

# Response of Prairie Stream Riparian Buffers to Livestock Exclusion and Short-Duration Grazing in Northeast Wyoming- A Pre- and Post- Photographic Comparison



Wyoming Game and Fish Department  
Sheridan Regional Office



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*Abstract: The Wyoming Game and Fish Department, Natural Resources Conservation Service offices in Buffalo and Sheridan and Lake DeSmet Conservation District photo monitored riparian buffer strips in Sheridan and Johnson counties of Wyoming. Eleven sites were monitored from the beginning of the project until 2006. The intent was to document changes from livestock exclusion or limitation via pre and post photographic comparisons. Reduced or no livestock grazing of riparian buffer strips had a positive affect on water quality, stream channel morphology, hydrology, riparian zone soils, instream and streambank vegetation and aquatic and riparian wildlife.*

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## INTRODUCTION

Riparian areas are lands adjacent to creeks, streams and rivers where vegetation is strongly influenced by the presence of water. According to the Wyoming Riparian Association, riparian habitats comprise less than 4 percent of Wyoming's land area and provide habitat for over 80 percent of all vertebrate species in the state. Riparian systems also provide fish habitat in the form of overhanging vegetation and undercut stream banks. Cooler water temperatures and high quality water also benefit fish populations.

Improper livestock grazing of these highly productive areas can be detrimental. Degraded riparian areas have little vegetation to protect and stabilize stream banks. This ultimately lowers water tables and the saturation zone, thus reducing summer stream flows. Wildlife and fish are greatly reduced, as well as the amount and quality of livestock forage. Other activities also affect riparian areas, such as straightening or diverting sections of the stream channel, operating vehicles or heavy equipment in riparian areas, cultivating to the edge of streams or rivers, removing beaver and allowing overpopulations of big game animals.

This project involved photomonitoring eleven prairie streams in Sheridan and Johnson counties of northeastern Wyoming, once management issues were corrected. In all cases, riparian buffers were fenced to end their extended and concentrated livestock use. Of these, two streams that had been straightened were returned to their original channels. Short duration, low intensity livestock grazing is being practiced in two buffers while nine landowners elected to participate in the continuous Conservation Reserve Program (cCRP) sign-up. The cCRP helped these livestock producers establish riparian buffers on their ranches to meet desired management goals. They worked with staff in their local Natural Resources Conservation Service (NRCS) and conservation district offices to identify suitable lands to enroll and submitted the offer to their local Farm Service Agency (FSA) office. Contracts under the cCRP sign-up are 10-15 years in length and provide cost-share and annual rental payments. To provide added economic incentives, most producers received cost-share assistance from either the Wyoming Game and Fish Department (WGFD) or U.S. Fish and Wildlife Service.

The WGFD, NRCS Buffalo and Sheridan field offices, Lake DeSmet Conservation District and landowners cooperated in this pre and post photographic comparison. Participating landowners provided a unique opportunity for resource managers to monitor and document the restoration of riparian habitats under the various management scenarios described above and in the results section. The changes have been nothing short of astonishing.

## STUDY AREA

Riparian buffers are located in northern Johnson County and western Sheridan County, Wyoming, within the Northwestern Great Plains ecoregion. Soils in these watersheds are predominantly erosive silt and clay loams. Primary land use in these watersheds is livestock grazing with some areas devoted to irrigated hayland. Precipitation ranges from 10 to 20 in (250 to 510 mm), most of which falls as spring and summer rain. Winter precipitation is snow. Climate is cold continental with dry winters and warm summers. Temperature averages 39 to 45°F (4 to 7°C). The growing season lasts 120 to 140 days.

## METHODS

The WGFD, NRCS field offices in Buffalo and Sheridan and Lake DeSmet Conservation District of northern Johnson County, photomonitoring eleven riparian buffers. The purpose was to compare conditions and document changes over time. Digital images were taken prior to or shortly after livestock were restricted from the established riparian buffers. In most cases, several pictures were captured from each photo point. This allowed subsequent photographers to align permanent features to approximate the original location within several feet. In 2006, we photographed all sites and attempted to retake the images on the same day as the originals (+/- 4 days). We used MicroImage's TNTMIPS, a raster-based geographic information system, to "reference" the "after" image to the original ("before") image. This allowed us to match the "after" image with the "before" image, in terms of the viewing area and extent. In other words, the images are almost perfectly aligned to facilitate the viewer's visual comparison.

