Enhancing Ecosystem Resilience of Riparian/Wetland Habitats in the Upper Gunnison Basin: Phase II

Final Report
For
Upper Gunnison River Water Conservancy District

By

The Nature Conservancy and the Gunnison Climate Working Group
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Executive Summary

In September 2013, the Gunnison Climate Working Group, a public-private partnership, completed a two-year pilot climate adaptation project to enhance the resilience of riparian and wet meadow habitats within sagebrush shrublands in the Upper Gunnison Basin in Colorado. This project is part of a larger effort by the partnership working to understand the impacts of climate change on nature and people, develop social and ecological adaptation strategies, and promote coordinated action to prepare for change across jurisdictional boundaries.

Riparian areas, wetlands and wet meadows provide critical brood-rearing habitat for Gunnison Sage-grouse (*Centrocercus minimus*), proposed for listing as endangered under the Endangered Species Act. These habitats are also important for numerous other species, including neo-tropical migratory birds, elk, mule deer, and domestic livestock. Already compromised by erosion and lower water tables, these areas are likely to be further altered by drought, invasive species, and erosion from intense runoff events.

To address these challenges, the team used innovative, yet simple, restoration methods to raise the water table to support wet-loving plants and insects needed by wildlife species and livestock. Restoration expert Bill Zeedyk, Zeedyk Ecological Consulting, designed the treatments, which consisted of three types of structures: grade control, flow dispersal and headcut control. These treatments were primarily rock structures, but also included demonstration drift fences, log and fabric structures, and road repair. Youth field crews, agency partners, university and high school students, ranchers and volunteers constructed over 240 rock structures along approximately 10 stream miles on three private ranches and two public land sites managed by Bureau of Land Management and US Forest Service.

The team established a vegetation monitoring program to track ecological response, conducted geomorphological monitoring to establish baseline conditions, and installed groundwater monitoring wells to track water table changes over time. Preliminary response to the structures is promising; they are starting to capture sediments and hold/spread water, enabling riparian and wetland plants to colonize.

Team members and partners worked across agency and property lines, led volunteers to build rock structures on weekends, and worked tirelessly to implement this project. This is the type of collaboration that is needed to effectively prepare for a changing climate that has potential to significantly impact ecosystems, species and people across all political boundaries.

Our next steps are to develop materials to share techniques and best practices with other managers and ranchers and pursue the potential for scaling up the project to the basin level. In order to effectively build resilience over the long-term, it is important to create a plan for scaling up and building capacity to maintain structures, expand treatments with interested land managers/landowners, and monitor response over time.

This two-year project was funded by the Upper Gunnison River Water Conservancy District, Wildlife Conservation Society, Colorado Parks and Wildlife, Rocky Mountain Bird Observatory, US Fish and Wildlife Service - Southern Rockies Landscape Conservation Cooperative and private donors. The Colorado Parks and Wildlife, Gunnison County, Bureau of Land Management-Gunnison Field Office, Black Canyon of the Gunnison National Park, Grizzly Fence and Stone, Natural Resources Conservation Service, US Forest Service-Gunnison Ranger District, landowners and Zeedyk Ecological Consulting provided numerous in-kind contributions.

Acknowledgements

Funders and Contributors: This project could not have been completed without the generous support of the Upper Gunnison River Water Conservancy District (UGRWCD), Wildlife Conservation Society (WCS-Climate Adaptation Fund), Colorado Parks and Wildlife (CPW-Wetlands for Wildlife Program), US Fish and Wildlife Service (USFWS) Southern Rockies Landscape Conservation Cooperative (SRLCC), Rocky Mountain Bird Observatory (RMBO), and private donors. Special thanks to the Gunnison County, Gunnison Field Office of Bureau of Land Management (BLM), Colorado Parks and Wildlife (CPW), Black Canyon of the Gunnison National Park (NPS), Gunnison Ranger District-US Forest Service (USFS), Grizzly Fence and Stone, Zeedyk Ecological Consulting, LLC, and Natural Resources Conservation Service (NRCS) for contributing significant in-kind services. We also thank Frank Kugel and John McClow for continued support and for providing meeting space.

Project Team: The Project Team members include Gay Austin and Andrew Breibart-BLM-Gunnison Field Office, Renée Rondeau-Colorado Natural Heritage Program (CNHP), Nathan Seward-CPW, Jim Cochran-Gunnison County, Ken Stahlnecker-NPS, Liz With and Christina Santana-NRCS, Betsy Neely, Chris Pague and Jamie Robertson-The Nature Conservancy (TNC), Matt Vasquez and Ben Stratton-USFS, Jonathan Coop and Pat Magee-WSCU, and Bill Zeedyk-Zeedyk Ecological Consulting. John Scott-NRCS, a founding member of the GCWG, helped to launch this project before he retired.

Team members provided a number of in-kind services and contributed long hours in project planning, providing local knowledge and expertise, completing NEPA requirements, working with landowners/ranchers, delineating wetlands and writing permit applications to the US Army Corps of Engineers (USACE), sourcing and staging rock, overseeing field crews, building rock structures, cutting and hauling aspen logs, monitoring vegetation, recruiting volunteers for work days, organizing/leading field trips, providing housing for field crews, presenting the project at meetings, and reviewing and sponsoring grant proposals. A few highlights of team contributions are listed below.

