

RM-CESU -Progress Report, FY 09

Project Title:

Establishing a Baseline for Habitat Restoration In Bighorn Canyon NRA: Analysis of the Impacts of Historic Flash Floods on Natural and Cultural Resources, University of Wyoming.

Parks: Bighorn Canyon National Recreation Area

NPS Key Official: Cassity Bromley, Bighorn Canyon NRA, 307-548-5413

Funding Source: Rocky Mountains CESU Technical Assistance Funding

University PI: Robert Kelly, Ph.D. ²Department of Anthropology, University of Wyoming, Dept. 3431, 1000 E. University Avenue, Laramie, Wyoming, 82071, email:rlkelly@uwyo.edu; phone:

University Partner: University of Wyoming and Northwest College

Technical Assistant: Judson Finley, Ph.D.

Researcher: Judson Finley, Ph.D., University of Memphis Dept. of Earth Sciences; Dave Harvey (graduate student), University of Memphis Dept. of Earth Sciences

Project Description:

The project will begin with an examination of the stratified deposits behind two historic structures at two different historic ranches where intact sediment deposits are now exposed through excavation to restore the partially buried structures. This information can be used to determine the frequency and magnitude of sediment movement within the last 100 years. With this information, the database can be extended back into time by examining arroyos and associated landforms for evidence of past flash floods, or prolonged periods of heavy rain. The director of the summer field school program and students from Northwest College in Powell Wyoming will document and collect data from the field survey, and collect and compile published material related to the new database.

Objectives and Methods:

This project helps Bighorn Canyon NRA establish a baseline database to determine the relationships between recent climate change and historic land use patterns that has resulted in massive sediment movement from hill slopes in Bighorn Canyon. A 2006 flash flood made apparent the ability of a single storm to move massive amounts of sediment with destructive results. Is sediment mobilization the result of overgrazing, a decrease in grass cover due to persistent droughts, an increase in the frequency and intensity of flash floods, or a combination of all factors? At Bighorn Canyon NRA, there is direct, observable

evidence of historic landscape instability that is evident through destruction of sections of the prehistoric Bad Pass Trail system, but more importantly via burial of historic structures. Several of the nearly 100 year old historic structures associated with historic ranches in the park were constructed at the base of a hillside with windows facing upslope. These windows eventually had to be blocked out as the heavy slope wash deposits began to accumulate on the uphill side of the structures. In one case a two story structure had almost 9 feet of sediment accumulation on the uphill side, and another was almost totally buried. Information is available about the construction date of these historic structures and an examination of the stratified deposits can be used to determine the frequency and magnitude of the sediment movement, and is hence a proxy record of historic flash floods. With this information, the database can be extended back into time by examining arroyos and associated landforms for evidence of past flash floods, or prolonged periods of heavy rain. Climate is one of the Vital Signs selected by the Greater Yellowstone Inventory and Monitoring Network. This project will provide critical site-specific historic data which will complement information collected and analyzed by the network.

In 2010 Western Area Power Administration will begin upgrading two 115KV power lines to 230KV through 15 miles of the recreation area, and the project will be serviced with over 32 miles of access roads during construction. Landscape restoration, re-vegetation, and noxious weed control measures will begin on the power line corridor and all associated construction and service roads when construction is completed, and these efforts will carry on for several years thereafter. Bighorn Canyon NRA has limited documentation on local environmental records, and merging the results of this study with woodrat midden data (published in 2002), and tree ring based reconstruction of precipitation patterns (published in 2003) would be beneficial in understanding current local climate conditions, and trends for planning long term re-vegetation, and landscape restoration efforts during the course of this project.

Project Results:

Field work in 2009 included documentation of the stratigraphic profile exposed behind a historic structure at the Carolyn Lockhart Ranch on Davis Creek, a tributary of the Bighorn River in Bighorn Canyon NRA. Restoration work associated with one historic log structure exposed a 3-meter-long stratigraphic section to a depth of approximately 120 cm behind (upslope) of the structure. Investigation of the profile revealed a buried soil that may date to the initial historic, ranching-era occupation of the site and may pre-date the initiation of hill slope erosion above the structure. A bulk sediment sample was collected from the soil to submit for radiocarbon dating at Beta Analytic, Inc. in Miami, Florida. Three distinct stratigraphic layers overlie this soil and may relate to extreme storms or flash floods that resulted in massive erosion on the hill slope above the structure. Sediment samples were collected from the profile for determination of sediment grain-size at the University of Memphis, Department of Earth Sciences. The radiocarbon age plus three age-constrained historic sediment deposits will

provide an important baseline for quantifying the amount of hill slope erosion that has occurred in the last 100 years near Davis Creek.

A survey of arroyos surrounding the Lockhart Ranch revealed several localities with thick (>3 m) deposits of gravelly alluvium, or what is typically referred to as sediment debris flow deposits. Sediment debris flows are often times massive, gravel-rich deposits that are poorly sorted and indicative of transport and deposition in high-energy alluvial environments. Stratigraphic sections documented as part of this study in the arroyos surrounding Davis Creek show numerous distinct deposits indicating that high-energy floods have been a regular part of the landscape history in Bighorn Canyon NRA. The Davis Creek localities often exhibit 'graded' bedding where coarse, gravelly deposits transition into relatively fine-grained sand deposits. Fine-grained sediments were deposited in what we may consider "normal" relatively low-energy runoff conditions.

One stratigraphic section was chosen as a baseline for comparison of prehistoric and historic flood events. This section is approximately 4-m long and was exposed from the ground surface to a depth of approximately 2-m below surface. Four major stratigraphic deposits were documented and included coarse, gravelly alluvium indicative of flood events, as well as fine-grained sandy deposits typical of more normal runoff conditions. At least three small but distinct layers of charcoal were documented in the profile, which will provide an important age control for paleofloods in Bighorn Canyon. The charcoal is not associated with prehistoric archaeological occupations, but is instead likely associated with wildfires indicating the important relationship of fire in climate change and landscape response. Results of the radiocarbon dating of these three samples will be included in a final report along with analysis of sediment samples collected from this locality.

As part of the 2009 fieldwork, a radiocarbon sample was collected from an exposed archaeological fire hearth associated with the Pretty Creek archaeological site (24CB4&5). The fire hearth was documented during a 2005 evaluation and is exposed in a small cutbank above the second terrace of Layout Creek. This is an important aspect of the prehistoric component of this study since the erosion of Layout Creek and the creation of the first terrace above the stream channel likely occurred during a period of increased moisture when Layout Creek carried more runoff and was able to erode its channel. Thus, the age of this fire hearth will constrain the age of increased precipitation and runoff in Bighorn Canyon, which will provide important supplemental information concerning potential prehistoric flash flood events.

Expected Final Report:

Final data and report expected in May, 2011.

Were there students involved in the project, or degrees expected as a results of this work?

- Graduate research assistant