

Stream Habitat Investigations and Assistance

Federal Aid Project F-161-R16

Final Report

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Federal Aid in Fish and Wildlife Restoration

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State: Colorado

Study No.: F-161

Title: Final Report: Stream Habitat Investigations and Assistance

Period Covered: July 1, 1997 - June 30, 2006

Study Objectives: To quantify changes in trout biomass and stream trout habitat resulting from river channel and aquatic habitat restoration treatments and provide technical assistance for statewide stream improvement projects.

PROJECT BACKGROUND

Federal Aid project F-161-R, Stream Habitat Investigations and Assistance, began July 1, 1990 with two jobs. Job 1 activities quantified changes in brown trout biomass and trout habitat resulting from stream restoration treatments installed in a segment of the South Platte River flowing through the Upper Spinney Mountain State Wildlife Area. Job 1 was completed during the segment ending June 30, 1997. Job 2 covered activities including consultations, assistance with design for statewide CDOW habitat projects plus providing information and assistance to other state agencies mainly Colorado Department of Transportation (CDOT) requests involving aquatic issues associated with bridge and stream crossing projects. This job remained active through June 30, 2006.

Federal Aid Project F-161-R was extended until June, 2000, then for an additional five years, until June 30, 2005 and finally a one year extension until June 30, 2006. Starting in 2000, Job 3 with an objective to: research, describe and evaluate river channel and aquatic habitat treatments was added to include statewide requests for assistance with aquatic habitat rehabilitation projects. Job 4 covered activities associated with project reporting.

PROJECT REPORTING

Project activities were reported in fifteen annual Job Progress Reports submitted during the period July 1, 1990 through June 30, 2005. A Job 1 final report was submitted June 1999. The Final Project Report will satisfy Federal Aid reporting for Jobs 2, 3 and 4 plus an executive summary of activities conducted over the length of these investigations.

PROJECT ACTIVITIES and INVESTIGATIONS

After 1981, when Spinney Reservoir began storing water in the Upper South Platte River drainage, the Colorado Division of Wildlife (CDOW) began acquiring additional public fishing waters in South Park, an area that always has been a popular destination for metro Denver/Colorado Springs anglers. The purchase of a large private ranch in 1986, located

between Elevenmile and Spinney Reservoirs and upstream of Spinney Reservoir, created the Upper and Lower Spinney State Wildlife Areas (SWA). The purchase of additional lands and fishing waters along the South Platte River resulted in securing a perpetual fishing easement known as the Badger Basin.

This tract plus the acquisition of South Fork fishing access upstream from Antero reservoir created three additional SWA: Badger Basin, Knight/Imler and 63 Ranch. All these acquisitions provided miles of public fishing waters. However, the aquatic habitats had been degraded by poor land use including mining and heavy livestock grazing since early settlement. Irrigation and water development also influenced aquatic habitats. If these degraded aquatic habitats were to reach their potential investments in aquatic habitat rehabilitation were necessary. The first step was to create the Stream Habitat Investigations and Assistance Federal Aid Project.

In 1991 the first rehabilitation project was completed in about a 2,000 ft over width channel segment of the South Platte River located on the Upper Spinney SWA. This project site had not been grazed since 1986 when it was purchased by the CDOW. Land use, in the absence of grazing, greatly improved but the river channel remained over width and still lacked deep water pool habitat for over winter trout survival.

Restoration techniques and trout biomass sampling were reported in 1991-1996 Job Progress reports. A Job 1 Final report was completed in 1997. Brown trout biomass monitoring continues and still shows a gradual increasing trend that started after the 1991 restoration project. A manuscript containing restoration techniques and trout biomass trends is currently under preparation.

Building on the success of the first project another restoration project was completed in 1993 immediately downstream of Spinney Reservoir. Restoration techniques were reported in the 1993-1994 Job Progress Report. This second project was also well received by anglers. Funding for South Park habitat restoration projects remained limited.

