downstream of the reservoir.

–Channelization–
In an effort to reduce flooding and increase the efficiency of water transport, many rivers have been channelized, cleared of vegetation, and their sinuous shapes straightened. Unfortunately, this steepens the gradient, increasing water speed, reducing infiltration and increasing erosion. While this may reduce water lost by evapo-transpiration, it also increases direct evaporation from the water surface as shading is reduced. In addition, flash flooding increases as wetlands are destroyed or degraded.

–Encroachment of alien plants, including salt cedar (Tamarix pentandra)–
Salt cedar produces large amounts of seed, which germinate readily. In many situations it out-competes species such as cottonwood and willow for water and light, and uses much more water than either of these two plants (Carmen and Brotherson, 1982). It also changes the soil chemistry of a site by bringing salts to the surface, making it difficult for other plants to survive (Hollingsworth, 1973), and in many areas it forms a dense monoculture. The tree has relatively little value for wildlife and is extremely difficult to eradicate, responding to either burning or cutting by resprouting. Removal of this plant often restores much of the natural hydrological and biological dynamics to an area (Anderson and Barrows, 1998).

–Loss of beavers–
With the reduction of beavers, an important component in the riparian ecosystem was lost and riparian ecosystems began to degrade. Small ponds no longer filtered out sediment, and water quality declined. Vast acreages of wetlands surrounding ponds were encroached upon by surrounding, drier upland forests. Water tables were lowered, and the water budget of many watersheds decreased as water traveled rapidly downstream and out of the upper watersheds.

PLANNING AND DESIGN

Reference Ecosystem Description

From a biological standpoint, riparian areas, wetlands and springs offer some of the best biodiversity in the semi-arid high desert of the Colorado Plateau, as a far greater proportion of wildlife uses the riparian corridor than the surrounding landscape. In one study conducted in the Upper Rio Nutria Watershed, a sub-watershed of the Zuni River, 37 percent of the individual birds occupied the riparian corridor of the Rio Nutria, an area which encompasses only about 2 percent of the land area surveyed. The diversity of bird species in the riparian corridor was also far greater than in the surrounding uplands.

Beavers (Castor canadensis) were at one time found on most streams in the Southwest in areas where there was permanent water and sufficient woody vegetation to provide food (Hill, 1982). Where beavers were present, they modified their habitat as no other single species did. Their dams created large areas of still water and habitat for fish, waterfowl and other birds, mammals, amphibians and invertebrates. The ponds themselves filtered sediment out of the streamwater and improved water quality downstream. Water percolated into the soil, recharging aquifers and creating moist upland habitat in the areas surrounding the dams. Over time, as ponds filled with sediment and became shallower, they eventually turned to marshes and then meadows. By then the beavers had moved on to other parts of the stream or watershed to begin the process anew. These dynamic shifts in habitat were important components in maintaining the biodiversity of the landscape.

Project Goals

To assist the recovery of degraded riparian areas in the Zuni watershed through the reintroduction of beavers at select sites in order to precipitate favorable changes in the hydrologic regime.

Monitoring

The project does not have a monitoring plan.

Stakeholders

In late 1991, the Zuni Tribe established the Zuni Conservation Project to lead a program of watershed restoration and resource development. Community-based, consensus-building workshops have been organized to inform the planning process, as have interviews with religious leaders, farmers, livestock growers, and other land users. Not only are project activities developed in consultation with local stakeholders, they must be approved by a tribal council of elders. In this way, traditional Zuni land use practices have become central to the scope and mission of Zuni's efforts to restore environmental conditions and improve land use planning.

PROJECT ACTIVITIES

Description of Project Activities:
Knowing the effects that beavers have on their environment, it was believed that selective translocation of these animals into degraded watersheds would have beneficial effects on water quality, watershed health, and riparian wildlife habitat. Selective relocation was necessary, since not every site had the potential to sustain the animals during the crucial initial stages of the reintroduction. Beginning with a small remnant population, practitioners began moving beavers to stream areas where there was already abundant food (mostly willows), but where the stream channel was incised and didn't carry water year round--though some water, with a few relatively deep pools, was necessary in order to give the beavers a safe habitat. Beavers are selected from a site where they are reproducing well and where their local population is stable. In some cases, they have also been taken from areas where farmers or other land users report excessive damage or other problems such as blocked irrigation lines or access to fields. They are moved during the early spring, before litters are born, or late in the summer, when the kits are grown and are relatively independent. Only rarely are they moved in winter because the animals would then lack sufficient time to build either a lodge or bank den (both types of shelters are used here) or to develop a food pile big enough to last through the season. Practitioners employ wire snares made from 3/32 in aircraft cable, which is closed into a loop through a one-way lock mechanism that tightens on the animals as they pull against it. When properly placed, these snare loops are approximately 10 inches in diameter, with the bottom suspended 2 inches off the ground. The loose end of the snare is secured with additional wire to any sturdy object such as a tree or rock, or in some cases a clump of firm vegetation. The loop should be large enough for the beaver to get its head and one limb through the opening (beavers have a wedge-shaped skull, which is very difficult to snare). In the past both cage traps and leg-hold traps have been used, but snares have been found to be more effective and far less expensive. They are placed along well-used

