**Idaho and Oregon Agriculture**

*Monitoring Vegetation Impacts of Livestock Management Practices Used to Reduce Predator Conflicts on Idaho and Oregon Grazing Allotments*

**Project Team**

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**Project Overview**

***Project Synopsis:***

Ranchers in the western U.S. are employing intensive grazing management strategies to mitigate predator conflicts. The impacts of night penning, a successful practice in reducing livestock predation, on vegetation are not fully understood, concerning federal agencies. This project, in collaboration with Alderspring Ranch, Krebs Livestock, and USDA APHIS National Wildlife Research Center, assessed the effects of night penning on NPP using Landsat satellite data. Findings shed light on the feasibility of using these data to understand vegetation response and initial NPP changes post-night-pen establishment on partners' grazing allotments.

***Abstract:***

The practice of night penning, which involves corralling livestock into a fenced, secure area overnight, aims to safeguard animals from predators. Although this method has proven successful in minimizing interactions between livestock and wildlife, the extent of its impact on vegetation communities is still being explored. This project examines the feasibility of using Net Primary Productivity (NPP) values from the Rangeland Analysis Platform (RAP) to quantify the impacts of night penning on rangeland vegetation communities. RAP provides spatially distributed values of vegetation composition, cover and productivity, derived from LANDSAT 5, 7 & 8, at a 30m resolution for rangelands across the United States. Our DEVELOP team partnered with Alderspring Ranch, Krebs Livestock, and the U.S Department of Agriculture Animal & Plant Health Inspection Service (APHIS) to analyze the impacts of night penning on vegetation communities. We identified control sites that captured the topographic characteristics of night pen sites used by our partners. We then quantified and compared changes in annual NPP between night pen and control sites. Our analysis of RAP NPP data, using a control-treatment design did not find impacts of night penning on vegetation. However, this was a preliminary analysis, and does not conclusively quantify the impacts of night penning on rangeland vegetation. Our analysis indicated that RAP may be a feasible tool to study livestock management impacts on rangeland vegetation; however, any such studies must be validated through ground observations.

***Key Terms:***

Rangland Analysis Platform (RAP), rangeland production (RP), plant functional type (PFT), cover composition (CC), net primary production (NPP), Compound Topographic Index (CTI), Heat Load Index (HLI), night penning.

***Application Area:*** Rangeland Management, Agriculture

***Study Location:*** Eastern Oregon and Central Idaho

***Study Period:*** May 2000 – October 2023

***Community Concerns:***

* Rangelands cover about 25% of the Earth's land area and are dominated by grass, forb, and shrub vegetation. These ecosystems support over half of the global livestock populations, sustain diverse species, and enhance biodiversity. The successful management of these rangelands is vital to maintain the ecosystem services they provide.
* Mitigating predator conflicts is an important component of maintaining successful rangelands in a landscape experiencing increasing conflicts with wildlife competing for scarce resources.
* Night-penning is an effective strategy for reducing livestock predation, but the impacts on the rangeland vegetation are not well documented.

***Project Objectives:***

* Select control sites that capture topographic characteristics of night pen sites
* Quantify and compare changes in vegetation characteristics between night pen and control sites

**Partner Overview**

***Partner Organization(s):***

|  |  |  |  |
| --- | --- | --- | --- |
| **Organization(s)** | **Contact (Name, Position/Title)** | **Partner Type** | **Sector** |
| **Alderspring Ranch** | Glenn Elzinga, Rancher | End User | Private |
| **Krebs’ Livestock Inc.** | Cameron Krebs, Rancher | End User | Private |
| **U.S. Department of Agriculture, Animal & Plant Health Inspection Service, National Wildlife Research Center** | Stewart Breck, Research Wildlife Biologist | End User | Federal Government |

***Decision-Making Practices & Policies:***

Krebs Livestock and Alderspring Ranch manage grazing allotments across Oregon and Idaho and are committed to running successful businesses producing food and fiber, defending their livestock from predation, and working to ensure their land is being managed in a way that is not harmful to the natural environment. Currently, most of their research consists of observations of the night-pen areas in the field. These ranches work with Stewart Breck (USDA APHIS) to mitigate predator conflicts and face concerns from Forestry officials about the impacts of management practices on the rangeland vegetation. Each of these end users support local management of livestock and rangeland ecosystems impacted by predation and night-penning, primarily using ancillary data collection processes that could be further expanded by incorporating NASA earth observations into their methods.

