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PROJECT SPOTLIGHT

Stream Restoration and Fish in Oregon's Upper Grand Ronde River System

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Introduction

The economic, recreational, and cultural importance of salmon to the Pacific Northwest is enormous. Once abundant from central California through Idaho, Oregon, and Washington to British Columbia and Alaska, salmon have disappeared from much of their historical range. The decline in salmon numbers has been going on for at least a century, but the issue has become more widespread and acute recently.

The Grande Ronde River system, located in the Blue Mountain ecoregion of northeast Oregon, has historically produced large runs of native spring chinook salmon and summer steelhead trout. Since the early 1970s, these runs have declined substantially. Loss of spawning habitat and elevated stream temperatures are important factors affecting the decline of these fish stocks (Hafele 1996). Livestock grazing, timber harvesting, road construction, and mining have contributed to habitat degradation and elevated stream temperatures in the Grande Ronde River system.

Within the Grande Ronde River system, McCoy Meadows was once a large wetland meadow complex with sinuous stream channels, wetlands, backwater areas, ponds, and beaver colonies. Beaver trapping, road construction, logging, stream channelization, and livestock grazing have drastically altered the character and function of this complex. These activities produced a shallow and wide stream channel with little riparian vegetation, degraded habitat, and high water temperatures.

EDITOR'S NOTE

In this issue of *NWQEP NOTES*, we continue our series on National Nonpoint Source Monitoring Program (NMP) projects that have been completed and have documented improvements in water quality due to best management practice (BMP) implementation.

The Upper Grande Ronde River system in northeast Oregon was once known for its abundant salmon and trout streams. Livestock grazing, timber harvesting, road construction and mining in the watershed have lead to the decline of fish stocks over the past 30 years, mostly due to habitat degradation and elevated stream temperatures. The goal of the Upper Grande Ronde NMP project was to assess effectiveness of channel restoration in a large wetland meadow complex within the Upper Grande Ronde River system, as measured by improved stream habitat, reduced stream temperatures, and increased numbers of salmon and trout. The study employed a before/after monitoring design with control and reference sites. Restoration activities included riparian fencing, channel reintroduction to a historic wet meadow meander pattern, new channel construction with meander pattern, new bridge and culvert at a road crossing, and extensive riparian planting and creation of off-channel pond habitats. Results of the study indicated that channel restoration can improve habitat and water quality for sensitive aquatic species. The authors note the importance of creating pool habitat for providing cool temperature refugia, and also concluded that livestock exclusion by itself is not enough to recover sensitive aquatic life if stream channel and habitat conditions remain degraded.

As always, please feel free to contact me regarding your ideas, suggestions, and possible contributions to this newsletter.

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In 1995, the owners of McCoy Creek Meadows Ranch partnered with a multi-agency team to begin a watershed project to restore water quality, fish and wildlife habitat, and wetland function in the McCoy Creek meadows**.** The resulting restoration work was extensive. This work was administered by the Confederated Tribes of the Umatilla Indian Reservation (CTUIR). The Bonneville Power Administration (BPA), Natural Resource Conservation Service (NRCS), Grande Ronde Model Watershed Program (GRMWP), Oregon Department of Fish and Wildlife (ODFW), DEQ, and EPA also participated.

The Oregon Department of Environmental Quality (DEQ) began conducting chemical, physical, and biological monitoring at selected stream sites in the Upper Grande Ronde watershed since 1993, with funding from the US Environmental Protection Agency (EPA) Section 319 National Nonpoint Source Monitoring Program (NMP). The goal of this study is to assess the effectiveness of channel restoration efforts in McCoy Creek. Measures of success are improved stream habitat, reduced stream temperatures, and increased numbers of trout and salmon.

Monitoring for this study was completed in 2005. Data analysis is currently underway and a final project report is scheduled for completion in 2007. This article discusses just the fish survey portion of the overall study by summarizing the methods and initial results of fish surveys conducted by DEQ staff from 1994 through 2005. The relationship between site conditions and fish assemblages and the effect of channel restoration on fish assemblages are presented.

Study Sites

The project selected eleven sites on wadeable streams in five subbasins of the upper Grande Ronde River, where land use is primarily timber and grazing. Each site consists of a reach length containing both riffle and pool habitat types. The sites represent a range of conditions related to land use, management practices, and prevailing habitat. Reference sites are characterized by complex channel and riparian habitats, and occur in subbasins with minimal or no grazing. The remaining sites occur in subbasins with varying levels of grazing use (Table 1).

Study Design

Monitoring is based on a before and after treatment with control design. McCoy Creek is the treatment subbasin; Dark Canyon Creek is the control subbasin (Table 2). Both McCoy and Dark Canyon creeks have histories of grazing and degraded habitat. Dark Canyon is used for cattle grazing with no riparian fencing or other improvements. Monitoring in Dark Canyon Creek was terminated in 2002 because of access restriction. The remaining sites represent a range of less impacted reference conditions. Results were used to assess stream conditions relative to different land use and management practices, and to evaluate conditions in McCoy Creek before and after restoration.

McCoy Creek Restoration

In 1968 and again in 1977 the lower two miles of McCoy Creek were channelized, straightened, and relocated to drain wetlands and maximize grazing land. These actions produced a wide, shallow channel and resulted in near elimination of out of bank stream flow and a significant decrease in meadow storage capacity and connectivity with cool ground water. The focus of restoration was to reverse the adverse affects of channelization.

Riparian fencing has been in place on lower McCoy Creek since 1988; however response of the stream channel to livestock exclusion was limited. Channel restoration was initially implemented in July, 1997 when a half mile section of the channelized creek was reintroduced into its historic meandering wet meadow channel in the upper meadow area (Figure 1). A second phase was completed in September 2002, with the diversion of an additional 1.2 mile (1.9 km) section of channelized creek into a constructed meandering channel in the lower meadow area (Figure 2). In addition, a new bridge and culvert were constructed at a road crossing in October, 2001. This work was accompanied by extensive riparian planting and the creation of off-channel pond habitats. The working

Table 1. Grande Ronde NMP study site location and description.