Jim Cochran, Nathan Seward and Liz With recruited ranchers and landowners to participate in the project. Nathan Seward provided technical expertise, recruited volunteers, served as crew leader on work days, and organized a panel on the project at the Colorado Chapter of the Wildlife Society. Bill Zeedyk designed all the restoration treatments and provided technical oversight during construction. Andrew Breibart, Gay Austin, Matt Vasquez and Ben Stratton planned and implemented work on BLM and USFS lands, completed NEPA requirements, and supervised field crews in staging rock and building structures. Andrew Breibart also installed groundwater wells. Matt Vasquez organized the harvesting and transport of aspen logs for structures on USFS lands. Gay Austin completed the wetland delineation and application permit for BLM lands and conducted vegetation monitoring. Jonathan Coop and Pat Magee recruited their classes from WSCU to build rock structures, assisted in grant review, field trips, presentations, and/or setting up time lapse cameras with students.

Jim Cochran, Nathan Seward, Matt Vasquez and Bill Zeedyk developed the drift fence specifications. Ken Stahlnecker provided housing for field crews. Christina Santana secured funding for rock supplies and Christina and Liz With organized field trips for stakeholders and other outreach activities. Jamie Robertson and Teresa Chapman-TNC, developed data analyses and maps, Renée Rondeau, CNHP, led the vegetation monitoring, with Gay Austin, BLM and Susie Parker, USFS. Steve Vrooman, Keystone Restoration Ecology, conducted baseline geomorphological monitoring. Claudia Strijek, WSCU, developed a short video about the project. Luann Rudolph-TNC tracked budgets, grants and contracts. John Sanderson and Missy Davis, TNC, assisted with fund-raising proposals. Terri Schulz and Chris Pague provided scientific technical support for this project. Imtiaz Rangwala, Western Water Assessment provided climate data and interpretation. Patrick McCarthy, TNC (former Director of the Southwest Climate Change Initiative), provided early guidance and leadership on this project.

Landowners: Working with willing landowners and ranchers has been essential to the success of this project. We particularly thank Brett Redden, Rufus Wilderson, and Ted Harter (Moncrief Ranch Manager) for their collaboration on this project; they have been very patient, supportive and cooperative with planning, permitting, staging materials, building rock structures with crews and volunteers, monitoring visits, as well as assisting with field trips. They have also played an active and important role in outreach and communication related to the project.

Field Crews: The Western Colorado Conservation Corps (WCCC), TNC's Southern Rockies Wildland Fire Use Module, USFS Youth Conservation Corps (YCC), CPW, and students from WSCU, staged rock and/or built the large number of structures over the two-year period. WSCU professors also actively engaged their students in work days, monitoring, and installing time lapse cameras.

Volunteers: Gunnison High School students, Gunnison Basin Sage-grouse Strategic Committee, High Country Citizens Alliance, ranchers, landowners, Project Team members, BLM, USFS, CPW, Claudia Strijek, Andrew Arell, Michele Parenti, Sue Navy and many others too numerous to list here also contributed their time to help build rock structures.

Contractors: We appreciate the hard work of our contractors: 1) Renée Rondeau, CNHP, provided ecological expertise throughout the project, field evaluations of the sites, conceptual ecological model, GPS mapping of structures, vegetation monitoring and permanent photos; 2) Bill Zeedyk, Zeedyk Ecological Consulting, provided the restoration expertise, treatment design and technical oversight of field crews, and initial geomorphological monitoring; 3) Tim Lapello and Lynn Cudlip, BioEnvirons, conducted the wetland delineations and permit applications to the USACE; 4) Warren Wilcox, Gunnison Gravel and Earthmoving, provided rock supplies, hauling, road repair and construction of low-water crossings; 5) Spencer Gordon, Grizzly Fence and Stone, constructed the demonstration drift fences; 6) Steve Vrooman, Keystone Restoration Ecology, completed the geomorphological monitoring; and 7) Matt Jennings and Sam Parks, WCCC, led the field crew in staging and building rock structures.

Gunnison Climate Working Group: We thank all the members of the GCWG for your vision and support of this project: BLM-Gunnison Field Office, CNHP; CPW, Gunnison County, Gunnison County Stockgrowers Association, Lake Fork Valley Conservancy (LFVC), National Center for Atmospheric Research (NCAR), NPS, NRCS, Rocky Mountain Biological Lab (RMBL), TNC, Trout Unlimited (TU), UGRWCD, USFWS, USFS, WSCU, and Western Water Assessment (WWA).

Finally, we also thank Carrie Sheata, US Army Corps of Engineers (USACE), for assistance with permitting for this project.

Final Report: By Betsy Neely, TNC. Thanks to reviewers including Andrew Breibart, Teresa Chapman, Jim Cochran, Nathan Seward, Renée Rondeau, and Bill Zeedyk.

Cover photograph credits: clockwise from upper left: 1) Betsy Neely-WCCC field crew and BLM staff building Zuni Bowl at Lower Wolf Creek-BLM; 2) Andrew Breibart-WCCC field crew completes Media Luna at Upper Wolf-BLM; 3) Claudia Strijek-volunteers building Media Luna at Wolf Creek Ranch/Kaichen State Habitat Area; 4) Betsy Neely-USFS staff complete One Rock Dam at West Flat Top-USFS.

Introduction and Background

The climate of the Southwestern United States is warming and is projected to get warmer in the coming decades. Colorado is experiencing larger and more severe wildfires, prolonged drought, earlier snowmelt, high tree mortality, increases in dust events, and changes in phenology (timing of plant and animal life cycle events, e.g., flowering). Climate scientists predict more summer heat waves, decreasing late-season snowpack, declines in river flow and soil moisture, and longer and more frequent droughts (Rangwala, personal communication; Overpeck et al. 2013). These changes put people, plants, animals and their habitats at risk.

