Yale SCHOOL OF THE ENVIRONMENT

Ucross High Plains Stewardship

RESEARCH BRIEF

# Evaluating Mesic Restoration Efforts in Montana with Geospatial Tools

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## The Need.

The western United States historically and currently struggles with water availability. Climate change is exacerbating the issue, and agriculture is at the front line of this issue. People who rely upon the land will be vulnerable to the effects of climate change, including ranchers who raise livestock throughout the western United States, ranging from the Great Plains to the Intermountain West. The majority of the grazing occurs in drylands where precipitation is directly related to productivity of plants. Increased periods of reduced precipitation have begun to decrease the productivity of this vital forage, putting strain on ranchers and their livelihoods. To combat this issue, ranchers in Montana have installed beaver dam analogs on their land in an attempt to elevate water availability to support forage production. The team hopes these installations will provide stability for cattle ranchers in the west and enable them to stay profitable in a time of increasing variability in weather.

## The Project.

In conjunction with The Nature Conservancy-Montana (TNC), Montana Conservation Corps (MCC), and World Wildlife Fund (WWF), our team created a protocol to monitor the impacts of low-tech structures, sometimes referred to as beaver dam analogs, that have been installed in central Montana. Low-tech structures are human-made objects that are placed in streams to mimic the ecological and physical impacts of a beaver dam. This protocol leverages GIS and remote sensing technologies, and includes metrics, such as greenness, that can be detected remotely. The western partners have collaborated with local ranches to install these structures to increase herbaceous productivity and drought resilience to benefit ecosystem function and forage availability for livestock. The ability to keep forage

Photo Credit: Aaron Clausen

production elevated through periods of drought is becoming more important as the frequency of extreme weather events increases. We have developed an user-friendly and cost-efficient method to begin to understand and monitor the impacts of these structures across multiple years. Through this research, we can begin to understand drought resilience and evaluate the effectiveness and practicality of this approach.

## The Findings.

Our team used a combination of Google Earth Engine (GEE) and QGIS to understand how the beaver dam installations impacted areas of interest over time. Our team calculated a normalized difference vegetation index (NDVI) to investigate changes in vegetation greenness and productivity. We also calculated a normalized difference wetness index (NDWI) to understand how the cover of moist soil and surface water was changing over time. Both of these indices were calculated in GEE using Sentinel-2 satellite imagery with 10-meter resolution and a return interval of five days. Using QGIS our team created a tool to estimate the impacted area resulting from beaver dam analog installation. This tool uses topography and stream flow direction to output an area of interest that can then be uploaded to GEE. (The tool is available for download from our website.) After upload, the indices listed above can be calculated. The beaver dam analog installation project is still ongoing, therefore this tool will be used in the future to investigate how beaver dam analogs are impacting the land.

## The Impact.

While the impacts of these installation projects won't be known for years, there is evidence from elsewhere in the country that beaver dam analogs can play a critical role in increasing the resilience of local vegetation to drought. This tool has the ability to inform scientists as well as ranchers of trends observed in the landscape. Additionally the QGIStool can be used to identify future sites to install beaver dam analogs that will optimize water accumulation. This project has allowed our team to think creatively and critically about how we can best empower ranchers to work towards security, even as the world around us changes. For further information regarding this project, please visit our google site here.

## The Student Team.

Rowan Sharkey, Research Assistant | Rowan Sharkey, Research Assistant | Rowan Sharkey is a Masters of Environmental Management candidate at Yale School of the Environment, focusing specifically on ecosystem management and conservation. Having received her B.A. in Data Analytics and Environmental Studies at Denison University, her interest lies in environmental data analyzation, story telling, and communication. | See what Rowan has been up to. | Blog

Sam Wilson, Research Assistant | Sam Wilson is a graduate student at Yale School of the Environment working towards a Masters in Environmental Science, focusing on using remote sensing, big data, and field work to analyze relationships in rangeland ecosystems. He received a B.S. in Geography from Montana State University in 2019 and spent the next few years living in Bozeman, Montana.  In his free time he enjoys skiing, hiking, reading, and learning! Blog