Site	River Mile	Elevation (ft)	Management	Study Site Type
McCoy Creek Lower #1 (MCCL1)	0.12 – 0.30	3350	Riparian fencing	Meadow below restoration area
McCoy Creek Lower #2 (MCCL2)	0.30 – 0.41	3360	Riparian fencing	Meadow below restoration area
McCoy Creek Restored (MCCR)	0.95 – 1.45	3380	Riparian fencing and planting	Restored wet meadow reintroduced channel
McCoy Creek Lower Reconstructed (MCCLR)	0.12 – 0.80	3350	Riparian fencing and planting	Restored wet meadow reconstructed channel
McCoy Creek Middle (MCCM)	2.00 –2.08	3400	Riparian fencing	Forested above restoration area
Dark Canyon Creek Lower (DARKL)	0.40 –0.47	3300	Open grazing	Control meadow
Dark Canyon Creek Upper (DARKU)	3.00 – 3.07	3550	Open grazing	Control forested
Limber Jim Creek Lower (LIML)	0.40 –0.47	4300	No grazing, cattle excluded	Reference condition meadow
Limber Jim Creek Upper (LIMU)	3.20 –3.26	4650	No grazing, cattle excluded	Reference condition forested
Lookout Creek (LOOK)	3.00 – 3.07	4700	Open range, minimal grazing	Reference condition forested
Meadow Creek Lower (MEADL)	2.30 – 2.41	3440	Riparian fencing	Meadow
Meadow Creek Starkey (MEADS)	12.00 – 12.12	3770	Seasonal grazing	Managed experimental forest

Table 2. Key sites, sample period, study type, and treatment.

Site	Sample Period	Study Type	Treatment
McCoy Creek Lower #1 and #2	1993 – 2001	Before Treatment	Channelized with cattle excluded by fencing beginning in 1988. Diverted to reconstructed channel in 2002.
McCoy Creek Restored	1997 – 2005	After Treatment	Section of historic meandering channel restored by diverting water from adjacent channelized section in 1997.
McCoy Creek Lower Reconstructed	2003 – 2005	After Treatment	Reconstructed meandering channel. This section replaced McCoy Creek Lower #1 and #2 in 2002. Cattle remain excluded.
Dark Canyon Creek Lower	1993 – 2002	Before and After Treatment	Control - no treatment. Cattle use the active channel.

Figure 1. Downstream View of the McCoy Creek Meadows Restoration area (Childs 2002). In the center is the meandering channel reintroduced in 1997. The old channelized creek is seen on the right.

hypothesis was that restoring wet meadow conditions and improving riparian vegetation cover would result in cooler stream temperatures and improved fish habitat within the restoration area.

Monitoring

DEQ monitoring included continuous recording of water and air temperature, sampling for water chemistry, periodic stream habitat assessments, and aquatic macroinvertebrate and fish surveys. Monitoring was conducted from June, 1993 through September, 2005.

Project investigators chose snorkeling as the most appropriate fish sampling technique to minimize impact on the sensitive salmonid populations. Compared to other options such as electrofishing or netting, snorkeling is considered the least disruptive way of observing fish in the field and is an effective technique for obtaining information on the abundance, distribution, habit preferences, and behavior of fish in many habitat types (Helfman 1985).

Biologists conducted snorkel surveys once each season during the first week in August, 1994 through 2005 by floating the length of each reach from the downstream boundary to the upstream boundary. Observers identified the taxa present and counted or estimated numbers of individuals within each taxa. Classification was limited to in-stream visual identification. Because of this limitation and resulting uncertainty, several groups were classified only to the family or genus level. However, most taxa were identified to species level. It is likely that the abundance of sculpins, benthic fish that hide in the substrate, was underestimated by snorkel surveys.

Results

Ten fish taxa were identified in the study sites. The average number of individuals by taxa observed at each site during the study period are summarized in Table 3.

Discussion

Classification

Seven of the taxa identified were fishes native to Oregon. The classifications of origin, pollution tolerance, and water temperature type for each taxon are listed in Table 4.

The attributes given in Table 4 reflect species preferences for stream conditions and possible responses to human disturbance and are useful in interpreting the fish survey results. Native taxa are those groups believed to have been present prior to European settlement. Alien taxa are groups that have been introduced through human intervention. Sensitive species are greatly reduced or disappear in association with disturbance, such as increased water temperature, increased turbidity and siltation, and reduced concentrations of dissolved oxygen. Tolerant species can survive increased water temperature, turbidity and siltation, and decreased dissolved oxygen and in fact often increase in abundance with disturbance as intolerant species are eliminated. Intermediate species are neither tolerant nor sensitive to disturbance, but are typically

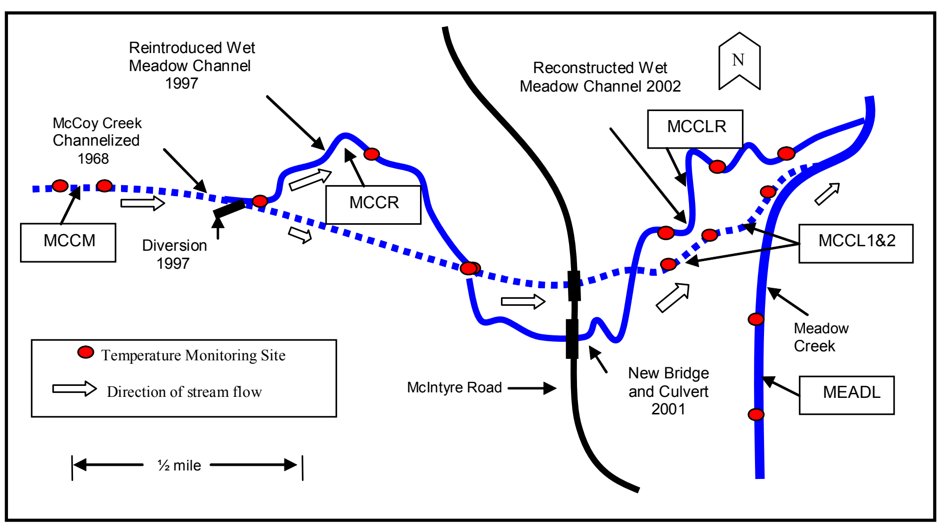

Figure 2. Schematic diagram of McCoy Creek Meadows Restoration area. Study reaches are bracketed by temperature monitoring points. Site name abbreviations are listed in Table 1. The McCoy Creek Restored (MCCR) and McCoy Creek Lower Reconstructed (MCCLR) study reaches had temperature monitoring points located mid-way as well as at the upper and lower boundaries.