trails or at sites where beavers come on land to feed. These runway and feeding sites usually have a tree large enough to secure the snare, and this method also traps the beaver on dry land where the possibility of drowning is minimized. Snares are occasionally placed along spillways on beaver dams and/or paths through aquatic vegetation, but these areas have the disadvantages of deep water (which could drown a beaver or make it difficult to disentangle) and of providing few places to fasten snares. With proper use and snare placement, mortality rates are approximately 5 percent or less. Mortalities generally occur when a beaver gets entangled in water deep enough to drown the animal or other beavers attack it while it is in the snare. Checking the traps every day minimizes both mortality and trauma from both of these causes. Once a beaver is caught in a snare, it is held down firmly with a catch pole and lead into either a cage or large plastic or metal garbage can, where the snare is cut off. This often requires two people, but it can be done by one experienced handler. A garbage can is easier than a cage for one person to handle and has the advantage of protecting workers from bites. The cage works well when the animal needs to be transported a long distance or through rough country, where two people can carry it suspended from a pole or shovel handle. Most beavers behave aggressively when first approached in the snare, but calm considerably when confined. Ideally, the animals are released the same day they are caught, but they have been held as long as 48 hours without apparent ill effects to the animals. It is recommended that the animals be kept in a cook, dark, quiet place, as this keeps them calm and minimizes stress and possible complications (Day and others, 1980). The project has relocated about 23 beavers in seven riparian rehabilitation areas on the Reservation. Between one and five beavers have been moved at a time, but approximately three are moved on average. A relatively high degree of success has been attained when releasing three or more beavers in the same area. Sub-adults seem more inclined to stay in a relocation area than adults with an already established territory. By moving beavers relatively far from their home territory or watercourse, the likelihood that they will return to the site from which they were trapped is minimized. The characteristics sought in a release site are as follows: (1) at least some available water lasting into the early summer; (2) enough cattails and/or willows or other woody vegetation for the beavers to eat (though other projects have involved bringing food in for beavers until natural vegetation becomes established around ponds); and (3) an area that has the potential to provide the greatest benefit to wildlife--in other words, it is close to other suitable habitat or it was formerly high quality habitat.

PROJECT OUTCOMES

Ecological Outcomes Achieved

Eliminate existing threats to the ecosystem:

In most cases, within 1-2 weeks of their reintroduction, the beavers begin building dams and slowing the flow of water. Within one year, they generally will have created a well-established series of dams, which begins to salvage enough water to drop sediments out of suspension, raise the stream bed, and improve overall habitat. Surface water gradually spreads over a wider area, and larger and larger pools begin to remain year-round. Within three to five years, remarkable changes will be evident, including very large increases in available surface and subsurface water, more abundant riparian vegetation, and reduced erosion. The most significant changes are: Improved Hydrology Once plants get established, the cycle of reduced erosion and increased plant health becomes self-perpetuating. The plants trap more sediment, reduce erosion, and slow the flow of water, allowing it to percolate into the soil and raise the water table, which in turn increases the abundance and productivity of the plants. Reduction of Salt Cedar Infestation In some parts of the Reservation, an extensive salt-cedar eradication effort has been undertaken. While beavers unfortunately do not eat salt cedar, the raised water tables and ponds of surface water they create have killed salt cedar in some areas. Native willows and cottonwoods are much more tolerant of inundation. Other researchers (Everitt, 1980) have reported that salt cedar apparently does not do well under conditions of frequent or severe flooding, while native species such as cottonwood and willow thrive under these conditions. Willow Flycatchers One of the species that has benefited most from the beaver relocations is the southwestern willow flycatcher (Empidonax traillii extimus), federally listed as endangered in 1998. This small neotropical migrant is a riparian-obligate passerine, one of four recognized subspecies of the willow flycatcher. It nests in riparian areas and near wetlands and lakes where there is dense growth of willow and other riparian species, often with a scattered overstory such as cottonwood. Before the beaver relocation program, the Reservation normally had from three to five flycatcher territories in use in a given year. In the last three years, singing males or pairs of flycatchers have established territories in at least five additional locations, all of them with active beaver dams. In one area the loss of a lake that was drained in order to repair the dam was offset by the presence of beaver dams and ponds adjacent to the flycatcher territories. The flycatchers have continued to breed successfully despite the loss of the lake water and, since the beavers became active, the yellow-billed cuckoo, a candidate for endangered species status, has been recorded in one of the areas for the first time. In addition to these (and other) species of birds, the improved riparian habitat has benefited deer, elk, fish, and amphibians.