**Earth Observations & End Products Overview**

***Earth Observations:***

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| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Rangeland Analysis Platform (RAP) - MODIS** | Normalized Difference Vegetation Index (NDVI), Enhanced Vegetation Index (EVI), and Land Surface Temperature (LST) | These Data, which are used to estimate NPP in the Rangeland Analysis Platform across the United States were used to compare night penning sites to control sites on our partner ranch locations.  |
| **RAP Landsat 5 TM** | Multispectral imagery, including bands such as near-infrared (NIR), red, green, and blue | These Data were used to classify land cover types and estimate percent cover of vegetation, bare soil, and other land surface components.  |
| **RAP Landsat 7 ETM+** | Multispectral imagery, including bands such as near-infrared (NIR), red, green, and blue | These Data were used to classify land cover types and estimate percent cover of vegetation, bare soil, and other land surface components.  |
| **RAP Landsat 8 OLI** | Multispectral imagery, including bands such as near-infrared (NIR), red, green, and blue | These Data were used to classify land cover types and estimate percent cover of vegetation, bare soil, and other land surface components.  |

***Ancillary Datasets:***

* National Agriculture Imagery Program (NAIP) dataset – displayed in infrared for visualizing tree canopy distribution and cross-validating our selection of control sites.
* Digital Elevation Model (DEM) USGS 3DEP – Used to access Elevation, Slope, Aspect, Heat Load Index (HLI), and Compound Topographic Index (CTI), variables used to select control sites and run analyses.
* Alderspring Night Pen Polygon Shapefiles – The basis for our analysis of vegetation impacts on night penning locations.
* Krebs Night Pen GPS locations – buffered with a diameter of 165ft to account for the true area of the night pen locations. The basis for our analysis of vegetation impacts on night penning locations.

***Software & Coding Languages:***

* ArcGIS Pro 3.1.0 – Raster manipulation and map production
* Google Earth Engine Application Programming Interface (API) – Processing of satellite imagery and selection of control sites
* R Version 4.3.2 – Validation, data analysis, and data plotting

***End Product(s):***

|  |  |  |
| --- | --- | --- |
| **End Product(s)** | **Earth Observations Used**  | **Partner Benefit & Use** |
| **Informative Paper** | N/A | This 2-page paper will provide partners with our key takeaways and information pertaining to our project. It can be used to show rangeland management officials or other parties what impacts these current livestock management practices have on the landscape. |
|  **Control Sites** | NAIP + DEM (CTI, HLI)  | Control Sites were carefully selected using topographic indices and on the ground knowledge of land managers. These will be used for field studies and future assessment of night pen impacts.  |
| **Site Specific Time Series** | RAP (LANDSAT 5 TM, LANDSAT 7 ETM+, LANDSAT 8 OLI) | This tool will help allow partners to understand the site-specific impacts of night penning. This can help keep track of grazing management goals (i.e. quantifying the presence/impact of night-pens on shrub removal) |

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***Product Benefit to End User:***

The end results of this project will provide the partners with an easy-to-read informative summary and preliminary results to quantify the impacts of night-penning on rangeland vegetation. End products can be incorporated into future field collection and analysis to more thoroughly answer remaining questions regarding rangeland management practices. Beyond this, these tools will provide the public with education and awareness regarding the impacts of night-penning and the potential for future research in this area.

***Project Continuation Plan:***

Our preliminary analysis indicates that night penning is an effective management tool with no visually discernable impacts on vegetation. However, continuing to monitor vegetation impacts and conducting further research will give us a clearer understanding of the impacts of night penning. Future efforts should include on-the-ground validation, analysis of repeated night pen usage effects on vegetation, exploration of alternate parameters like NDVI for vegetation response quantification, measurement of vegetation cover and bare ground percentage between night pen and control sites, finer temporal resolution studies, and more robust statistical analysis. These additional analyses will enhance our understanding of intensive cattle management practices.

**References**

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