Table 3. Average fish abundance from August snorkel surveys at Grand Ronde NMP sites 1994 through 2005. Data are listed by site and by taxa. Values are mean number of individuals in each of the taxa.

Site	Cat spp	Cot spp	Ict_ fam	Lep mac	Onc myk	Onc tsh	Pty ore	Rhi spp	Ric bal	Sal font
Dark Canyon Lower	0.2	0.2			26.8			2.2		
Dark Canyon Upper		2.3			48.3					
Limber Jim Lower		2.1			52.3					0.1
Limber Jim Upper		0.5			16.2					
Lookout		2.6			78.9	0.1				
McCoy Lower #1	39.6	0.5	0.1		5.8		8.1	49.6	298.1	
McCoy Lower #2	113.3		25.3		4.4		25.3	259.0	428.1	0.1
McCoy Lower Reconstructed	308.7	1.7	0.0	46.0	82.3		408.7	214.0	799.7	
McCoy Middle	73.1	0.5	0.3		10.7		32.6	61.8	311.8	
McCoy Restored	432.5	0.5	18.4	0.8	35.3		393.4	447.0	1479.3	
Meadow Lower	99.7	0.9			7.0		165.8	147.7	830.0	
Meadow Starkey	130.6	2.6			61.0		62.9	180.4	225.8	

Legend
TAXA:
Cat spp = *Catostomus spp.*(sucker)
Cot spp = *Cottus spp.* (sculpin)
Ict fam = *Ictaluris spp.* (bullhead)
Lep spp. = *Lepomis spp.* (sunfish)
Onc myk = *Oncorhynchus mykiss* (rainbow/steelhead trout)
Onc tsh = *Oncorhynchus tshawyscha* (chinook salmon)
Pty ore = *Ptychochelius oregonesis* (pikeminnow)
Rhi spp. = *Rhinicthys spp.* (dace)
Ric bal = *Richardsonius baleautus* (redside shiner)
Sal font = *Salvelinus fontinalis* (brook trout)

Table 4. Classification of fish observed at the eleven Grande Ronde NMP sites 1994 through 2005 (classification attributes from Zaroban et al. 1999).

Family/ Genus Species	Common Name	Origin	Pollution Tolerance	Temperature Type
Catostomidae/				
Catostomus spp.	Sucker	Native	Intermediate, tolerant	Cool
Centrarchidae/				
Lepomis spp	Sunfish	Alien	Tolerant	Warm
Cottidae/				
Cottus spp.	Sculpin	Native	Intermediate, sensitive	Cool,cold
Cyprinidae/				
Rhinicthys spp	Dace	Native	Intermediate	Cool
Richardsonius baleatus	Redside shiner	Native	Intermediate	Cool
Ptychocheilus oregonesis	Northern pikeminnow	Native	Tolerant	Cool
Ictaluridae/				
Ictaluris spp.	Bullhead	Alien	Tolerant	Warm
Salmonidae/				
Salvelinus fontinalis	Brooktrout	Alien	Intermediate	Cold
Onchorhynchus mykiss	Rainbow trout	Native	Sensitive	Cold
Onchorhynchus tshawytscha	Chinook salmon	Native	Sensitive	Cold

replaced by tolerant species in situations of increasing disturbance. Intermediate species may be useful indicators of moderate disturbance to high quality waters or to disturbance that is mostly associated with alteration of physical habitat. The temperature classifications (warm water, cool water, and cold water) were determined by Zaroban et al. (1999) using species ranges, spawning seasons, spawning temperatures, and physiological optima. Temperature regimes ranged broadly at Grande Ronde NMP sites.

For the purpose of analysis and comparison of results based on tolerance classifications, sculpin numbers were not used because identification was to the genus level and some species of sculpin are classified as sensitive, while other sculpin species are classified as intermediate in tolerance to disturbance. Other than sculpin, the only sensitive taxa observed were juvenile steelhead trout or resident rainbow trout, and one juvenile chinook salmon, which was observed in 1994 in Lookout Creek.

Abundance and Species Composition and Site Conditions

Abundance and species composition varied widely among sites and were strongly associated with a gradient of maximum water temperature and to a lesser extent with habitat quality. These values are summarized by site in Table 5.

The sites dominated by sensitive salmonids were located on Limber Jim Creek and Lookout Creek, where stream temperatures were cool and habitat quality was high. Cattle are excluded from the Limber Jim Creek subbasin. Lookout Creek is located in a forested open range area, but land use impacts are minimal. The sites dominated by intermediate and tolerant taxa were the McCoy Creek and Meadow Creek sites where habitat quality was compromised by land use practices and water temperatures were warmer than at ungrazed sites. Greater fish abundance was observed at these more disturbed sites where production was boosted by warmer temperatures and increased nutrient input, and conditions favored the success of more tolerant species. The one exception to this pattern was Dark Canyon Creek where riparian and channel conditions are degraded by grazing practices, but water temperatures remain cool during the summer season due primarily to ground water inflow (Whitney 2000). Although habitat quality was poor, this site was populated primarily by sensitive salmonids, demonstrating the dominant importance of water temperature in determining fish assemblage composition.

Analysis of environmental variables associated with fish assemblage compositions at Grande Ronde NMP sites has shown water temperature to be the most significant explanatory variable (Drake 1999). Correlation analysis of fifty environmental variables indicated channel and riparian characteristics related to disturbance and elevated stream temperatures, such as width, depth, and shade, as well as water quality variables indicative of disturbance, particularly the nitrogen-phosphorus ratio (total inorganic nitrogen:ortho phosphate), were also correlated to fish assemblage composition. Water temperature, expressed as the 7-day moving average seasonal maximum temperature, correlated most

Table 5. Mean values for seasonal maximum temperature, habitat score, fish abundance, and fish species composition by site, 1994 – 1999. Sites are listed in ascending order based on water temperature.

