**Southern Idaho Ecological Conservation**

*Investigating the Impact of Targeted Grazing to Improve Wetland Habitat in the Sterling Wildlife Management Area*

**Project Team**

***Project Team:***

Preethi Malur Balaji (Project Lead)

Talissa Cota

Kangsan Lee

Melissa McNally

***Advisors & Mentors:***

Keith T. Weber (ISU GIS Training and Research Center)

***Fellow:***

Ryan Healey (Idaho – Pocatello)

***Team Contact:*** Preethi Malur Balaji, preet.balaji20@gmail.com

***Partner Contacts:*** Maria Pacioretty, maria.pacioretty@idfg.idaho.gov; Jeff May, jeff.may@idfg.idaho.gov

**Project Overview**

***Project Synopsis:***

The Idaho Department of Fish and Game established the Sterling Wildlife Management Area in 1968 to safeguard upland and wetland habitats, promote the well-being of diverse wildlife, and offer wildlife-based recreation, with a particular emphasis on hunting. Sterling Wildlife Management Area land managers aim to improve the area's waterfowl and ring-necked pheasant (*Phasianus colchicus*) populations by managing and enhancing the wetland habitat. Standing, senesced vegetation is a significant issue at the Sterling Wildlife Management Area, resulting in decreased wildlife use and reduced public access. Therefore, the Idaho Department of Fish and Game has worked with local ranchers to introduce targeted grazing at a small scale to manage the landscape and decrease biomass. For this project, the Idaho Department of Fish and Game partnered with NASA DEVELOP to receive results showing the effects of grazing and tools to help with future monitoring and management of the study area.

***Abstract:***

Wetland ecosystems are vital for biodiversity conservation and ecosystem services but are often threatened by invasive plant species. Targeted grazing has been proposed as a sustainable alternative to chemical herbicides or burning for controlling invasive plants. The Sterling Wildlife Management Area (SWMA) in Bingham County, Idaho, has an issue with decadent and accumulated vegetation growth encroaching on wetland habitat, which presents challenges for wildlife, decreases biodiversity, and limits public access. Land managers introduced targeted cattle grazing in January 2021 to reduce biomass. NASA DEVELOP partnered with the Idaho Department of Fish and Game (IDFG) to determine the impacts of grazing by using NASA Earth observations from Landsat 8 Operational Land Imager (OLI) in Google Earth Engine (GEE). Images were processed with TerrSet’s Land Change Modeler (LCM) and ArcGIS Pro’s Change Detection Wizard to further understand the land changes after grazing. A Normalized Difference Vegetation Index (NDVI) analysis was performed to assess the impacts on vegetation productivity and to compare variances in biomass before and after grazing. A Normalized Difference Water Index (NDWI) was used to compare changes in ground moisture content to evaluate the suitability of the area for migratory birds post-grazing. Results showed a decrease in the vegetation index and an increase in the water index post-grazing. The DEVELOP team’s analysis suggests that the grazing helped break down the thick, senesced vegetation and increased the ground moisture. Providing a workflow model will allow partners to continue monitoring in this area and other management areas around the state.

***Key Terms:***

change detection, NDVI, NDWI, Landsat-8, Google Earth Engine, TerrSet2020, ArcGIS Pro, targeted grazing

***National Application Area Addressed:*** Ecological Conservation

***Study Location:*** Sterling Wildlife Management Area, Bingham County, ID

***Study Period:*** 2013-2022, Forecasting to 2022

***Community Concerns:***

* Excess biomass makes it difficult for visitors to move through the land, limiting public access
* Tall, emergent vegetation degrades the open water zone of the wetland habitat, negatively impacting wildlife in both population numbers and biodiversity

***Project Objectives:***

* Generate quantitative results that show the effects of grazing
* Quantify change in vegetation productivity and surface water cover
* Compare vegetation productivity and surface water cover before and after cattle grazing treatment
* Develop a step-by-step tutorial to provide the IDFG with tools for future monitoring and analysis

**Partner Overview**

***Partner Organization:***

|  |  |  |
| --- | --- | --- |
| **Organization** | **Contact (Name, Position/Title)** | **Partner Type** |
| **Idaho Department of Fish and Game** | Maria Pacioretty, Habitat Biologist;  Jeff May, IT Software Engineer | End User |

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

IDFG conserves, protects, perpetuates, and manages wildlife, fish, and plants in Idaho. SWMA managers previously utilized mowing and prescribed fires to manage wetland vegetation. However, due to limited resources, staff, and funding, IDFG implemented an alternative, more cost-effective approach by collaborating with local ranchers to introduce high-intensity, short-duration targeted grazing to decrease wetland vegetation.