Wet meadow and streamside habitats are critical for brood-rearing of the Gunnison Sage-grouse, one of the rarest bird species in North America and proposed for Federal listing as endangered. These habitats are also important for other wildlife species such as neo-tropical migratory birds, elk, deer, as well as domestic livestock. Already compromised by erosion and low water tables, these areas will likely be further altered due to drought, erosion from high intensity runoff events, and/or shifting of habitat to higher elevations associated with a changing climate, resulting in the decrease of food production and chick survival. Through strategic restoration, we are working to reduce the adverse effects of climate change on the grouse, other wildlife species, and ranchers' livelihoods.

Gunnison Climate Working Group: This report summarizes the results of a two-year climate adaptation project of the Gunnison Climate Working Group (GCWG)[1], a public-private partnership working to reduce the impacts of climate change on nature and people in the Upper Gunnison Basin. The group's goals are to: 1) increase understanding and awareness of threats posed by climate change to species, ecosystems and the benefits that nature provides to the people of Gunnison Basin; 2) identify and prioritize strategies and techniques for helping people and nature cope with climate change; and 3) promote coordination, collaboration and effective implementation of climate change adaptation strategies. The Gunnison Basin is one of four pilot adaptation projects of the Southwest Climate Change Initiative, a broader partnership effort working to build capacity among natural resource managers for understanding and responding to climate change.

Goals: The overall goals of this collaborative project were to:

1. Complete design of an on-the-ground climate adaptation project;
2. Restore and enhance the resilience of at least 500-800 acres of priority Gunnison Sage-grouse brood-rearing habitat to enhance the adaptive capacity of the grouse and other wildlife species;
3. Establish a repeatable and economical monitoring program to measure vegetation/species response;
4. Share tools and methods with others working to restore impaired watersheds and/or conserve vulnerable riparian areas within sagebrush shrublands to help bolster climate adaptation efforts.

Methods: The Project Team, a subset of the Working Group, prioritized 12 sites for treatment, evaluated nine sites in the field, and selected four sites that met the desired conditions. Bill Zeedyk, author of *Let the Water Do the Work: Induced Meandering, an Evolving Method for Restoring Incised Channels* (2012) designed all the restoration treatments. The team then developed and implemented work plans to prepare for installation of structures. The team working with field crews, volunteers, ranchers and agency partners, constructed 243 restoration structures to increase stream functionality and therefore enhance resilience on three private ranches and two public lands sites: BLM and USFS in the Upper Gunnison Basin. Treatments consisted primarily of grade control structures, flow dispersal structures and headcut control structures. See below for details. The team established 67 transects and 80 permanent photo-

[1] Gunnison Climate Working Group Members: Bureau of Land Management-Gunnison Field Office, Colorado Natural Heritage Program; Colorado Parks & Wildlife, Gunnison County, Gunnison County Stockgrowers Association, Lake Fork Valley Conservancy, National Center for Atmospheric Research, National Park Service, Natural Resources Conservation Service, Rocky Mountain Biological Lab, The Nature Conservancy, Trout Unlimited, Upper Gunnison River Water Conservancy District, US Fish & Wildlife Service, US Forest Service, Western State Colorado University, and Western Water Assessment.

points to track vegetation response, established baseline geomorphological monitoring to track changes in sediment deposition, and shared methods and results with others working to conserve the Gunnison Sage-grouse, other wildlife species, and similar ecosystems range-wide.

Resilience: By definition, resilience is the capacity of a system to absorb impacts without changing states or the ability of the system to recover from primary stresses or disturbances (Glick et al. 2011; Zavaleta and Chapin 2010; Seavy et al 2009). For the purposes of this project, we focused on increasing resilience of wet meadow/riparian systems to help them cope with projected impacts of increased intensity and frequency of droughts and flooding associated with climate change. Key attributes of resilient wet meadow/riparian systems are: 1) a properly functioning hydrology; 2) a stream channel that is connected to its floodplain; 3) stream banks that retain moisture and reduce erosion during flood events; and 4) a native and diverse wetland species composition. By reducing existing stressors to the areas such as channel incision (process of down-cutting in a stream channel leading to a decrease in channel bed elevation and can lead to further head-cutting that migrates upstream), accelerated erosion and livestock trailing, we aimed to increase the water storage from surface water flows and raise water tables. Improving the overall function of the system and health of the riparian vegetation will help the system adapt to projected impacts of climate change.

Specific Objectives: To enhance ecosystem resilience of wet meadow/riparian systems in the Upper Gunnison Basin, our specific objectives were to:

1. Disperse flows more widely across floodplain surfaces to maximize infiltration and increase bank storage during flood events;
2. Stabilize eroded wet meadow soils to control head-cutting and reduce gully expansion thereby retaining bank storage and extending base flows.
3. Expand the size, extent and distribution of riparian/wetland sites in response to objectives #1 and #2.
4. Increase health, vigor and density of riparian/wetland vegetation, such as native sedges, rushes, wet-loving grasses and forbs.

Summary of Accomplishments

Over the past two years, the Project Team selected and field-evaluated priority restoration sites, designed restoration treatments, established vegetation monitoring transects and permanent photo-points (and reread 2012 monitoring transects at Redden Ranch and Wolf Creek Ranch), conducted baseline geomorphological monitoring, and completed construction of a total of 243 restoration structures at three private and two public land sites[2] in the Upper Gunnison Basin. In 2013, the team also repaired/augmented key structures built in 2012 at Wolf Creek Ranch. The team enlisted the help of field crews (Western Colorado Conservation Corps, Youth Conservation Corps, and the Conservancy's Southern Rockies Wildland Fire Module), along with volunteers, university students, and partners.