## RESULTS

Common observations for the majority of these riparian buffer strips included:

- Point bars are now vegetated and building an alluvial terrace (floodplain).
- Incised channels are accumulating bed loads and raising the elevation of the stream.
- The channel width is decreasing and the average depth is increasing.
- Riparian zones that were once dominated by cool season herbaceous vegetation now have a warm season component. This leads us to believe that warm season grasses and forbs were once common in riparian zones along these prairie streams. While this transformation (along with new soil deposition), promotes invasive weeds (e.g Canada thistle and leafy spurge), once controlled, these native plants provide a line of defense against future weed invasion, although one exception may be Russian olive.
- Moist riparian soils are eventually dominated by taller grass and forb species. In the absence of livestock or through controlled proper grazing, these species will persist.
- When the floodplain develops a capillary fringe that's above the zone of saturation, terrestrial phreatophytic vegetation, such as willow and cottonwood species begin to establish. On point bars, the rate of deposition is greatly accelerated once woody vegetation is present.
- Desirable green-line vegetation is increasing.
- Woody vegetation is increasing (as compared to adjacent unprotected stream sections).
- Sloughing and nicked banks are quickly healing.
- Exposed soils found outside the wetted perimeter of the stream channel are rare. Exceptional flows can create sandbars that may require one or two growing seasons for vegetation to establish.
- High flow events rarely result in nicks and cut banks.
- If the stream channel is incised, drought can have a devastating affect on riparian associated shrubs and trees. Even old-growth plains cottonwoods are not exempt, if they are removed from the current channel.
- Cover and forage values for terrestrial wildlife have greatly improved.
- More vegetation is overhanging streams resulting in cooler water, better cover and more terrestrial invertebrate prey for trout.

The comparison photographs and descriptions that follow document the results and success of this program.



**Original Photo –**  
May 30, 2001.  
Clear Ck. Site 1



**Photo Retake –**  
June 1, 2006.  
Clear Ck. Site 1



**Description -** The lower portion of Clear Creek was enrolled in the FSA’s cCRP for a 15-year period. Additional financial incentives were provided by the WGFD. The landowner fenced 42 acres of riparian-forested community to exclude livestock grazing. This cottonwood/willow community also supports boxelder, chokecherry, native plum and other species generally found in wooded draws of the Northern Great Plains. Leafy spurge (*Euphorbia esula*), which is very invasive plant, was one of the dominant understory plants occurring in the original picture. The dramatic decline in leafy spurge (yellow flowered forb) is due to the landowner’s persistence in releasing and relocating flea beetles, a bio-control agent. Also notice that the point bar is developing vegetation and collecting sediment, resulting in steeper inside banks.



**Original Photo –**  
May 30, 2001.  
Clear Ck. Site 1



**Photo Retake –**  
June 1, 2006.  
Clear Ck. Site 1



**Description** – Cobble and gravel point bars were common sights along the prairie streams being photo monitored. After five years of rest, these gravel point bars became armored with herbaceous vegetation, which has the capacity to collect small amounts of sediment during high water events. As point-bars raise, a capillary fringe that's above the zone of saturation develops. At that time, terrestrial phreatophytic vegetation, such as willow and cottonwood species, begins to respond. Once woody vegetation establish, the rate of deposition greatly accelerates. Ultimately, the bars are expected to build to the elevation of the existing floodplain and narrow the stream channel.



**Original Photo –**  
May 30, 2001.  
Clear Ck. Site 1



**Photo Retake –**  
June 1, 2006.  
Clear Ck. Site 1



**Description** – Again, leafy spurge was a dominant understory plant along this riparian buffer strip in 2001, prior to releasing and relocating flea beetles. The boxelder trees (*Acer negundo*) in the background show considerable stress due to the prolonged drought. Mortality and reduced vigor were also observed in old-growth plains cottonwoods (*Populus deltoids*).



**Original Photo –**  
May 30, 2001.  
Clear Ck. Site 1



**Photo Retake –**  
June 1, 2006.  
Clear Ck. Site 1



**Description** – The gravel point bar seen in the original picture shows considerable improvement after five years of livestock exclusion. With vegetation established, the stream is protected during high water events and can filter sediments, which will further reduce the width-to-depth ratio. Once deposition occurs, there seems to be a full complement of plant species that are well adapted to occupy and secure these new soils under most hydrologic conditions. Consequently exposed soils are rarely apparent. At this site, emergent aquatic vegetation is established in the saturated soils (low spot on the point bar) and sedge and rush species are occupying soils that are periodically saturated.