During 1997, Job 3 was added to expand technical assistance statewide. South Park river rehabilitation projects benefited from a steady funding source plus a CDOW/DOC (Department of Corrections) cooperative agreement that used a DOC Vocational Heavy Construction program. This program provided student inmate heavy construction operators and CDOW biologists for technical assistance and was sponsored by the Colorado Contractors Association. This successful program was described in the September/October 2003 issue of Colorado Outdoors and referenced in annual job progress reports starting in 1998.

EXECUTIVE SUMMARY

This summary lists statewide restoration projects as well as South Park projects. River channel and aquatic habitat treatments used and developed for these projects are included. Riparian vegetation treatments and how we used them to stabilize stream banks and enhance

riparian vegetation communities are included. Recommendations for use in selection of future South Park restoration projects are presented.

River Channel and Aquatic Habitat Treatments

During our investigations 22 river channel and aquatic habitat treatments were installed and tested in B,C, E and F channels described in Rosgen's channel classification (Rosgen 1994) All restored river channel segments had gradients less than one percent. A familiarity with natural river processes and adequate understanding of individual restoration treatments is essential when matching treatments with stream and aquatic habitat degradation. Primary and secondary benefits were assigned for each treatment realizing these benefits overlap between individual sites within a river. The treatments benefited natural river processes, reduced river bank erosion or increased aquatic habitats. The 22 treatments listed in Table 1 include assigned benefits. Written descriptions and installation techniques included in Table 1 are described in Colorado Rivers, (Van Velson 2005).

Table 1. Benefits assigned to river channel and aquatic/trout habitat treatments used in restoration projects.

Treatments to Improve Natural River Processes			
River Channel Treatment	Benefits		
	River processes	Reduces bank erosion	Aquatic habitats
Reduce river channel width	Primary	Secondary	Primary
Pool excavation	“	“	“
Elevate riffle substrate	“	Limited	“
Improve woody overhead trout cover	“	Secondary	“
Riparian vegetation	“	Primary	Secondary
Riparian bench	“	“	“
Woody Material Treatments Used to Reduce River Bank Erosion			
River Bank Treatments	Benefits		
	Natural processes	Reduces Bank Erosion	Aquatic habitats
Log spur	Secondary	Primary	Secondary
Log vane	“	“	“
Horizontal log	“	“	Primary
River bank root wad	“	“	“
Channel edge log/root wad	“	“	“
Boulder Treatments Used to Reduce River Bank Erosion			
River Channel Treatments	Benefits		
	Natural processes	Reduces bank erosion	Aquatic habitats
Cross vane	Secondary	Primary	Primary
Single boulder deflector	“	“	Secondary
Hard point	“	“	Limited
Boulder J hook	“	“	Primary
Boulder vane	“	“	Secondary
Treatments to Enhance Mid-Channel Aquatic and Trout Habitats			
Aquatic Habitat Treatments	Benefits		
	Natural processes	Reduces bank erosion	Aquatic habitats
Random boulders	Limited	Limited	Primary
Boulder clusters	“	“	“
Rock garden	“	Limited	“
Stumps	“	“	“
Mid-channel Root wads	“	“	“
Off bank root wads	“	Secondary	“

Riparian Vegetation

Management of riparian vegetation is paramount in maintaining healthy river systems. Deep-rooted riparian trees, shrub and grasses create the glue holding riverbanks together. Healthy riverbank vegetation is crucial to river health because it stabilizes eroding river banks in addition to creating trout cover. Along river banks the re-establishment and preservation of riparian vegetation was an integral component of all our river channel and aquatic habitat restoration projects. Conversely riverbanks lacking adequate riparian vegetation were extremely unstable.

Prior to restoration degraded river and aquatic segments contained (1) failed riparian systems that needed rehabilitation, (2) natural river processes in need of restoration or (3) insufficient in-stream aquatic habitats. It was common to prescribe river channel and aquatic habitat treatments for restoration of all three degraded habitats. Our experiences establishing riparian vegetation in river restoration projects were summarized in 1992, 1993, 1994, 1998, 1999, 2003 and 2005 Job Progress Reports.