Sites and number of installed structures are listed below (See Maps in Appendix A for details):

1. Redden Ranch (55 rock structures)
2. West Flat Top at Henkel Road USFS (85 rock structures, including 2 livestock drift fences and 2 log and fabric structure in Section 36 and a fenced exclosure)
3. Wolf Creek Ranch/Kaichen State Habitat Area (57 rock structures along Middle Fork and East Fork of Wolf Creek)
4. Wolf Creek BLM (43 rock structures along the West Fork, Upper Fork and Lower Fork of Wolf Creek)
5. Kezar Basin: Moncrief Ranch (3 livestock drift fences)

[2] Note: The Wolf Creek restoration site consists of both private (Wolf Creek Ranch) and Gunnison Field Office, BLM lands. Although adjacent and within the same restoration site, they were treated separately due the differences in landownership.

Goals and Outcomes

1. ***Complete design of an on-the-ground climate adaptation project including finalizing a basin-wide vulnerability assessment, developing a conceptual model, and mapping and prioritizing areas for habitat restoration and reconnection.***

Site Selection and Prioritization: The Gunnison Basin Climate Vulnerability Assessment (Neely et al. 2011) identified the Gunnison Sage-grouse and its brood-rearing habitat as highly vulnerable to climate change. The GCWG determined the need to focus on enhancing the resilience of brood-rearing habitat as a key climate adaptation strategy. The Project Team conducted a site selection analysis to identify priority sites for treatment by:

a. Developing spatial units of priority brood-rearing habitat sites based on the Gunnison Basin Sage-grouse Strategic Committee's Gunnison Sage-grouse Habitat Prioritization Tool (2012);
b. Filtering sites by climate-related and habitat factors including elevation above 8,000 ft., baseline sagebrush ecosystem performance, predicted high sagebrush productivity by 2050 (Wylie and Rigge 2012; Rigge et al. 2012), proximity to Gunnison Sage-grouse lek(s), and habitat size;
c. Filtering sites by feasibility factors, e.g., NEPA status, landownership, willing landowner, accessibility, and restoration need;
d. Reviewing local knowledge;
e. Conducting field evaluation; and
f. Selecting final sites for treatment.

After narrowing the list of 30 potential sites to 13 priority sites, the team conducted site evaluations and focused on two private ranches during the first year and two public lands and one private ranch during the second year.

Conceptual Ecological Model: Renée Rondeau, CNHP, incorporated projected climate change drivers, such as increased intensity and frequency of drought and reduced snowpack, into the existing conceptual ecological model for Gunnison Sage-grouse developed at the Gunnison Basin Climate Adaptation Workshop for Natural Resource Managers in 2009 (Neely et al. 2010) and the Gunnison Sage-grouse Range-wide Conservation Plan (Gunnison Sage-grouse Steering Committee 2005). This model provides context for how projected climate change will likely impact Gunnison Sage-grouse populations and their brood-rearing habitat.

Site Design and Treatments: Bill Zeedyk, Zeedyk Ecological Consulting LLC, and co-author of *Let the Water do the Work: Induced Meandering, an Evolving Method for Restoring Incised Channels* (2012) designed restoration treatments for the priority restoration sites, including mapping and staking locations for structures, setting stream reach objectives, and estimating rock supplies needed. Treatments included grade control structures (one rock dams, log mats, and low water crossings), flow dispersal structures (media lunas, low water crossings and drift fences) and headcut control structures (Zuni bowls, rock rundowns, laybacks and log and fabric structures). See Appendix B for figures of restoration structures used in this project.

Bill Zeedyk and the team wanted to showcase the drift fence, another technique to help restore and build resilience of wet meadows within the sagebrush ecosystem. Drift fences have been used effectively in other areas to disperse water flows across floodplains. A line of fence, positioned perpendicular to the stream channel, is intended to alter big game and cattle movements and help reduce trailing without reducing access to forage. The team developed several different designs in order to evaluate construction and maintenance costs, effectiveness, and longevity over time, in addition to evaluating the effectiveness of this type of drift fence in restoring wet meadows/riparian areas. Spencer Gordon, Grizzly Fence and Stone, constructed the drift fences at Moncrief Ranch and West Flat Top. See Appendix C for the drift fence specifications.

Private Landowner Agreements: Team members met with ranchers, landowners and ranch managers of the three private ranches to explore opportunities to work together, obtain permission to construct restoration structures, and develop landowner agreements. Where land was under conservation easement, landowners contacted conservation easement holders and cooperators to ensure their permission to implement the project.

Wetlands Delineation and Permits: Bio-Environs LLC, an ecological consulting firm, completed the wetland delineations and permit applications to the US Army Corps of Engineers (USACOE) for two private ranch sites. The Redden Ranch activities qualified for a Nationwide General Permit #18 because wetlands were not identified in the project area. The Wolf Creek activities required an application for a Nationwide General Permit #27 which was authorized and required post-construction documentation in 2013. The drift fences at Moncrief Ranch did not require permit applications. BLM completed the wetland delineation and permit application for the BLM lands at Wolf Creek; BLM activities qualified for a Nationwide General Permit #27. The USFS determined that a 404 permit was not needed for the West Flat Top activities since the proposed restoration sites are not perennial waters of the United States or wetlands. All treatment areas are currently intermittent and ephemeral drainages and their impaired, eroded, and dewatered riparian zones are not applicable under 404 permitting provisions of the Clean Water Act.