**Original Photo –**  
Sept. 13, 2000.  
Clear Ck. Site 2



**Photo Retake –**  
Sept. 18, 2006.  
Clear Ck. Site 2



**Description** – Another 15-year cCRP riparian buffer strip exists upstream on Clear Creek. As with the previous cCRP, additional financial incentives were provided by the WGFD. This landowner fenced 73 acres of riparian habitat. Most of which has the potential of supporting a cottonwood/willow community. In many cases, invading noxious weeds quickly occupy exposed soils. The landowners spent considerable time and money controlling them until native vegetation could establish.



**Original Photo –**  
Sept. 13, 2000.  
Clear Ck. Site 2



**Photo Retake –**  
Sept. 18, 2006.  
Clear Ck. Site 2



**Description** – Large cobble point bars and outside meander cut banks were a common occurrence on this section of Clear Creek. Six years of livestock exclusion have allowed perennial wetland vegetation to colonize the point-bars, which continue to collect and trap sediment. Although not observable in this photo retake, woody plants are also establishing on most point-bars. In addition, a healthy riparian green-line is developing near steep cut banks (note vegetation along the outside meander). Lateral movement will eventually undercut this stabilized bench and create habitat for brown trout (*Salmo trutta*). Russian olive (*Elaeagnus angustifolia*) is also establishing.



**Original Photo** –  
Sept. 13, 2000.  
Clear Ck. Site 2



**Photo Retake** –  
Sept. 18, 2006.  
Clear Ck. Site 2



**Description** – Note the perennial vegetation that has established along the cut bank on the outside bend of the oxbow. The long-term stability of this vegetation is unknown, but it's conceivable that over time, a stable floodplain bench may develop and the angle of repose may improve along the face of the cut bank. The bench would reduce the erosive power of future high water events. Woody vegetation has also begun to establish on the point bar.



**Original Photo –**  
Sept. 13, 2000.  
Clear Ck. Site 2



**Photo Retake –**  
Sept. 18, 2006.  
Clear Ck. Site 2



**Description** –Tall, deep-rooted herbaceous vegetation is establishing within the riparian greenline on both point bars and steep cut banks. This vegetation could plausibly develop an angle of repose that further protects the streambank from erosion. As floodplain soils deepen and remain moist, tall plant species quickly dominate the community, such as basin wildrye (*Leymus cinereus*), Reed canarygrass (*Phalaris arundinacea*), prairie cord grass (*Spartina pectinata*) and common cattail (*Typha latifolia*). Unfortunately, Russian olive (*Elaeagnus angustifolia*) is also establishing where seed sources exist.



**Original Photo –**  
Sept. 26, 2003.  
Clear Ck. Site 3



**Photo Retake –**  
Sept. 18, 2006.  
Clear Ck. Site 3



**Description** – The third site on Clear Creek is a 104 acres riparian buffer strip with 54 acres qualifying for the FSA’s cCRP. Notice the two islands that are filling and connecting. As sediment accumulates in the vegetation buffer, we expect the island will connect with the floodplain and the channel width-to-depth ratio will narrow substantially. Most islands within the riparian buffer strips being monitored seem to be undergoing a similar process.



**Original Photo –  
March 2001.  
Muddy Creek**

*Photo courtesy of the  
Lake DeSmet  
Conservation District*



**First Retake –  
August, 2002.  
Muddy Creek**

The incised channel (shown in the original photo) was the consequence of the stream being straightened in the 1970's. Channel length decreased from 3,400 to 747 linear feet during this process. The straightened channel allowed the water to accelerate through the area with high erosive power. Over time, the channel was able to cut a thirteen-foot deep gully. After enrolling in the cCRP program the NRCS and WGFD worked together to return the stream to its original meandering course, thus stabilizing the degradation process. Five years after enrollment, little evidence remains to detect previous effects.

This cCRP excludes livestock grazing from approximately 30.5 acres with 19 acres qualifying for the FSA's cCRP.



**Second Retake –  
August, 2006.  
Muddy Creek**





**First Retake –**  
August 2002.  
Muddy Creek

This picture was taken shortly after the stream was returned to its original meandering channel.



**Photo Retake –**  
August, 2006.  
Muddy Creek



**Description** – The channel seen in the first retake occurred shortly after diversion-dikes returned the stream to its original meandering channel. The new water course raised the water table throughout the flood plain and restored hydrologic conditions for growing preferred riparian plant species. The channel is covered with overhanging vegetation that maintains cooler water during the summer months, thus enhancing conditions for trout. Basin wildrye is now dominating upper-terrace soils found in the floodplain.