SITE	Temperature 7 day max. (oC) *	Habitat Score (%) **	Abundance (fish/mile)	Sensitive Species (%) ***	Intermediate Species (%) ***	Tolerant Species (%) ***
Limber Jim Cr, Upper	15.9	79.0	288	96.3	0.0	0.0
Lookout Cr	18.3	80.0	1218	96.7	0.0	0.0
Limber Jim Cr, Lower	19.4	63.5	865	94.7	0.6	0.0
Dark Canyon Cr, Lower	20.4	53.4	393	83.8	3.3	0.0
Dark Canyon Cr, Upper	22.0	54.7	765	92.6	0.0	0.0
Meadow Cr, Starkey	25.1	58.7	5670	10.8	77.6	11.1
McCoy Cr, Lower #2	26.4	54.8	7637	0.6	93.6	5.8
McCoy Cr, Middle	26.7	59.3	6291	3.5	87.6	8.7
McCoy Cr, Restored	27.1	59.6	5614	1.2	84.9	13.9
Meadow Cr, Lower	27.7	47.9	10974	0.5	87.2	12.1
McCoy Cr, Lower Reconstructed	28.1	59.4	5242	5.1	71.8	23.0
McCoy Cr, Lower #1	28.2	54.9	4728	1.4	96.3	2.3

*seven day moving average of the daily maximum temperature using continuous temperature recorders
**scores based on modified EPA Rapid Bioassesment Protocols expressed as % possible total score
***percent of all taxa observed. Species composition was calculated from total abundance. However, Cottidae species were not classified for tolerance, thus the sum of composition is less than 100 %.

Continued on p. 9

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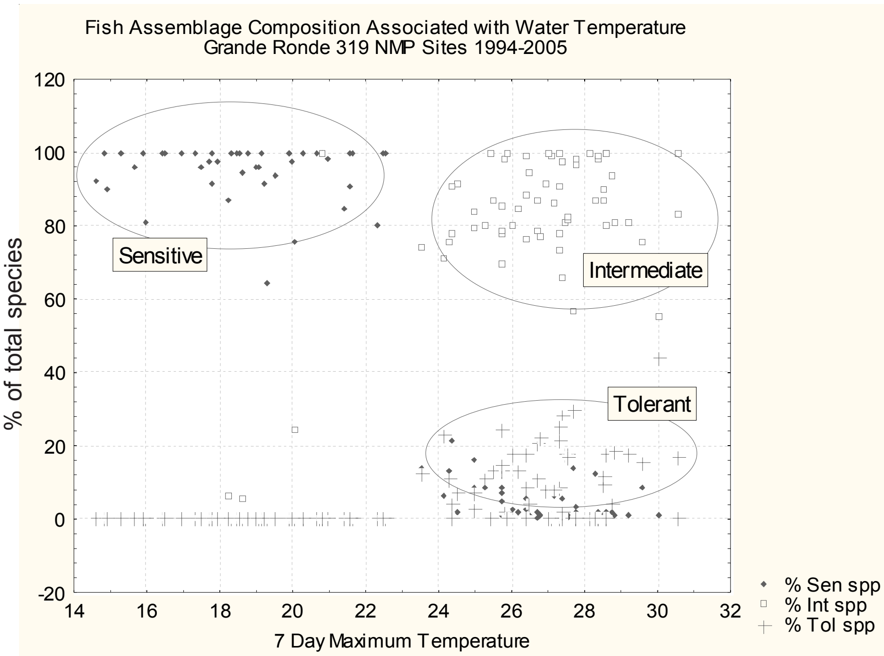

Figure 3. Fish assemblage species composition related to water temperature, 1994– 2005. Fish Taxa are represented as percent sensitive species (%Sen spp), percent intermediate species (%Int spp), and percent tolerant species (%Tol spp). Fish surveys were timed to take place during the week of typical seasonal maximum temperatures.

Figure 4. A channelized section of McCoy Creek in the lower meadow area after installation of livestock fencing in 1988 but prior to reconstruction of meandering channel, completed in 2002. The channel here is wide and shallow, with limited fish habitat.

strongly with the composition of fish assemblages. This relationship of water temperature and species composition is illustrated in Figure 3.

Water temperature influences the metabolism, behavior, reproduction, and survival of fish. The sensitive species represented in Figure 3, juvenile steelhead trout and resident rainbow trout, are coldwater fish with definite temperature requirements. Temperatures exceeding 23- 25 ^{o}C are life-threatening for most salmonids. Sublethal effects of elevated stream temperatures on juvenile rearing salmonids include increased incidence of disease, reduced growth rate, increased competition for limited habitat and food, and reduced ability to compete with other species that are better adapted to higher temperatures.

Results from the Grande Ronde snorkel surveys agree with experimental temperature limits. Figure 3 shows that salmonids dominated the fish assemblages at sites with average 7-day maximum temperatures below 23 ^{o}C. Where average 7-day maximum temperatures exceeding 23 ^{o}C, salmonid numbers were dramatically reduced.

Salmonids were observed responding to elevated temperatures by seeking refuge in pockets of cool water. This behavior was evident in the distribution of trout during the August snorkel surveys. At sites where maximum temperatures approached or exceeded thermal limits (24 to 30 ^{o}C), trout were observed only in small areas where water temperatures were cooler due to ground water inflow or thermal stratification in pools. This was particularly evident at the Meadow Creek and McCoy Creek sites. In McCoy Creek, where temperatures have exceeded 28 ^{o}C, pockets of thermal refugia (isolated areas where conditions permit fish to escape harmful conditions and survive) were measured to be as much as 4 degrees cooler than the surrounding water temperature. In July 1994, prior to channel restoration, trout were observed holding in a small pocket of cool water measured to be 23.2 ^{o}C, while the water surrounding this cool spot was 27.3 ^{o}C. At the cooler study sites, particularly Limber Jim Creek and Lookout Creek where temperatures did not exceed 20 ^{o}C, trout distribution was more even throughout the study reaches, with fish holding in areas where cover was provided by habitat attributes such as undercut banks, boulders, broken water, pools, large wood, and overhanging vegetation.

McCoy Creek Restoration Results

Before and after channel restoration comparisons show improved habitat, increased area of cool water, and increased numbers of salmonids (trout) in the restored sections.

