USA: Colorado: Little Snake River Restoration on Three Forks Ranch

Overview

The Three Forks Ranch in Routt County, Colorado was purchased by David Pratt in 1999. Upon acquiring possession of the property, Pratt hired Dave Rosgen of Wildland Hydrology to design and implement a restoration project aimed at improving the hydrology and habitat conditions of a 10.5-mile stretch of the Little Snake River flowing across his property. The largest privately funded river restoration ever undertaken in the U.S., the project included interventions to improve channel dynamics and water quality; streambank stabilization measures; and a host of habitat enhancement actions. Five years of post-project monitoring have shown that, despite higher-than-usual flows in 2005, the river is functioning as expected, and the fishery is benefiting from more dynamic habitat conditions.

Project Details

Lead Entity:

Wildland Hydrology

Lead entity types:

- Private Sector

Adaptive management

Describe adaptive management processes and mid-course corrections taken to address unforeseen challenges and improve outcomes in each of the following categories:

Other:

An interesting sidelight of this project is the desire of some downstream neighbors to restore another sixteen miles of the Little Snake River. Three Forks Ranch has agreed to fund the Rosgen master plan for this next length of river and to help these neighbors obtain funding from governmental agencies. The Natural Resources Conservation Service, US Fish & Wildlife Service, Wyoming Game and Fish, and Colorado Division of Wildlife are all assisting in making the next phase of the project a reality.

State of Progress:

- Closed/completed, no further follow-up

Project Start:

2000-06-27

Project End:

2001-06-27

Total budgeted expenses:

- USD 2-5 million

Main source of funds:

- Private donation

Global Regions:

- Northern America
- Americas
- World

Countries:

- United States of America

Ecosystem Functional Groups / Biomes:

- Rivers and streams biome

Extent of project:

- Other

Extent of restoration:

- Other

Degradations:

- Other forms of unsustainable agricultural practices

Description:

Three Forks Ranch has been an agricultural enterprise since the 1870's, when gold played out at nearby Hahn's Peak in Routt County. The river bottom, being fertile, easily accessible and irrigable, was overused and abused for many years. Overgrazing and haying resulted in the destruction of the willow community along the river banks. Bank degradation soon followed, and a near-irreversible cycle began. Over time, the river channel became wide and shallow, and stream banks became abrupt drops of 3-6 feet into the river. Each spring, snowmelt runoff added to the problem. Water temperatures increased and dissolved oxygen levels declined. These two factors, along with increased sedimentation, greatly reduced the fish habitat in the river.

Planning and Review

Goals and Objectives

Was a baseline assessment conducted:

UNSURE

Was a reference model used:

UNSURE

were_goals_identified:

YES

Goals and objectives:

- Other

Goals Description::

The restoration goals were to restore natural stream bank stability, establish woody riparian vegetation, greatly reduce bank erosion, create wetlands, and improve fish habitat.

Stakeholder Engagement

Were Stakeholders engaged?:

unsure

Ecosystem Activities and Approaches

General Activities: Restoration of the Little Snake River consisted of three main components: modification of the channel to optimize hydrology; stabilization of the streambank to reduce of erosion; and improvement of habitat conditions for the river's fishery. Hydrologic interventions included deepening and narrowing the channel in several places in order to decrease the width/depth ratio; restoring the natural sinuosity of reaches that had been straightened to facilitate irrigation or road building; and deepening pools in order to create lower water temperatures and increase dissolved oxygen levels. In places where the channel split its flow and both streambanks were eroding, the stream was realigned to occupy only a single channel in order to prevent excess streambank erosion and allow for revetment. Streambank stabilization and grade control structures were constructed on all stream reaches. Steep, eroded banks were removed in many places, and native cobble was used as a revetment in an effort to eliminate future erosion. Furthermore, approximately 22,000 large boulders were placed along about four miles of river in the form of Rosgen-designed structures--e.g., J-hooks, W-wiers, and cross-vanes--to divert the stream's energy away from the banks and toward the center of the stream. These rock structures also created pools for fish. In areas where the curvature of the channel was too severe, the curvature of the channel bends was reduced. When the massive reconstruction was completed, thousands of mature willows were transplanted on the outside of every meander bend to further stabilize the banks and to provide shade to reduce water temperature. Sods mats were also installed to prevent erosion along many sections of streambank. Because recreational fishing represents a significant source of income for the ranch, structures designed to provide diversity of habitat--including rearing, spawning and all-season cover--were also installed on all the stream reaches. Converging rock clusters were used to provide in-stream cover in the presence of high bedload streams. The convergence/divergence maintains the scour hole and seams without the associated gravel bar formation. Side channels constructed in the floodplain were designed to have a variety of slopes and velocities. "Beaver pond" channels were designed to provide a 2-foot check every 200 feet in order to create a backwater channel with a constant flow-through diversion. Within the ponds, the depths were designed to be less than 3.5 feet, ranging in width from 40 to 100 feet. Small, Rosgen E4 stream type tributaries with low sediment yield feed the pond adjacent to the Middle Fork of the Little Snake River. Due to this condition, an in-stream pond was designed for native Colorado River cutthroat trout habitat. The outlet structure from the pond was designed as a drop-outlet drain to prevent migration of fish upstream into the system. Another major phase of the project was to create off-channel fisheries in abandoned river channels using oxbow lakes and interconnecting streams. Irrigation channels were converted to natural steams and "constructed beaver dams" formed oxbow lakes. Seventy-five acres of wetlands were created in this process, along with a diversity of aquatic and terrestrial habitat. The following are measures taken on specific reaches of the river. Restoration work performed on two miles of the main stem of the Little Snake River began at the confluence of the North and Middle Fork tributaries. Approximately 56 cross-vanes, 14 J-hook vanes, 3 "W" weirs and 402 converging rock structures were installed. Thirty-seven banks were stabilized with willow/sod mat transplants. 11,500 feet of side channel habitat was created using design criteria. Oxbow lakes were reshaped and/or created, and 42 "beaver dam" plugs for fish habitat in the hay meadow/floodplain and low terraces were constructed. Restoration work was performed on 10.5 miles of the South Fork of the Little Snake River. Approximately 3 cross-vanes, 420 J-hook vanes, and 990 converging rock structures were installed. 155 banks or bends were stabilized with willow/sod mat transplants. 51,010 feet of channel were realigned using design criteria, and other miscellaneous rehabilitation efforts were completed. Restoration work was performed on 0.6 miles of the North Fork of the Little Snake River. Approximately 6 cross-vanes, 8 J-hook vanes, and 88 converging rock structures were installed. Five banks or bends were stabilized with willow/sod mat transplants, and 700 feet of channel was converted from a braided to a single-thread channel using design criteria. Finally, restoration work was performed on 0.9 miles of the Middle Fork of the Little Snake River. Approximately 6 cross-vanes, 32 J-hook vanes, 1 "W" weir and 225 converging rock structures were installed. Two banks were stabilized with willow/sod mat transplants. 3,150 feet of side channel habitat was created using design criteria. Oxbow lakes were reshaped and/or created; one cutthroat trout pond was constructed; and 8 "beaver dam" plugs for fish habitat were created.