**Original Photo –**  
July 26, 2000.  
Columbus Creek



**Photo Retake –**  
July 26, 2006.  
Columbus Creek



**Description** – Before enrolling in the FSA’s cCRP, the riparian buffer strip was in fair condition. Nevertheless, the channel remains incised. This incision has caused the water table to decline. The former floodplain has become disconnected from the channel and acts as a higher terrace, which left woody vegetation more susceptible to drought stress. This is apparent by the decadent/dead condition of boxelder, chokecherry and other trees/shrubs.



**Original Photo –**  
July 26, 2000.  
Columbus Creek



**Photo Retake –**  
July 26, 2006.  
Columbus Creek



**Description** – The foreground of the original photo shows silver sagebrush (*Artemisia cana*) mixed with grasses. The photo retake shows a higher frequency of this species. Without livestock grazing, almost all woody plants have increased in frequency and canopy cover, including both upland and riparian associated species. The one exception is attributed to the loss of trees/shrubs from drought stress.



**Original Photo –**  
July 26, 2000.  
Columbus Creek



**Photo Retake –**  
July 26, 2006.  
Columbus Creek



**Description** – Again, drought effects are clearly evident in this photo. Drought conditions from 2000 to 2006 were considered extremely dry, but conditions in 2006 appear much worse. Boxelder, chokecherry and other woody vegetation show many signs of decay. The incised channel has disconnected the stream from the floodplain and lowered the water, thus leaving woody vegetation high-and-dry. Active rehabilitation steps may be necessary to aggrade the stream channel.



**Original Photo –**  
August 11, 2000.  
French Creek

*Photo courtesy of the  
Lake DeSmet  
Conservation District*



**Photo Retake –**  
August 10, 2006.  
French Creek



**Description** – This riparian buffer strip on French Creek excludes livestock for a 10-year period. The 119 acre buffer strip provides excellent habitat for both terrestrial and aquatic species. Thick, healthy vegetation after six years of rest provides terrestrial wildlife with forage and cover. This same vegetation improves the fishery by shading the stream and stabilizing undercut bank habitat. Warm season grasses such as prairie cord grass are re-establishing along the stream. This plant does an excellent job securing stream banks.



**Original Photo –**  
August 11, 2000.  
French Creek

*Photo courtesy of the  
Lake DeSmet  
Conservation District*



**Photo Retake –**  
August 10, 2006.  
French Creek



**Description** - Once point bars recover, sediment deposition allows vegetation to encroach the channel, resulting in a narrower stream. A narrower watercourse must deepen to accommodate flows, thus increasing its capability to support fish throughout the winter months.



**Original Photo –**  
August 11, 2000.  
French Creek

*Photo courtesy of the  
Lake DeSmet  
Conservation District*



**Photo Retake –**  
August 10, 2006.  
French Creek



**Description** – The photo retake shows a water gap in the foreground with a fence-line contrast between it and the cCRP. The original photo shows an unstable oxbow. After livestock exclusion the inside and outside bends of the oxbow are vegetated, thus protecting the banks during spring runoff events.



**Original Photo –**  
April 24, 2000.  
5-mile Creek



**Photo Retake –**  
April 26, 2006.  
5-mile Creek



**Description** – This riparian buffer strip excludes livestock grazing on approximately 150 acres. The livestock exclusion contains approximately 50 acres of green ash community that qualifies for the FSA’s cCRP. In-stream vegetation is helping to narrow and deepen the channel. Also notice that slough banks and nicks are healed.



**Original Photo –**  
April 24, 2000.  
5-mile Creek



**Photo Retake –**  
April 26, 2006.  
5-mile Creek



**Description** – The channel in the original photo is incised. Unfortunately, it can take years for aggradation to restore the hydrologic condition necessary to benefit riparian vegetation, such as willows. Once willows begin to colonize, however, beaver can accelerate the rise in elevation in the bottom of the channel. Again cut banks and unvegetated scars have been filled with herbaceous vegetation. The stream is also significantly narrower.



**Original Photo –**  
April 24, 2000.  
5-mile Creek



**Photo Retake –**  
April 26, 2006.  
5-mile Creek



**Description** – The steep bank in the original photo was susceptible to erosion during high water events. Submergent vegetation that has established in the channel should continue to filter fine sediment, allowing the stream to narrow and deepen.



**Original Photo –**  
April 24, 2000.  
5-mile Creek



**Photo Retake –**  
April 26, 2006.  
5-mile Creek



**Description –** With six years of livestock exclusion, this channel is narrower and more stable. Riparian and aquatic vegetation are now collecting bed load.