Coyote Willow

Willows were the most important riparian shrub creating stream bank stability particularly in South Park and most restoration projects. In South Park the most common willow species along the South Platte River and its tributaries up to an elevation of about 9,000 feet is coyote willow (*Salix exigua*). In Colorado sandbar willows (*Salix exigua* Nuttall *ssp interior*), are found at elevations ranging from 1,500 to 5,800 ft., while Coyote willow (*Salix exigua* Nuttall *ssp. exigua*), ranges between 3,600 and 9,200 feet in elevation. Both species are closely related genetically and frequently interbreed in areas where their ranges overlap (Dorn 1997).

Coyote willows prefer alluvial soils containing a mixture of silt, sand and small gravels. These soils are often found in river deposition areas including point bars.

During our investigations we tested two types of coyote willow plantings: willow stub cuttings and bare root stock. Bare root stocks usually are produced in nurseries and have well developed root systems. Willow stubs rely upon nutrition from the stems to develop a root system. Each had an advantage and we used both to establish willow stands.

Our experiences indicated permanent soil moisture and composition of soil materials in the planting site were extremely important. Both types had high survival when planted in permanent soil moisture. Planting sites containing permanent soil moisture in the upper one foot of the soil column are best suited for bare root willow stocks. Willow stub plantings are recommended in sites where permanent soil moisture is located one to two feet below the ground surface.

Bare root plantings

Bare root coyote willow stocks became available during the mid 1990's from the Colorado State Forest Nursery on the Foothills campus of Colorado State University. Bare root

stocks are available for planting from March through May. The present cost of bare root stock is \$0.46/ plant.

Bare root plantings have growth advantages over stub plantings because they already have an established root system. Bare root plantings survive best at sites where the elevation of permanent soil moisture during low river flow remains within one foot of the ground surface. In the upper South Platte River drainage, survival of our bare root plantings normally exceeded 90%.

Stub willow plantings

Stub willows collected near the project area are recommended because they are already adapted to local conditions. Coyote willows are well adapted for stub plantings. Other willow species, especially in higher altitudes with shorter growing seasons may not be as adaptable.

Willow stubs for plantings must be clipped prior to leaf out. Stubs collected from 4-6 year old willows seemed to have the best survival in South Park. Remove all side branches plus the previous years growth. If the new growth isn't removed, it will sprout leaves first and consume the energy in the stems before an adequate root system can develop. In South Park stub willow plantings are usually made after May 1 when the frost normally leaves the ground. Holes for planting stub willows must be deep enough and the stubs long enough to extend into the permanent soil moisture.

Mountain Willow

The mountain willow (*Salix monticola*) grows in elevations between 5,700 and 11,500 ft. (Dorn 1997). In South Park mountain willow was identified along the South Fork of the South Platte on the Knight/Imler SWA. This species has a "bush" appearance and, unlike the coyote willow, extends over the riverbank and creates valuable overhead trout cover generally lacking along many streams on the floor of the South Park Basin.

The value of this species became obvious when we identified Mountain willows overhanging a potential pool site. We carefully removed substrate material from beneath the Mountain willows to provide overhead trout cover. This activity created overhead cover for the newly created pool. We also used stubs collected from this source to establish stands of mountain willows in other sites to create over trout cover.

Beaked Sedge

Various sedges species provide excellent river bank stability. However our field observations indicated beaked sedge (*Carex ultriculata*) provided the quickest source of superior river bank stability.

Beaked sedge is present along streams and wetlands through South Park. It was abundant along E stream channels that transported fine sediments during higher flow events. It grows in fine and medium textured soils of bogs, swamp, wet meadows and along edges of stream and lakes. It prefers water-saturated soils and standing waters up to about 8 inches in depth. It is sod forming and can spread by white stolons. Once established, its dense root mass prevents stream bank erosion and maintains a high degree of riverbank stability.

Rapid re-vegetation of riverbanks is required at restoration sites containing newly constructed river channels, around disturbed construction sites and around sites containing restoration treatments. We transplanted beaked sedges into suitable soils and valued the short length of time required to provide maximum river bank stability. Beaked sedge was observed along inside river curves and on point bars containing deposition of clay, silt and fine sands.