Habitat. Restoration began in 1988 with construction of fencing to exclude livestock from the channelized section of McCoy Creek, but subsequent habitat recovery was slow. The stream channel remained shallow and wide, formation of new point bars and meanders was minimal, and deposition of fine material and growth of riparian vegetation was slow (Figure 4). Although small pockets of cool inflowing ground water existed in limited pool habitat, water temperatures were high (Whitney 2000). The conditions of minimal cover and elevated temperatures were unfavorable for rearing salmonids, which prefer cooler temperatures and cover for hiding. By contrast, the reintroduction of a 0.5 mile (0.8 km) section of McCoy Creek to its historic meandering channel in 1997 and the construction of an additional 1.2 miles (1.9 km) of meandering channel in 2002 resulted in more favorable habitat for native steelhead and resident rainbow trout (Figure 5). Channel restoration and construction decreased channel width and increased depth compared to pre-treatment conditions and created lower gradient and increased sinuosity, more pool area and bank cover, and improved connectivity with cool ground water. Comparing the 1997 restored channel to the channelized section from which it was diverted, gradient decreased from 0.7 ft/100 ft to 0.5 ft/100 ft, sinuosity increased from 1.01 to 1.52, width to depth ratio decreased by 45%, and pool habitat availability increased from 12% in the channelized section to 50% in the restored section (Childs 2002).

Figure 5. A section of the McCoy Creek channel reintroduced in 1997 into the historic meandering wet meadow channel. The channel is narrower and deeper with improved fish habitat and riparian vegetation. The water table is elevated, and connectivity with cooler ground water is improved.

Temperature. Continuous water temperature data logged at the lower boundaries of the study reaches did not show a significant reduction in seasonal maximum temperatures after channel restoration (Figure 6). However, data show a nonsignificant trend of decreasing temperature in McCoy Creek after channel diversion in 1997, while temperature in the control reach (Dark Canyon) increased during this period (Figure 7). Longitudinal temperature profiles show a broad range of temperatures within the restored and reconstructed reaches. This is particularly evident in the restored section diverted in 1997 (MCCR), where temperatures measured at midday in early August ranged from 11.6 °C to 21.7 °C (Figure 8). Temperatures were below 18 °C within 38% of the reach length. The cooler water temperatures were clearly associated with pools and deeper runs, where improved riparian vegetation condition indicated good connectivity with cooler ground water. Wet channel width to depth ratios in the restored reaches with colder water were approximately half that of nearby unrestored reaches indicating a narrowing and deepening in restored reaches compared to unrestored reaches (Childs 2002).

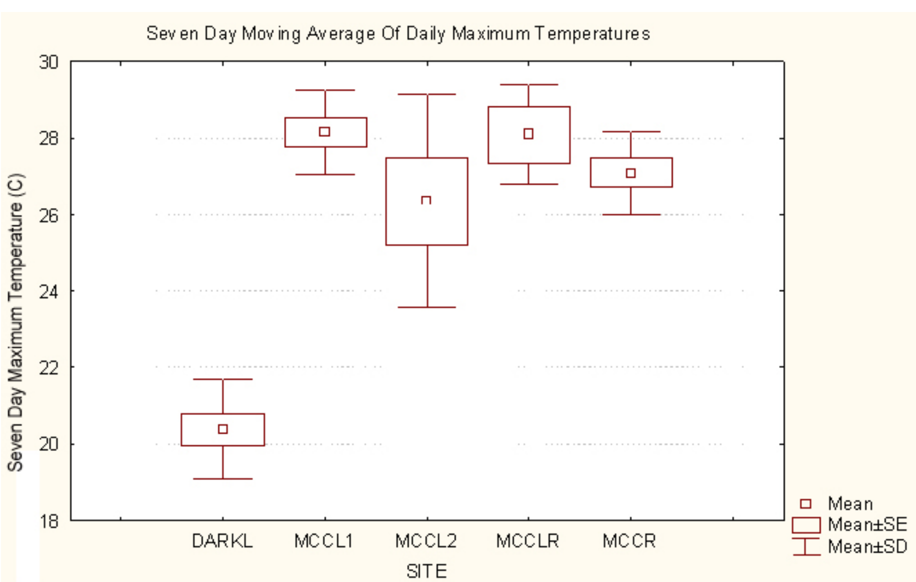

Figure 6. Mean seven day moving average of daily maximum temperature at control and treatment sites before and after restoration.

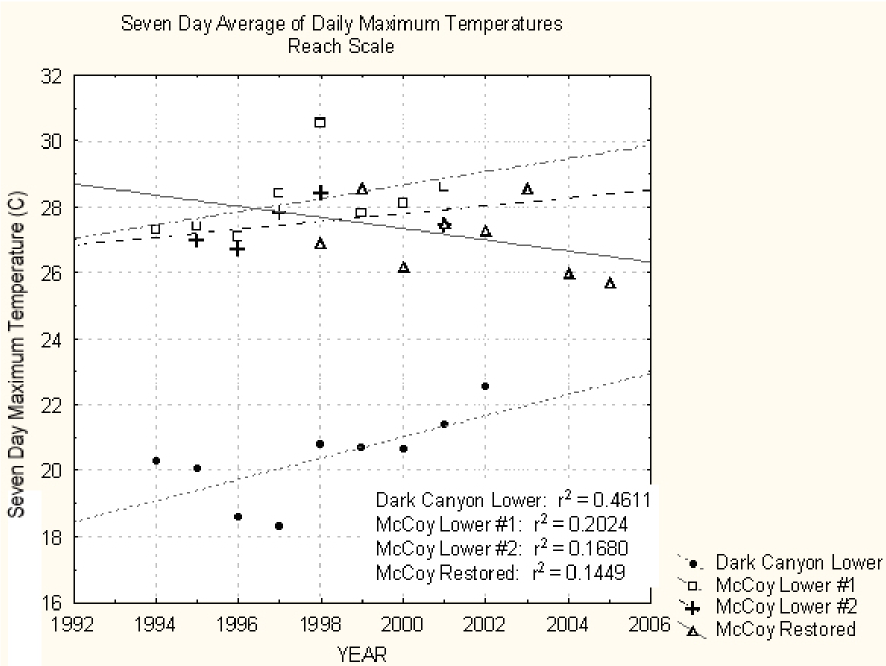

Figure 7. Seven-day average of daily maximum temperature at control and test sites over time. Temperature decreased in the McCoy Creek Restored section after diversion in 1997. During this period, temperature increased in the channelized section of lower McCoy Creek #1 and #2 and in Dark Canyon, the control site.