**Original Photo –**  
May 10, 1999.  
Prairie Dog Creek



May 15, 2000



September 14, 2000



May 23, 2002

**Description** – The original photo shows a channelized stream before it was returned to its original watercourse, which is 300 percent longer. The May 15, 2000 picture shows the ponding affect caused by the cross-dike that was installed to return the stream to its original channel. The September 14, 2000 and May 23, 2002 pictures provide a time-lapse view of point bar development. The May 12, 2006 picture shows a dramatically higher point bar. This project was designed by the NRCS Sheridan Field Office and funded by the U.S. Fish and Wildlife, WGFD and NRCS. The project site was fenced and is managed to promote riparian vegetation via the NRCS’s Wetland Reserve Program.

**Photo Retake –**  
May 12, 2006.  
Prairie Dog Creek





**Original Photo –**  
April 1993.  
Wolf Creek



**Photo Retake –**  
April 26, 2006.  
Wolf Creek



**Description** – The owner of this property stopped using the stream as a water gap and implemented a short-duration low-intensity grazing system. This change has restored riparian habitats and allowed Wolf Creek to narrow and deepen. Flushing flows have remove silt deposits, thus improving spawning habitats for trout. Today, an excellent brown trout population exists.



**Original Photo –**  
October 2002.  
Powder River



**Photo Retake –**  
October 2006.  
Powder River



**Description** - The Powder River riparian buffer strip is approximately 644 acres of land consisting of 442 acres qualifying for the FSA's cCRP. The riparian buffer strip is only 4 years into a fifteen-year contract period. This river has a tremendous bed load and the channel undergoes substantial change from year to year. Consequently it's difficult to identify cause-and-effect mechanisms.



**Original Photo –**  
October 2002.  
Powder River



**Photo Retake –**  
October 2006.  
Powder River



**Description** – The Powder River is a very dynamic stream system. The active channel can change dramatically in a matter of hours. Salt cedar (*Tamarix ramosissima*) expansion appears to be fairly static on this cCRP. Vegetation may be establishing on the point bars and outside toe of the oxbow. Vegetation on the outside bank is not expected to remain stable, as the river is known for significant lateral movement within its floodplain.



**Original Photo –**  
October 2002.  
Powder River



**Photo Retake –**  
October 2006.  
Powder River



**Description** – The photos show laterally active channel with some point bar vegetation. Again vegetation stability is unknown due the dynamics of the Powder River.



**Original Photo –**  
May 22, 2001.  
Piney Creek

*Photo courtesy of Steady  
Stream Hydrology Inc.*



**Photo Retake –**  
May 18 2006.  
Piney Creek



**Description** – The Piney Creek cCRP riparian buffer strip is approximately 30 acres. This stream has an excellent trout population. All cobble point bars, which were once commonplace, are now vegetated. The stream has also narrowed and deepened.

After livestock were excluded, Canada thistle (*Cirsium arvense*) quickly invaded most moist soils. Once this noxious weed was controlled, a host of native warm season plants replaced it. Most notable is prairie cord grass. Needless to say, noxious weeds rarely reestablish in the presence of this competitor.



**Original Photo –**  
May 22, 2001.  
Piney Creek

*Photo courtesy of Steady  
Stream Hydrology Inc.*



**Photo Retake –**  
May 18 2006.  
Piney Creek



**Description –** This riparian buffer strip contains man-made structures to adjust the thalweg to minimize erosional forces on banks. In this case, the new technology replaced the previous owner's attempt to armor the cut bank using various materials. Even so, this section of stream is still called "Corvair" Corner.



## **CONCLUSIONS**

Pre- and post- photographic comparisons demonstrated that short-term exclusion or carefully controlled grazing of domestic livestock on prairie streams in northeast Wyoming had a positive effect on water quality, stream channel morphology, hydrology and in-stream and riparian vegetation. These practices enhanced aquatic and riparian habitat and associated fish and wildlife populations. The increased forage available will also benefit livestock and can be maintained under carefully designed and controlled grazing systems.

Overall results indicated that native vegetation increased within the riparian buffer areas, stream channel width decreased and stream depth increased within the buffer areas. This along with more overhanging vegetation resulted in cooler water temperatures, better cover and more terrestrial invertebrates for trout. Improved water storage in the riparian zone increased the green-line area and woody species such as willow and cottonwood along with herbaceous wetland species. These conditions enhanced cover and forage for wildlife and domestic livestock. Stream bank sloughing and nick points have healed and the improved stream bank provided much better protection during high flow events