IDFG has monitored the area using photographs and by measuring yardsticks in the field. They would like to leverage Earth observation data in addition to the LiDAR and ground data already in use. The organization has a strong interest in increasing its remote sensing capacity to assist with management and monitoring practices.

**Earth Observations & End Products Overview**

***Earth Observations:***

|  |  |  |
| --- | --- | --- |
| **Platform & Sensor** | **Parameter(s)** | **Use** |
| **Landsat 8 OLI** | Green, Red, and NIR Bands | NDVI was generated using NIR and Red bands to compare vegetation density before and after grazing.  NDWI was generated using NIR and Green bands to identify water area changes during the study period. |
| **National Agriculture Imagery Program (NAIP)** | Red, Green, and Blue bands | NAIP was used to validate the georeferenced Landsat and PlanetScope dataset. |
| **PlanetScope**  **SuperDove** | Red, Green, Blue, and NIR bands | PlanetScope data were processed to calculate NDVI changes during the study period. |
| **Aerial LiDAR** | Elevation | LiDAR data were used to run LCM in TerrSet2020. |

***Ancillary Datasets:***

* Boundary index of SWMA: IDFG: To Classify boundaries
* Idaho Wetlands data layer: US Fish and Wildlife Service: To identify wetlands
* AgriMet weather data: Bureau of Reclamation: To monitor rainfall for Pheno-Calc processing
* Drought conditions (percent area): US Drought Monitor: To monitor drought history
* Grazing information: IDFG: To identify grazing area and period
* LANDFIRE (Vegetation type and height): USFS & U.S. Dept. of the Interior: To gather vegetation information
* National Land Cover Database: Multi-Resolution Land Characteristics Consortium: To identify landcover

***Modeling:***

* LCM in TerrSet (POC: Clark labs, Clark University)

***Software & Scripting:***

* GEE – Landsat Level 2 data acquisition and processing
* ArcGIS Pro – Clip Raster, Change Detection
* TerrSet – NDVICOMP, LCM
* Python – Matplotlib, Pandas, Numpy, Seaborn
* Pheno-calc (POC: Keith Weber, Idaho State University)

***End Products:***

|  |  |  |  |
| --- | --- | --- | --- |
| **End Products** | **Earth Observations Used** | **Partner Benefit & Use** | **Software Release Category** |
| **GEE Code (NDVI and NDWI download)** | Landsat 8 OLI | Partners can reuse this code for their future projects to download and generate NDVI and NDWI products. | V |
| **Vegetation Area Change (Change detection maps from NDVI)** | Landsat 8 OLI | Partners can identify which areas have an increased vegetation growth pattern. | N/A |
| **Water Area Change (Change detection maps from NDWI)** | Landsat 8 OLI | Partners can monitor water area changes using the NDWI dataset. | N/A |
| **Predicted NDVI images** | Landsat 8 OLI | Partners use these data to investigate the changes in vegetation due to grazing and other environmental factors. | N/A |

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

The available products are valuable resources for the IDFG partners for predicting future changes in the SWMA. These resources enable a comparison of ecosystem changes in areas with and without grazing activities in the coming years. This study also shows how Earth observation datasets can be used to help address local community concerns. Additionally, reproductible resources such as GEE code may broaden the end users’ prospective for future studies.

**References**

Hamad, R., Balzter, H., & Kolo, K. (2018). Predicting Land Use/Land Cover Changes Using a CA-Markov Model under Two Different Scenarios. Sustainability, 10(10), Article 10.

Henry, A., & Scaup & Willet LLC. (2022). Wetland Review Report for Sterling Wildlife Management Area (p. 98). Idaho Department of Fish and Game, Southeast Region.

LANDFIRE, E. R. O. and S. C. (EROS). (2022). LANDFIRE 2020 Existing Vegetation Height (EVH) CONUS 2022 Capable [Data.raster digital data]. LANDFIRE, Earth Resources Observation and Science Center (EROS), U.S. Geological Survey.

Larson, D. M., DeJong, D., Anteau, M. J., Fitzpatrick, M. J., Keith, B., Schilling, E. G., & Thoele, B. (2022). High abundance of a single taxon (amphipods) predicts aquatic macrophyte biodiversity in prairie wetlands. Biodiversity and Conservation, 31(3), 1073–1093.

Rose, D. (2014). Sterling Wildlife Management Area Management Plan 2014-2023 (p. 82). Idaho Department of Fish and Game, Southeast Region.