Materials and Supplies: Gunnison Gravel and Earthmoving, LLC, provided and transported local rock materials for most of the restoration structures, created two low-water crossings, and completed minor road repair. Field crews assisted in staging rock near rock structure locations. Where local collection of rock was needed due to difficult access, the team developed best practices to ensure minimal impact on the landscape and the Sage-grouse, e.g., collect only 10% of local rock in any one area, collect rock along existing roadsides, and no collection in areas with existing signs of grouse use. The USFS cut and hauled local aspen logs for the log and fabric structures at the West Flat Top exclosure. Grizzly Fence and Stone Inc. provided all fencing materials for the demonstration drift fences.

NEPA: Both BLM and USFS completed necessary NEPA requirements during the design and planning phase for this project. This work involved archaeological and wildlife clearances, documentation of proposed work, and public scoping.

2. Restore and enhance resilience of at least 500-800 acres of priority brood-rearing habitat –wetland and riparian areas within sagebrush shrublands -- in at least three locations to enhance the adaptive capacity of the imperiled Gunnison Sage-grouse and other wildlife species.

2012: The Project Team constructed 109 rock structures over 4.2 stream miles at two private ranches: Redden Ranch and Wolf Creek Ranch over nine days from September to November. A total of 140 people, including representatives from BLM-Gunnison Field Office, CPW, Project Team partners, landowners, local volunteers, and students and staff from WSCU and Gunnison High School, participated in the work days with TNC's Southern Rockies Wildland Fire Use Module. The team also identified Moncrief Ranch for potential treatment and began planning demonstration drift fences, a tool to reduce livestock and wildlife trailing to help build resilience of degraded wet meadows.

2013: The Project Team completed 134 rock structures over 6.0 stream miles at Wolf Creek, West Flat Top at Henkel Road, and Moncrief Ranch over 22 days from July to September, with three field crews: Western Colorado Conservation Corps (WCCC-4 weeks), TNC's field crew (one week), and the USFS Youth Conservation Corps (YCC) to stage rock and build rock structures. Volunteers participating in work days included representatives from Backcountry Hunters and Anglers, BLM, CPW, Colorado State University, University of Colorado, Crested Butte Land Trust, Gunnison Basin Sage-grouse Strategic Committee, High Country Citizen's Alliance, National Park Service (NPS), TNC, WSCU professors and students, and the local community. A total of 328 people participated in work days during the 2013 field

season. Grizzly Fence and Stone completed a total of five demonstration livestock drift fences at West Flat Top and Moncrief Ranch.

Technical Oversight: Bill Zeedyk provided technical oversight during the work days, with assistance by Nate Seward of CPW on private lands, Andrew Breibart and Gay Austin on BLM lands, and Matt Vasquez on USFS lands. Breibart and Vasquez supervised the WCCC and USFS YCC in staging rock and building rock structures.

Total Acres Benefited: Our estimate of restored habitat includes wet meadows, riparian areas and surrounding sagebrush shrubland on side slopes, critical for Sage-grouse conservation success and likely to benefit from the restoration structures. Wet meadows vary in topography and size, and the area restored is likely to increase as the structures store more water over time.

To address these complexities, the team developed a simple model of buffering riparian areas and streams to varying distances to estimate the restored/enhanced acres based on guidelines in the Gunnison Sage-grouse Conservation Plan (1997), Connelly et al. (2000), Gunnison Sage-grouse Range-wide Conservation Plan (2005), and Gunnison Sage-grouse Habitat Prioritization Tool (2012). See Table 1 below.

The wet meadow/riparian habitat was delineated by combining the CPW Riparian and Wetland Mapping Data GIS polygons (http://ndis.nrel.colostate.edu/ftp/index.html) with a buffered stream centerline. CPW riparian boundaries were mapped by photo-interpretation of 1998-1999 National Aerial Photography Program (NAPP) 1m resolution imagery with color and near infrared bands at a scale of 1:24,000. Riparian areas measuring less than 25 meters (75 ft.) in width were not recorded as polygons in the CPW Riparian data. Therefore, we digitized stream centerlines using Google Earth 1meter aerial imagery and buffered these centerlines to an average 3 meter width based off visual estimation of riparian vegetation from the stream.

CPW riparian polygons within 50 meters (150 ft.) of the stream centerlines were selected. The buffered stream centerlines were merged with the selected CPW riparian polygons to create a riparian habitat that ranged from 3 meters to 50 meters in width. This riparian habitat was buffered by 220 meters (660 ft.) in order to delineate the area of total sage grouse brood-rearing habitat affected. Please note: methods and results presented here are updated from the Wildlife Conservation Society report (September 2013). In this revised analysis, we did not use buffered areas (75 or 150 ft.) to estimate riparian areas.

The team estimates that the treatments enhanced a total of 10.2 stream miles and 21.8 wetland acres across the four sites. The team estimates that the project also enhanced approximately 689.3 acres of upland Gunnison Sage-grouse habitat, resulting in a total of 711.1 acres of both wetland and nearby sagebrush habitat. Originally, the team set out to restore over 500 wetland acres within this two-year project. We elected to treat higher elevation sites with smaller streams and narrower floodplains based on the premise that the Sage-grouse is expected to shift to higher elevations in response to climate change. Additionally, the team focused on the demonstration aspect of this project, resulting in lower wetland acreage restored than initially planned.

Table 1. Summary of restored stream length, estimates of restored/enhanced wet meadow area, and estimates of surrounding Gunnison Sage-grouse habitat restored, and estimates of total restored area over this two-year project at four restoration sites in the Upper Gunnison Basin.