Once established beaked sedge traps sediment and reduces channel width while creating a healthy river system. Occasionally along outside curves beaked sedge has gained a foothold along the margins of the channel substrate in deposition areas between low and bank full flow elevations.

Beaked sedge plants can be purchased in nurseries specializing in wetland and riparian stocks and transplanted into suitable soil environments.

River Restoration Projects and Reporting

South Park river restoration projects are summarized in F-161-R Annual Job Progress Reports listed in the Literature Cited. Three major restoration projects, using different funding sources, were completed outside the upper South Platte River drainage in segments of Grape Creek, Big Thompson River and Lefthand Creek. All these restoration projects are included in Table 2.

A summary of the Lefthand Creek Restoration Project can be accessed on line at: <http://water.montana/wildfish/Cases/casehistories.asp> . Project results were also reported by Ricciardiello (2004).

Project information obtained while restoring and monitoring river channel and aquatic habitats under Stream Habitat Investigations and Assistance were used as training for CDOW employees. An in-house publication entitled RIVERS and later COLORADO RIVERS were prepared for CDOW training sessions and copies distributed upon request. From 1995-2004 this information was presented at DWM training sessions.

Two workshops were conducted for Aquatic and Habitat personnel. During September 28-30, 1998 a *River Hydrology and Stream Habitat Restoration Workshop* was held in Buena Vista with a day in the classroom and field trips to South Park restoration projects. A *River Restoration Techniques Mini Course and Field Workshop* assisted by Habitat personnel spend one day in the class room, one day visiting South Park restoration projects and one day collecting

and analyzing Cebolla Creek hydrology data collected at the Mason Family SWA near Powderhorn.

Aquatic habitat restoration techniques and training was provided in 2004 and 2005 at the Wildlife Management Short Course held at Colorado State University.

Table 2. Major F-161-R river restoration projects completed in South Park and statewide, 1991-2005.

Year	Stream	County	Length*	Project Major Treatments	Ownership	Funding	Miscellaneous
1991	South Platte River	Park	.4	reduced channel width, excavate pools	CDOW – Upper Spinney SWA	CDOW/ Federal Aid	upstream/ Spinney Res. 1992-97 Job Pro. Repts. 1999 Job Final Rept.
1993	South Platte River	Park	.4	reduced channel width, excavate pools	Aurora/Colo. State Parks	CDOW/Cap. Const.	downstream/ Spinney Res. 1993-94 Job Pro. Rept.
1997	Grape Creek	Fremont	.2	reduce channel width, excavate pools	BLM/CDOW lease	CDOW/SE Region	Upstream of DeWeese Res. Job Pro. Rept.
1998	Grape Creek	Fremont	.3	reduce channel width, excavate pools	BLM/CDOW lease	CDOW/SE Region	Upstream of DeWeese Res. 1997-98 Job Pro. Rept.
1993	Big Thompson River	Larimer	.1	boulder vortex structures, excavate pools	Bureau of Rec.	CDOW/ Trout Unlimited	Lower reach starting upstream of Mall Road bridge.
1997	Big Thompson River	Larimer	.2	Reduce channel width, excavate pools, boulder placement	Bureau of Rec.	CDOW/FIF	Downstream/Olympus Dam 1997-98 Job Pro. Rept.
1998	South Platte River	Park	.2	Reduce channel width, excavate pools, boulder & log placement	Colo. State Parks	CDOW/Cap. Const.	CDOW/DOC restoration project Job Pro. Rept.
1999	South Fork of South Platte River	Park	.7	Excavate new channel, Boulder and log placement	Denver Water Dept.	DWD/CDOW Cap. Const.	CDOW/DOC restoration project 1999-00 Job Pro. Rept.
2000	Threemile Creek	Park	.5	Constructed new flood channel for Threemile Creek, dam and retention lake.	CDOW/Lower Spinney SWA	CDOW/Cap Const.	CDOW/DOC restoration project 1999-00 Job Pro. Rept.