Categories of ecosystem restoration activities and approaches utilized:

- Ecological restoration

Specific type of rehabilitation and/or restoration approach implemented:

- Reconstruction or heavily assisted recovery (e.g. introduction of nearly all biota, major landform modification, major hydrological modification)
- Assisted natural recovery with planting, seeding, or faunal introductions (e.g. enrichment planting or seeding; farmer assisted natural regeneration; rewilding)

Restoration activities implemented:

- Restoration of vegetation cover and ecosystem structure
- Soil and water management

Restoration activities implemented - cover and structure:

- Tree planting
- Shrub planting

Restoration activities implemented - soil and water:

- Grading to establish topography
- Restoration of wetland hydrology

Project Outcomes

Eliminate existing threats to the ecosystem: Despite higher-than-usual runoff duration and volume during 2005, the restored reaches throughout the project site remained stable and incurred no system-wide instability or large-scale channel adjustments. The majority of the structures continued to perform as intended, despite relatively long durations of high flows and shear stresses. After five years of observation, monitoring results indicate that the constructed project continues to successfully meet standard definitions of stream and river stability (Mackin 1948, Schumm 1977, Leopold and Bull 1979, Rosgen 1996, Biedenharn et al. 1997). As in other years, some channel adjustments inevitably occurred in 2005; however, these adjustments are not thought to exceed the range of variability observed in comparable, least disturbed natural systems of the region, particularly during system evolution to a new equilibrium state. The restoration effort has clearly resulted in substantially more pool volume and deep-water habitat with improved potential for riparian shading, lower in-stream temperatures, and higher dissolved oxygen content. Scour by the high flows of 2005 maintained pool volume at a majority of the structures located throughout the project. These pools continue to adequately support the stocked trout population in each of the three major forks of the Little Snake and along the Main Stem of the river. Furthermore, there has been continuing development and re-establishment of riparian vegetation throughout the project due to streamside plantings and improved grazing practices. In 2005, ambient temperatures and recorded stream temperatures at most locations in late summer were comparable to previous years. Fish were further protected from high water temperatures by the cold-water refugia provided by the deep pools created throughout the project. No substantial fish mortality was reported by Three Forks Ranch personnel who frequently observed the fish throughout the most critical summer period. In the fifth full growing season following construction, vegetation continues to re-establish along channel margins and floodplain surfaces. Grasses and forbs are the primary vegetation types colonizing the banks and riparian zone. This is evident along most of the project, even along many of the reshaped gravel and cobble bars. Willows (Salix spp.) are the predominant woody vegetation establishing along channel margins, and gravel and cobble bars. Changes in the willow assemblages can be characterized in two general ways. First, many transplanted willows have experienced some dieback, but there is new growth at the bases of the plants. This was first noted in previous years along the project and new growth of transplanted willows has continued. We expect that, given relatively normal precipitation and flow conditions, these plants will continue to successfully regenerate with proper grazing practices. Second, willows are colonizing many of the exposed gravel bars and cobble bars. While many of the early colonizers have established in locations that will not support perennial vegetation over the long term (i.e., too low into the active channel where excessive periods of inundation and high shear stresses preclude long-term establishment), a large number of more suitable sites have been successfully colonized. These locations are expected to develop into an important functional component of the riparian community. Willow, grass, and forb establishment will increasingly contribute to the overall geomorphic stability of the channel, as well as improve the available cover for aquatic fauna, input coarse particulate matter for desirable aquatic insects, and reduce water temperatures through shading. Factors limiting recovery of the ecosystem: The restoration reaches, like all streams, continue to be influenced by upstream land management practices. Upstream of the South Fork restoration reach and beyond the Three Forks Ranch property boundary, existing grazing practices increase fine sediment loading and channel instability through continual disturbance of streamside vegetation and soils. The restoration reaches cannot be assessed without considering the overall watershed, and the potential effects of upstream grazing practices on downstream reaches are a continuing point of concern. A sediment trap constructed above the project on the South Fork will require periodic maintenance to ensure its long-term effectiveness.

Monitoring and Data Sharing

Does the project have a defined monitoring plan?:

NO

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Long Term Management

STAPER