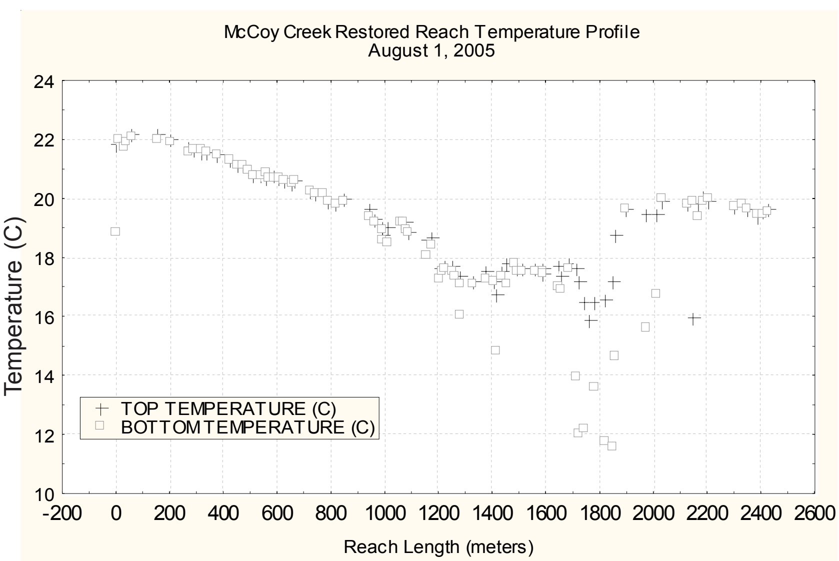

Figure 8. Longitudinal temperature profile through the entire McCoy Creek restored reach. Temperatures were measured near the surface and bottom in the deepest part of the channel at 84 intervals from the bottom to the top of the study reach. The decrease in bottom temperatures from 1300 to 2000 m probably represents an influx of colder ground water.

Fish. Pollution-tolerant and intermediate-tolerance species continued to dominate the fish assemblages in McCoy Creek even as of 2005. However, after channel restoration, trout numbers increased (Figure 9). Data show a progressive increase in the number of trout populating McCoy Creek after channel restoration, while trout numbers decreased in the control reach (Figure 10).

Conclusions

This project demonstrates that channel restoration can improve habitat and water quality for sensitive aquatic species including rainbow trout. However, recovery may not be apparent using traditional water column measurements. Channel restoration decreased stream channel slope and width-to-depth ratios, and increased sinuosity and percent pools. While water temperature did not show noticeable declines following restoration in well-mixed areas of the channel, the amount of cool water habitat associated with pools increased. Thermal stratification in pools was documented with near stream bottom water temperature three to four degrees C cooler than surface water temperature during peak summer thermal loading. Increased cool water habitat in pools provided important temperature refugia for summer rearing rainbow trout. The number of rainbow trout per stream length increased during the study period in the restored channel reaches, while trout numbers remained constant or decreased in untreated control and reference reaches.

Results from this study suggest the following conclusions:

- Livestock exclusion by itself will not result in recovery of sensitive aquatic life if stream channel conditions and habitat remain degraded.
- Restoring stream channels and improving stream habitat through channel restoration can benefit sensitive aquatic species in relatively short time frames (2-4 years).
- Water quality and aquatic life improvements may not be detected using traditional water column measurements.
- Pool habitat provides critical temperature refugia in small stream channels through critical summer rearing periods.

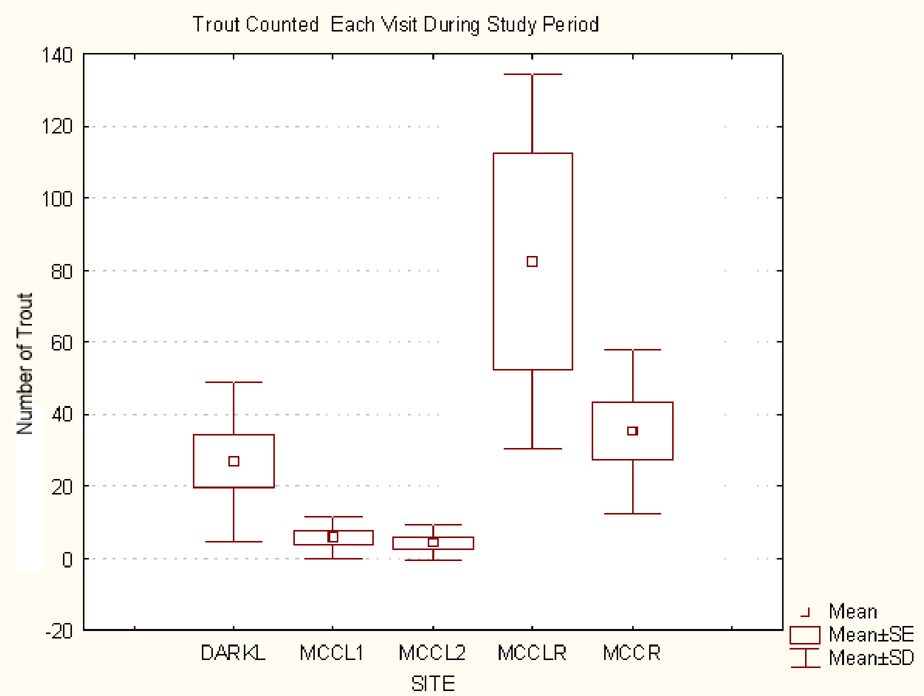

Figure 9. Mean number of trout in control and treatment sites before and after channel restoration.