* Stream length in miles

Table 2. (continued)

Year	Stream	County	Length*	Project Major Treatments	Ownership	Funding	Miscellaneous
2001	South Platte River	Park	.9	Reduce channel width, excavate pools, boulder & log placement	CDOW/Lower Spinney SWA	CDOW/Cap Const.	CDOW/DOC restoration project 2001-02 Job Pro. Rpt.
2001	Lefthand Creek	Boulder		Construct new channel with pools, plant riparian veg.	Longmont	Longmont	CDOW design & supervision Erosion Control CDOW/DOC restoration project 2002-03 Job Pro. Rpt.
2002	South Fork of South Platte River	Park	1.2	reduced channel width, excavate pools	CDOW/ Knight/Imler SWA	CDOW/Cap. Const.	CDOW/DOC restoration project 2002-03 Job Pro. Rpt.
2002	South Fork of South Platte River	Park	1.0	reduced channel width, excavate pools , boulder & log placement	CDOW/ Badger Basin SWA	CDOW/Cap. Const.	CDOW/DOC restoration project 2002-03 Job Pro. Rpt.
2003	South Platte River	Park	1.0	reduce channel width, excavate pools, boulder & log placement	Aurora/Colo. State Park	CDOW/Cap. Const.	CDOW/DOC restoration project 2003-04 Job Pro. Rpt.
2004	South Platte River	Park	.3	reduce channel width, excavate pools, boulder placement	CDOW/Lower Spinney SWA	CDOW/Cap. Const.	CDOW/DOC restoration project 2004-05 Job Pro. Rpt.
2005	South Fork of South Platte River	Park	1.7	Installed streamflow structures and developed existing channels, excavate pools	CDOW/Upper Spinney SWA	CDOW/Cap Const.	CDOW/DOC restoration project
2005	Tarryall Creek	Park	.6	Reduce channel width, excavate pools, willow & log placement	CDOW/ Tarryall SWA	CDOW/Cap Const.	CDOW/DOC restoration project

* stream length in miles.

PROJECT RECOMMENDATIONS

The CDOW/DOC cooperative agreement used to facilitate restoration of river channel and aquatic habitats in South Park since 1998 should be continued. Table 3 provides a prioritized list of South Park streams that would benefit from future restoration projects.

Long term evaluation of trout biomass, aquatic habitats and distribution of trout in restored South Park aquatic habitats could guide development of future rehabilitation techniques. One manuscript evaluating the two dimensional modeling approach to monitoring trout habitats before and after restoration in the South Platte River between Spinney and Elevenmile Reservoirs is in the publishing process. This publication may serve as a guide for additional trout habitat and behavioral studies.

Lack of deep water pool habitat, especially in winter ice covered river segments, was perceived as a bottleneck for adult trout stream populations. Pool excavation for creation of over winter adult trout populations was given top priority during restoration activities. Over winter sampling, trout observations and habitat measurements were not made to substantiate this assumption.

Generally the South Platte River lacked the typical in-stream trout cover component. The placement of in-stream single boulders, boulder clusters and in-stream logs were common restoration treatments. These treatments need evaluation.

Table 3. Prioritized South Park stream channels segments and projects that would benefit from CDOW/DOC restoration projects.

Stream	Length (mile)	Primary Treatment	Project Description
Middle Fork/ South Platte River	2.5	Reduce channel width, Excavate pools	Upper Spinney SWA/Lower end of Badger Basin perpetual easement
South Fork of South Platte River	1.0	“ “ “	River reach upstream of Badger Basin HQ - Lower end of Badger Basin perpetual easement
South Fork of South Platte River	1.0	“ “ “	Badger Basin perpetual easement adjacent to Hartsel town site
South Platte River	1.0	“ “ “	Lower Spinney SWA (Dream Stream)
South Platte River	.1	Design kokanee trap.	Construct weir & kokanee trap upstream from Elevenmile Reservoir.
South Platte River	1.0	Reduce channel width, Excavate pools	River segment downstream of Park Co. Rd 59.
Tarryall Creek (upstream from Tarryall Res.)	.5	Design new stream channel & irrigation diversion	Construct new stream channel and irrigation diversion.
Tarryall Creek (Upper SWA segment)	.2	Design trout passage around an irrigation diversion structure	Construct trout passage structure over irrigation diversion

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