Factors limiting recovery of the ecosystem:

Not everyone has been a supporter of the beaver program from the start. Many farmers initially complained that the beaver dams were a nuisance and kept water from entering their fields. In 1996 the project got help from an unexpected source: a drought. During that summer, one of the driest in recent decades, many reaches of the Zuni River dried up, and some farmers had partial or total crop failure. One family, however, had great success by irrigating their fields directly from a series of beaver ponds with the aid of a portable pump. This helped convince many families that beavers could in fact provide benefits to farmers. In other areas, where the river channel is relatively shallow and the arable land extends to near the river, the rising water behind the beaver dams has encroached on farm fields and pastures. While most farmers are glad to have the extra water, some are concerned about the loss of fields (some of which have been handed down for many generations) when these areas are flooded. At one farm near one of the relocation sites, two pastures that were separated by a small dirt road and a culvert through which the Zuni River passed have become a 50-acre wetland with year-round water, fish, waterfowl, willow flycatchers, yellow-billed cuckoo, and snipe (a rare breeder in New Mexico) during the breeding season. There is a reluctance to remove the beavers from the habitat they have created, and practitioners are currently working with this farmer to find an adequate road crossing and access to his far pastures. Another problem that has been encountered is the fact that the beavers will cut down most of the large trees in an area where they become especially abundant. Some areas look as though they've been hit by a cyclone, with cottonwood trees strewn everywhere, both in and out of the channel. In former times, beavers may have migrated to other areas once their habitat was so altered, allowing it to recover; however, with the limited habitat available in Zuni, there is a need to protect the trees that remain. To do this, the trunks of some trees are covered with sheets of aluminum. Used 16"□ x 32"□ aluminum printing plates are obtained from a local newspaper and

then utilized for this purpose. They are de-inked with lacquer thinner, and then one to four sheets are nailed on the trunk from ground level up to 32 inches. Other projects have used chicken wire and steel screen to protect trees from beavers. While perhaps visually unappealing, these methods are quite effective at preventing beavers from cutting these protected trees. One reintroduction site appeared to have ideal habitat in an incised arroyo with a relative abundance of water. However, the site was adjacent to an earthen dam that impounds a 50-acre lake. The one beaver introduced here soon made its way into the lake and began excavating a bank den in the earthen dam, damaging the dam and the road atop it. One persistent problem that has been encountered is how to treat smaller arroyos that have little vegetation. In an evaluation of the causes of siltation of a critical wetland in the Upper Nutria Watershed, a single arroyo was found to contribute 96 percent of the sediment that was deposited, despite the fact that the area drained by the arroyo was only 16 percent of the watershed area. Transplanting beavers into these areas has proven to be problematic when there is not enough vegetation to serve as a reliable food source for the animals. In these cases, some initial planting of willows prior to reintroduction may be needed. That being said, the project has had success transplanting beavers into arroyos that have barely enough water to keep a few small ponds filled year-round, so permanent water is not strictly a necessity.

Socio-Economic & Community Outcomes Achieved

KEY LESSONS LEARNED

Key Lessons Learned

Beavers provide an excellent and portable educational tool. Some of the project's beavers have visited classrooms from kindergarten through high school. They provide an avenue for teaching about wetlands, watchable wildlife, watershed health, and the activities of the Zuni Fish and Wildlife Department in general. It has become clear through this effort how much people's (especially children's) perceptions about the natural world depend on their immediate experience: kids become more transfixed and enchanted by this native rodent in their classroom or behind their houses than they do watching Siberian tigers or panda bears behind metal bars on a trip to the Albuquerque Zoo. Many classes have also been taken out into the field to see, walk on and explore beaver dams and lodges. This is an especially useful exercise, since the kids can readily see the difference that the animals make in their environment.

LONG-TERM MANAGEMENT

Long-Term Management

The beaver reintroduction program is part of a larger, ongoing restoration effort that employs a number of other methods and approaches (e.g. elimination of invasive species, revegetation, grazing exclusion). It his hoped that the improvements in hydrology brought about by the beavers will compliment these other activities.

FUNDING

Sources and Amounts of Funding

The Zuni tribe sued the United States government in 1978 for damage to federal land through mismanagement related to trust responsibilities. After ten years of litigation, the case was settled out of court and a trust fund of US$17 million was established through the Zuni Land Conservation Act of 1990 to restore the watershed using indigenous methods of land and water management.

LEARN MORE

Other Resources

Albert, Steven and Timothy Trimble. 2000. Beavers are partners in riparian restoration on the Zuni Indian Reservation. Ecological Restoration, 18(2): 87-92.

CONTACTS

Primary Contact

Organizational Contact