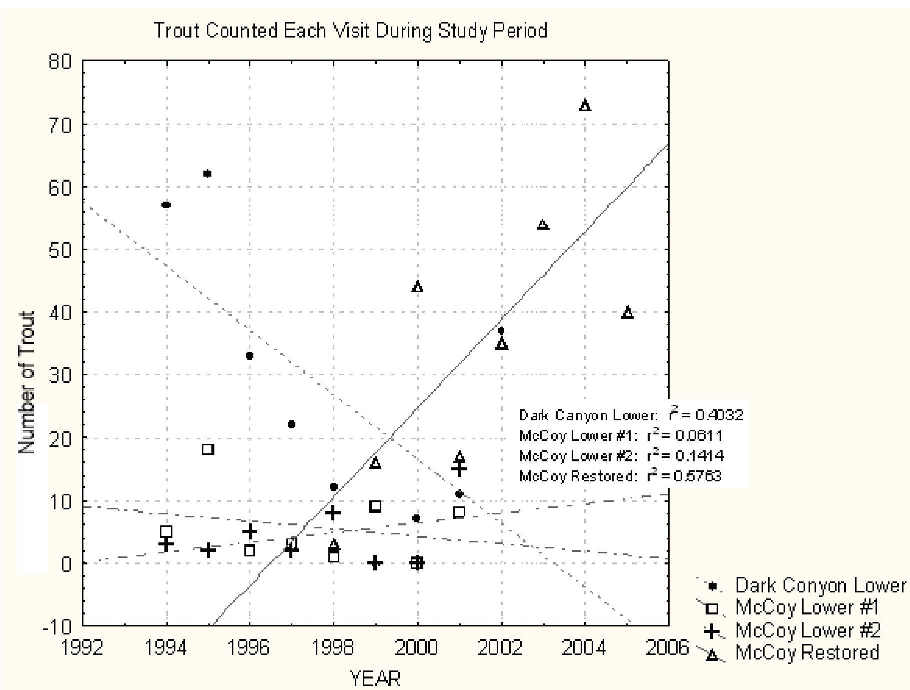

Figure 10. Number of trout in control and treatment sites before and after channel restoration in 1997. The number of trout increased in the restored section of McCoy Creek over time. The number of trout decreased in Dark Canyon (control), while there was no significant trend in the channelized section of lower McCoy Creek during this time.

For More Information

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INFORMATION

Stormwater Education and Weathercasting

Imagine a stormwater outreach and education program that reaches thousands of elevision viewers, is presented by one of the most trusted personalities in your watershed, and is free. In conjunction with the American Meteorological Society, the National Enviornmental Education and Training Foundation (NEETF) has developed the Earth Gauge program for inclusion in the nightly weather report. The job of weathercasting has evolved into a "station scientist" role as viewers demand more information on the "why" behind weather events. The Earth Gauge program is designed to not only help station scientists with the why, but to also provide viewer tips on improving the environment and watershed — one activity at a time. To see if your stormwater program can benefit, check out **http://www.earthgauge.net/index.html** or contact Sara Espinoza at Sara@neetf.org.

New Smart Growth Publication

The International City/County Management Association (ICMA) and the Smart Growth Network recently released *This Is Smart Growth*. This new publication illustrates how communities can turn their visions, values, and aspirations into reality, using smart growth techniques to improve the quality of development. Thirty-two national organizations — representing housing, environmental, community design and development, public health, transportation, local government, and other interests — have approved *This Is Smart Growth*.

The publication describes how, when done well, development can help create more economic opportunities, build great places where people want to live and visit, preserve the qualities people love about their communities, and protect environmental resources. *This Is Smart Growth* illustrates and explains smart growth concepts and outcomes, and features 40 places around the country, from cities to suburbs to small towns to rural communities, where good development has improved residents' quality of life.

Free copies are available from the EPA National Service Center for Environmental Publications at 800-490-9198 or via e-mail at ncepimal@one.net. Ask for publication number 231-K-06-002. *This Is Smart Growth* is also available electronically at **www.smartgrowth.org**.

Production of NWQEP NOTES is funded through U.S. Environmental Protection Agency (EPA) Grant No. X825012. Project Officer: Tom Davenport, Office of Wetlands, Oceans,

NCDFR Riparian and Wetland Tree Planting Pocket Guide Now Available

The North Carolina Division of Forest Resources (NCDFR) has recently released the Riparian and Wetland Tree Planting Pocket Guide. This new publication was developed by the Division's Nursery and Tree Improvement Program with assistance from the Forestry Non-Point Source Unit. The publication provides much needed guidance for successfully planting trees in riparian and wetland areas. The pocket guide's target audience are those engaged in NC's stream and wetland restoration work; however, the document can also be used by forest land owners that want to enhance forest management near water resources. While the tree species listed in the guide are most applicable to the southeastern U.S., the guidelines for planting and care are universal.

The publication can be downloaded directly from the NCDFR's web site at **http://www.dfr.state.nc.us/publications/RiparianPocketGuide.pdf**

Free copies can also be obtained by contacting the Forestry NPS Unit Staff at NCDFR Forestry NPS Unit, 1616 Mail Service Center, Raleigh, NC 27699-1616; phone: (919) 733-2162 ext. 250; email: victoria.tillotson@ncmail.net.

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WWW RESOURCES

Farmer's Guide to Agriculture and Water Quality Web Site

Many agricultural producers may not appreciate how their actions affect water quality, nor are they fully aware of what environmental requirements apply to them, what actions they can take to meet those requirements, and what incentive programs are available to them. North Carolina State University, in partnership with Ice.Nine Environmental Consulting, NC A&T State University, Cornell University, California Polytechnic University, Purdue University, University of North Carolina at Chapel Hill, US EPA Agricultural Compliance Assistance Center, and USDA-CSREES, has developed an educational resource for agricultural producers and agricultural service professionals to help them:

- Understand major nonpoint source water quality problems such as erosion and sedimentation, nutrient enrichment, and pesticide contamination;
- Assess agriculture's potential contribution to these problems, including pollutant sources and transport processes;
- Understand which environmental requirements and incentive programs affect them; and

- Learn how they can meet requirements for nonpoint source pollution control by improving farm management in a cost-effective manner.

This resource is presented in the form of a web site containing extensive information, as well as links to additional detailed information. Printable fact sheets that summarize major points are available for use in other settings. The web site is titled *A Farmers Guide to Agriculture and Water Quality Issues*, and is broken down into five major water quality focus areas:

- Erosion and sediment control;
- Nutrient management;
- Pesticides;
- Pathogens; and
- Wetlands and riparian area protection.