Site	Restored Stream Length Miles	Restored Wet Meadow Habitat Acres	Restored Gunnison Sage-grouse Habitat Acres (660ft buffer) Acres	Total Restored Estimate Acres
Redden Ranch	1.2	1.0	77.3	78.3
Wolf Creek Ranch and BLM	6.1 (3.1 BLM; 3 private)	9.4	399.4	415.3
West Flat Top at Henkel Rd	2.6	4.2	164.8	169.0
Moncrief Ranch at Kezar Basin	0.3	0.7	47.7	48.4
Totals	10.2	21.8	689.3	711.1

3. Establish a repeatable and economical monitoring program to measure vegetation/species response.

Vegetation Monitoring: Renée Rondeau, CNHP, in collaboration with BLM, TNC, USFS and WSCU, designed the vegetation monitoring program to evaluate progress towards objectives. The management objectives were to: 1) increase the average cover and density of native sedges, rushes, willows and wetland forbs in the restored portion of the sites between 2012 and 2014; and 2) decrease the average cover of rabbitbrush, sagebrush and other upland species in the restored portion of the sites between 2012 and 2014. Rondeau's team established a total of 67 transects and 80 photo-points using a stratified random sample design to measure cover, density and height of wetland plant species at four of the five restoration sites. In 2012, the team established transects and photo-points at Redden Ranch and Wolf Creek Ranch. In 2013, the team reread the 2012 transects and photo-points, and established new monitoring transects and photo-points on Wolf Creek BLM lands and West Flat Top USFS lands. See Appendix D for details.

Geomorphological Monitoring: Bill Zeedyk (with BLM, USFS and TNC) and Steve Vrooman, Keystone Restoration Ecology, conducted baseline geomorphological monitoring (i.e., longitudinal profiles and cross-sections) of stream channels to track sediment deposition in response to the structures over time at Wolf Creek Ranch, Wolf Creek BLM, Redden Ranch and West Flat Top on USFS lands. See Appendix E for details.

Groundwater Monitoring: Andrew Breibart, BLM, installed a total of nine groundwater wells to monitor changes in water table over time on BLM lands at Wolf Creek (six) and on Wolf Creek Ranch (two). Groundwater monitoring wells were established across a horizontal transect within meadows away from

the stream channel to determine the extent of change in water tables within the re-watered riparian/wetland ecosystems. A ninth well was installed in Chance Gulch, another priority site, where the BLM will be doing restoration with grant funds from Rocky Mountain Elk Foundation and matching funds from CPW in 2014.

Time-lapse Photography Monitoring: Jonathan Coop, WSCU Assistant Professor of Environmental Studies and Biology, installed two time-lapse cameras in September 2013 to capture the long-term ecological changes from the rock structures at the Lower Wolf Creek site on BLM lands.

4. Share tools, methods and findings with other groups working to conserve vulnerable wetlands/sagebrush and populations of the Gunnison Sage-grouse they support, in similar ecosystems across the West to help bolster their climate adaptation efforts.

Trainings: In September 2012, restoration expert Bill Zeedyk led a half-day hands-on training on building rock structures to kick off the first field season at Redden Ranch for 22 participants, including ranchers and representatives from ten organizations, agencies and colleges.

In July 2013, Bill Zeedyk, with help from team members, led a one-day training, consisting of one-half day lecture and half-day hands-on training at Wolf Creek, to kick-off the second field season for over 40 participants, including representatives from 18 different local, regional and federal agencies, organizations, and colleges.

Field Trips: The Project Team led a field trip for the Gunnison Basin Sage-grouse Strategic Committee to Wolf Creek Ranch and Redden Ranch in September 2012. Representatives participated from the CPW, Gunnison County, Poncha Pass Gunnison Sage-grouse Working Group, US Fish and Wildlife Service, NPS, WSCU and the local community.

The Project Team, in collaboration with rancher Brett Redden, presented the project and led a field trip to the Redden Ranch at the Colorado Headwaters Conference at WSCU in September 2012.

The Project Team, organized by Liz With, led a field tour to Wolf Creek Ranch for the Gunnison-Dolores Rivers Annual Watershed Meeting in August 2013 organized by NRCS with the Gunnison Conservation District, for private landowners, ranchers and other representatives from Delta, Gunnison, San Miguel and Shavano Districts.

Video: Claudia Strijek, WSCU student, produced a short video about the project for TNC and the GCWG (December 2012).

Presentations: CPW organized a panel with TNC, BLM, landowner Brett Redden, USFS and WSCU, at the Colorado Chapter of the Wildlife Society annual meeting in February 2013.

Project Team members Nathan Seward, CPW, and Andrew Breibart, BLM, presented the project at WSCU in April 2013.

TNC presented the project to the USFS Mountain Climate Meeting (October 2012), Southern Rockies LCC Steering Committee (November 2012), GCWG (December 2012), Gunnison Sage-grouse Festival (April 2013), National Adaptation Forum (April 2013), and the Southern Rockies LCC (Webinar-August 2013).

Results, Conservation Impacts and Climate Adaptation

The GCWG developed this demonstration project to help the imperiled Gunnison Sage-grouse and other wildlife species adapt to a changing climate by restoring and increasing resilience of wet meadow habitats within sagebrush shrublands. Many of these wet meadows, important brood-rearing habitat for the Sage-grouse, are already degraded, and thus considered to be an annual cycle bottleneck for the grouse. These wet meadows also provide important habitat for a number of other species, e.g., ungulates such as deer and elk, neo-tropical migratory birds, and domestic livestock. The team chose to monitor native plant growth as a measure of conservation impacts to the treatments, as monitoring grouse and other wildlife species is labor intensive and time-consuming.

While it will take a number of years to fully understand the conservation impacts of this two-year project, preliminary conservation impacts based on the vegetation transects and repeat photography are encouraging. At Redden Ranch, the rock structures built in the fall of 2012 are already capturing sediments allowing plants to colonize. At Wolf Creek Ranch, the rock structures built in the fall of 2012 have already spread water across the wet meadow. Wetland plant species composition significantly increased between 2012 and 2013 at two of the three stream reaches treated in 2012; there is a high probability that this is a largely a result of the structures rather than the precipitation. Additionally, we observed mortality of invasive species such as Canada thistle and musk thistle, and decadence of native species such as sagebrush and shrubby cinquefoil. See Appendix D for details and photographs.

The Wolf Creek Ranch (East Fork), where there are two active springs, demonstrated the largest changes of any of the sites. There were no significant differences between the treated and control areas when we analyzed the height and density plant data except for the forbs at East Fork of Wolf Creek. We expect this is due to the spring-fed nature of the creek and that given enough time, we may see the same response at the other sites. Given that the structures have been in place just under one year, we find the preliminary positive conservation impacts promising and we expect this trend to continue and the changes to become more distinct over the next few years.

Lower monthly and annual precipitation fell in 2012 than 2013. The higher rainfall in 2013 undoubtedly assisted with the rate of restoration observed at many of the structures. At the same time, there has been ample evidence that the structures aided the restoration process more than the additional precipitation. This evidence is seen by comparing the control sites to the treated areas as well as reviewing the repeat photographs; the repeat photography backs up the data analysis. For example, many of the repeat photographs of the treated sites displayed increases in sediments behind the structures, especially at Redden Ranch and on the East Fork of Wolf Creek; whereas the control photo-points did not detect any additional sediment loading or significant changes in the vegetation cover.

The team moved one road out of the upper wet meadow at Wolf Creek Ranch onto the adjacent sagebrush shrubland upland. This will help to restore the wetland over time. Initial observations of one of the two low water crossings at Wolf Creek (on private and BLM lands) indicate that the structure, constructed in September 2013, is already dispersing water flow across the meadow. This emphasizes the importance of properly modifying low standard rural roads to help achieve wetland restoration objectives (Zeedyk 2006).

Outreach Activities

We have used several communication methods, including video, fact sheets, website, presentations at conferences and meetings, field trips, media and press releases, trainings and reports. Our most important audiences include land and water management agencies (BLM, UGRWCD, USFS, and NRCS), county governments, and ranchers and landowners. Interestingly, while we have done a large amount of outreach and communication about this project, the cost of these activities has been minimal due to in-kind

donations and the electronic nature (vs. printed) of our presentations and reports. See Appendix F for project photographs.

1. Video:

   Claudia Strijek. 2012. Sticks and Stones. Produced for TNC and the GCWG. WSCU. It is available for viewing at: http://www.youtube.com/watch?v=s-EJBMlKFv8&feature=youtu.be.

2. Fact Sheets:

   Gunnison Basin Climate Adaptation Project fact sheet is available on the Conservation Registry website at: http://www.conservationregistry.org/assets/0000/8607/Gunnison_Basin_Climate_Adapation_Factsheet_07.12.pdf

   Gunnison Climate Working Group Fact Sheet: Managing for Change in the Gunnison Basin: Building Resilience. http://www.conservationgateway.org/ExternalLinks/Pages/managing-change-gunnison-.aspx

3. Website:

   The Nature Conservancy's Colorado Center for Conservation Science and Strategy website has a brief overview of the project at: http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/colorado/scienceandstrategy/index.htm.

   The Nature Conservancy's Nature.org/Colorado website: Simple Structures Help Wildlife: http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/colorado/colorado-simple-structures-help-wildlife.xml

4. Presentations:

   National Adaptation Forum meeting, Symposium entitled *On-the-Ground Action for Wildlife Adaptation: Funding Opportunities and Examples from the Field*, in Denver, Colorado: Betsy Neely, TNC: "Implementing Adaptation Strategies in the Gunnison Basin, Colorado"

   Southern Rockies LCC in August 2013: see Gunnison Climate Webinar or Recorded Webinar at: Climate Change Resilience in Gunnison Basin Climate Webinar (WMV 16.3 MB)

   Other presentations: The Colorado Chapter of the Wildlife Society, WSCU, Gunnison Sage-grouse Festival (on file, available upon request).

5. Field Trips:

   TNC, WSCU, and CPW led a field trip for the Headwaters Conference to the Redden Ranch in September 2012 following a panel discussion at the University. CPW, Gunnison County, and Bill Zeedyk led a field trip for the Gunnison-Sage-grouse Strategic Committee members in September 2012. The Project Team led a field trip for the Gunnison Conservation District board members in August 2013.