Within each of these focus areas, users can explore a number of issues. For example, under the Pesticide focus area, information is organized as follows:

1. Water Quality Problems Related to Pesticides
   a. What are pesticides?
   b. Types of pesticides
   c. Pesticide use in the U.S.
   d. Pesticide behavior
   e. Pesticide losses
   f. Environmental impacts of pesticides
2. What is Agriculture's Contribution to Pesticide Pollution?
3. Environmental Requirements & Incentive Programs for Pesticide Management
   a. Requirements
      i. FIFRA
      ii. Other Federal laws
      iii. State laws
      iv. Worker protection
   b. Agencies and Incentive Programs
      i. Federal
      ii. State
4. How Can Producers Meet Requirements for Pesticide Management?
   a. General principles
   b. BMPs for improved pesticide management
   c. Pesticide management practices

The website material is national in scope. Much of the content is available in Spanish, as well as English. Information providers, such as Cooperative Extension Agents and NRCS District personnel, will find the site useful for conducting outreach. Please visit the website at **http://www.cals.ncsu.edu/wq/wqp**. The site is also linked to US EPA's Agricultural Compliance Assistance Center at **http://www.epa.gov/agriculture**.

The web site's home page offers access to feedback forms where users can send comments, corrections, and questions about both the web pages and the fact sheets to staff at NCSU.

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SPECIAL ANNOUNCEMENT

Due to funding limitations, *NWQEP NOTES* will no longer be available in printed version after our March 2007 issue. The newsletters will continue to be posted to the NCSU Water Quality Group's website and will be in pdf format, which can be downloaded for printing. If you would like to be notified when future issues of *NWQEP NOTES* are posted on-line, please send an email to Cathy Smith at **cathy_smith@ncsu.edu** and you will be placed on a notification list.

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MEETINGS

Meeting Announcements — 2007

April

Emerging Issues Along Urban/Rural Interfaces: Linking Land-Use, Science, and Society: April 9-12, 2007, Atlanta, GA. Visit website: http://www.sfws.auburn.edu/urbanruralinterfaces/

National Mitigation & Conservation Banking Conference: The Next Decade of Banking: April 10-13, 2007, St. Louis, MO. Contact Carlene Bahler at 703-837-9763, or visit website at: http://www.mitigationbankingconference.com/

2nd National Conference on Ecosystem Restoration (NCER): April 22-27, 2007, Kansas City, MO. Visit conference website at: http://conference.ifas.ufl.edu/NCER2007

May

18th Annual Nonpoint Source Pollution Conference: Seeking New Solutions to Old Problems: The Nonpoint Source Program at 20 Years: May 21-23, 2007, Newport, RI. Sponsored by the New England Interstate Water Pollution Control Commission and the Rhode Island Department of Environmental Management. Visit conference website at http://www.neiwpcc.org/npsconference.

August

StormCon '07: August 20 - 23, 2007, Phoenix, AZ. Visit website at http://www.stormcon.com

August

StormCon '07: August 20 - 23, 2007, Phoenix, AZ. Visit website at http://www.stormcon.com

September

Science and Education of Land Use: A Transatlantic, Multidisciplinary and Comparative Approach: September 24-26, 2007, Washington, DC. Visit website at http://www.nercrd.psu.edu/TALUC/TALUC.html

October

WEFTEC.07: 80th Annual Technical Exhibition and Conference: October 13-17, 2007, San Diego, California. Visit website: http://www.weftec.org

15th National Nonpoint Source Monitoring Workshop

Monitoring for Decision Making
August 26-30 2007
Austin, Texas
The Driskill Hotel

Call for Papers and Posters: You are invited to submit proposals for oral and poster presentations. Presentations will be 20 minutes, followed by 10 minutes for discussion. Poster presentations are also encouraged.

Presentations should focus on one of the following session topics: Monitoring for Decision making • NPS pollution and karst aquifers • Detecting change in water quality from BMP implementation • Modeling applications for NPS pollution and control strategies • Integrating social indicators monitoring with environmental monitoring • Innovative management strategies in agriculture and urban landscapes • Nonpoint source pollution TMDLs • River restoration projects • Presenting monitoring data to the Public • Monitoring the impacts of agricultural drainage management • Monitoring the long term impact of 319 projects • Innovative monitoring in agricultural and urban landscapes • Riparian area and stream protection/restoration • Programs and approaches for animal operations and nutrient management

Instructions for Submitting Proposals: Proposals can be submitted two ways. Pick **one** of the following:

1. Submit online at: http://www.rivers.txstate.edu/NPS07/
2. Email or mail a proposal.

All proposals must include the following information: *(MS Word or Text file)*

a) Author name, affiliation, session topic the presentation will address, and preferred presentation format (oral or poster). Also include mailing address, phone, fax and email.
b) The circumstances creating the need for the project and relationship to the State/Tribal Nonpoint Source Management Program.
c) The measurable objectives of the project.
d) The project design and methods employed in: developing the project, enlisting cooperators, developing implementation programs or approaches, measuring implementation, monitoring the effectiveness of the implementation, and developing TMDLs.
e) Partnerships (public and private) supported and/or created by this project, including partner role and contribution to the project.
f) A description of how the project integrated monitoring, decision making, and implementation.
g) A discussion of results (e.g.):
    - How was monitoring data used for decision making?
    - What were the specific results?
    - Did the monitoring indicate the project goals were accomplished?
    - What management action was taken?
    - How did these changes relate to water quality monitoring results?
    - How was the model used in conjunction with the implementation?
    - How was the TMDL implemented?

Mail to:
Nonpoint Source Workshop
River System Institute
601 University Drive
San Marcos, Texas 78666
Phone (512) 245-9200; Fax (512) 245-7371
Conference Website: http://www.rivers.txstate.edu/NPS07
Deadline for submission of abstracts is **April 22, 2007.**

Review and Notification: Authors will be notified of receipt of their abstract. The workshop program committee will review abstracts. Accepted abstracts will be published in the workshop program. Authors will be notified by May 15, 2007 regarding the status of their abstract.

Questions: Chuck Dvorsky
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