6. Media:

   High Country News: Keller, S. August 2013. Colorado Agencies Move Water to Help a Rare Bird Adapt to Climate Change http://www.hcn.org/blogs/goat/agencies-move-water-to-help-a-rare-bird-adapt-to-climate-change

   Colorado Central Magazine: Parenti, M. June 2013. Quenching the Parched West: http://cozine.com/2013-june/quenching-the-parched-west/

7. Reports:

   Gunnison Basin Climate Change Vulnerability Assessment Executive Summary: http://www.conservationgateway.org/ExternalLinks/Pages/gunnison-basin-climate-ch.aspx

   Gunnison Basin: Climate Change Vulnerability Assessment for the Gunnison Climate Working Group by TNC, CNHP, Western Water Assessment, University of Colorado, Boulder, and University of Alaska, Fairbanks. http://www.conservationgateway.org/ExternalLinks/Pages/gunnison-basin-climate-ch.aspx

Lessons Learned

Partnership: We have learned that building strong relationships and engaging landowners, ranchers, partners, stakeholders, researchers and experts from the local community and the region are critical to implementing a climate adaptation project. It is also important to recruit strong expertise, develop a solid work plan and team charter with established clear roles and responsibilities, so that all team members understand the big picture and their contribution to the goals and outcomes. It is critical to have open and frequent communication among all team members, and to build trust with landowners and ranchers. Additionally, it is through the active participation in on-the-ground projects like this that conservation practitioners and community members truly begin to understand what it means to address the impacts of climate change.

We have also learned that simple restoration techniques can help to build ecosystem resilience to climate change. At the same time, in order to effectively build resilience over the long-term, it is important to create a long-term plan and build capacity in order to maintain and repair restoration structures over time.

Related specifically to the type of climate adaptation project that we did, it is critical to conduct long-term monitoring to determine if the restoration structures are working and to adapt techniques over time. Monitoring will help determine whether the projects are cost effective and producing desired outcomes; the heart of adaptive management. Taking time upfront to develop repeatable methods and data sets is critical to tracking the response of the ecosystem and species to the restoration structures. It is also important to install permanent markers using rebar (and GPS specific locations) to ensure accurate and successful monitoring over time.

Rather than using a model to estimate acres impacted by the treatments, it may be easier to use GPS in the field to walk the perimeter of the area affected by the treatments. Further work is needed to determine the best methods for tracking restored/enhanced acreage.

Finally, to ensure effective and efficient resilience building projects in the basin, it is critical to train local field crew leaders who can supervise field crews and volunteers on work days.

Next Steps and Recommendations

Scaling-up: While this project has been relatively small in scope, it has served as an important demonstration of simple and effective tools for restoring and increasing resilience of wet meadow and riparian systems. There are numerous degraded streams (with incised channels) needing restoration across the Upper Gunnison Basin. Local partners are discussing the possibility of expanding the project across landownerships at the watershed level. The treatments used for this pilot project provide potentially significant results that could improve habitat quality and functionality over a much larger ecologically-meaningful scale.

The Gunnison Conservation District has already obtained funding for restoration projects on private lands for 2014. The Conservancy recently submitted a proposal to fund scaling-up of this project to the Basin level. If funded, we hope to work with the team, the UGRWCD, ranchers, volunteers, youth field crews, and universities to help build local capacity for creating and enduring long-standing program to continue application of these methods to build resilience of wet meadows and riparian areas. Action steps include convening interested partners to develop a vision, goals and objectives, outcomes, methods, e.g., analyses to determine how many and what types of drainages are needed to scale up the project across the basin, assessing enabling conditions, and developing a work plan and timeline for implementation.

Expansion of existing work: Assuming, landowners and land managers are willing, we recommend expanding on the initial work at existing ranches and public lands sites where feasible.

Structure maintenance: The existing structures will need maintenance and repair, particularly after the first large precipitation events. In addition, over time, the original structures may need a second round of treatment as the stream responds to the structures and water accesses the floodplain.

Trained crew leaders: It is critical to have trained crew leaders in the community who can supervise local volunteers, students and youth field crews to build structures over the long-term. There are excellent models to consider, including Wildland Restoration Volunteers and the Albuquerque Wildlife Federation. We recommend building a sustaining volunteer effort that that is dedicated to expanding this effort.

Monitoring: The methods developed for monitoring the structures were designed to be repeatable, rapid, and meaningful. We strongly recommend that these transects continued to be monitored again in subsequent years as we expect the changes to be even more evident than reported in this report. The height and density data is fairly laborious to collect and has a high observer bias and may not be critical to repeat as long as species cover data is detecting a change. Ideally, WSCU professors and students could adopt the long-term monitoring of the project sites. We also need rain gages at each project area to assist in the monitoring, as none are on site locally.

Roads: We recommend that future efforts consider properly modifying low standard rural roads to help achieve wetland restoration objectives. See Zeedyk (2006).

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Appendices

A. Project Maps

1. Priority Restoration Sites, Upper Gunnison Basin
2. Wolf Creek Ranch Restoration Structures (East and Middle Forks)
3. Wolf Creek BLM Restoration Structures (West Fork)
4. Wolf Creek BLM Restoration Structures (Lower and Upper Wolf Creek)
5. Redden Ranch Restoration Structures
6. West Flat Top at Henkel Road USFS Restoration Structures (Section 36)
7. West Flat Top at Henkel Road USFS Restoration Structures (Exclosure)
8. Moncrief Ranch in Kezar Basin Livestock Drift Fences

B. Restoration Structures (Materials developed by Bill Zeedyk, Tamara Gadzia, Quivira Coalition, and Craig Sponholtz, Dryland Solutions)

1. One Rock Dam
2. Filter Weir
3. Media Luna
4. Zuni Bowl
5. Plug and Pond
6. Rock Rundown
7. Log and Fabric Step Falls

C. Drift Fence Specifications (Jim Cochran, Gunnison County, Nathan Seward, Colorado Parks and Wildlife, and Matt Vasquez, US Forest Service, and Bill Zeedyk, Zeedyk Ecological Consulting)

D. Vegetation Monitoring Report (Renée Rondeau, Colorado Natural Heritage Program)

E. Geomorphological Monitoring Report (Steve Vrooman, Keystone Restoration Ecology)

F. Project Photographs