**NASA DEVELOP National Program**

****USGS at Colorado State University - Fort Collins, CO

**Spring 2016**

**Short Title: Laramie Mountains Ecological Forecasting**

**Subtitle:** Mapping Fire History in the Laramie Mountain Range, Wyoming with a 30-Year Landsat Time Series

**VPS Title:** Shedding Light on Fire History Using NASA Earth Observations

**Project Team & Partners**

**Project Team:**

Stephanie Krail (Project Lead), StephanieAKrail@gmail.com

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**Advisors & Mentors:**

Dr. Paul Evangelista (Colorado State University, Natural Resource Ecology Lab)

Dr. Amanda West (Colorado State University, Natural Resource Ecology Lab)

**Partner Organizations:**

Wyoming Game and Fish Department (End-User), POC: Ryan Amundson

United States Forest Service (End-User), POC: Daron Reynolds

Colorado State University, Natural Resource Ecology Lab (Collaborator), POC: Dr. Amanda West, Boundary Organization

**Project Details**

**Applied Sciences National Applications Addressed:** Ecological Forecasting

**Study Area:** Laramie Range, WY

**Study Period:** May 1985- September 2015

**Earth Observations & Parameters:**

Terra, MODIS – Vegetation Phenology

Space Shuttle, SRTM V2 – Digital Elevation Model

Landsat 5, TM – Land cover

Landsat 7, ETM+ – Land cover

Landsat 8, OLI & TIRS – Land cover

**Ancillary Datasets Utilized:**

* USFS Administrative Boundaries – Forest management boundaries
* USFS Vegetation Records – Historical vegetation records for Wyoming
* Natural Resource Ecology Laboratory Records – Aspen field data
* USFS Fire History Records – Records of previous fires in Wyoming
* LANDFIRE Reference Database (LFRDM) – Vegetation and fuel data
* Monitoring Trends in Burn Severity (MTBS) Project – Records of previous fires and current vegetation type

**Models Utilized:**

* Laboratory for Applications of Remote Sensing in Ecology, Oregon State University, LandsatLinkr package
* Boosted Regression Tree (BRT)
* General Linear Model (GLM)
* Multivariate Adaptive Regression Splines (MARS)
* Random Forest (RF)
* Maximum Entropy Modeling (Maxent)

**Software Utilized:**

ArcGIS – Landsat imagery processing, derivation of indices, map creation

IDL and ENVI – Landsat imagery calibration and pre-processing

R & RStudio – Statistical modeling and graphing

Software for Assisted Habitat Modeling (SAHM) for VisTrails – Species distribution modeling

**Project Overview**

**80-100 Word Objectives Overview:**

Aspen (*Populus tremuloides*) plays a crucial role in ungulate species health by supporting diverse forage, ensuring adequate fawn rearing, and providing cover from predators. This project is the first of two terms that will correlate burn history and ungulate species distribution in the Laramie Mountain Range, Wyoming. We used multi-temporal and multi-spectral indices to create a time series of the regional fire history, identify fire return intervals, and determine the intensity of each fire event. Our findings supplement the data on ungulate species distribution to be modeled during the following term.

**Abstract:**

The Laramie Mountain Range located in southeastern Wyoming is a diverse community, which supports a multitude of natural and human activity. Recreational opportunities, ample views, and critical mule deer (*Odocoileus hemionus*) and elk (*Cervus canadensis*) habitat are facets that heavily depend upon the presence of aspen (*Populous tremuloides*) communities. However, the success of these relationships is inhibited by the limited distribution of aspen tree cover in the Laramie Range, which currently stands at one percent. The Laramie Mountain Ecological Forecasting project is comprised of two terms where the ultimate objective is to evaluate the carrying capacities of mule deer and elk in the Laramie Mountain Range by identifying current aspen distribution. Since aspen regeneration is correlated with post-fire environments, land cover data was utilized to map fire history, return interval, and severity to monitor aspen regeneration. Imagery was compiled from the Shuttle Radar Topography Mission (SRTM), Landsat 5 Thematic Mapper (TM), Landsat 7 Enhanced Thematic Mapper Plus (ETM+), and Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS). The collected imagery was preprocessed and mosaicked using LandsatLinkr and visually inspected in ArcGIS for fire occurrence. The results were validated with supplementary data collected from the Moderate Resolution Imaging Spectroradiometer (MODIS), LANDFIRE Reference Database (LFRDB), Monitoring Trends in Burn Severity (MTBS), and United States Forest Service (USFS) Fire History Records.

**Community Concerns:**

* Aspen stands are crucial to the survival and overall health of mule deer and elk by supplying critical forage, habitat, and cover.
* The burgeoning of Sudden Aspen Decline (SAD) in the west is a growing concern for the fitness of the mule deer and elk populations.
* Extensive research exists on techniques to increase aspen growth throughout the Western U.S. At the forefront of these techniques, prescribed burning allows land managers to directly assist in the regeneration of aspen stands across the landscape. Further monitoring of the success of prescribed burning as a means to facilitate aspen regeneration is critical to the health of mule deer and elk populations nationwide.

**Current Management Practices & Policies**:

Currently, field surveys are the only tool utilized to track aspen growth and monitor ungulate habitat. However, given limited access to the study area and financial constraints of the project partners, this method delivers fragmented conclusions about aspen regeneration on the landscape. While land managers would like to employ prescribed burning as a means to increase aspen growth and preserve critical habitat, no research has previously been conducted to examine the relationship among fire, aspen and ungulate populations.

**Decision Support Tools & Benefits:**

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| **End-Product** | **Earth Observations Used** | **Benefit & Impact** |
| Fire History Map | Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI & TIRS | Identification of previous fires to better understand aspen growth and aid in the management of the Laramie Mountain Range |
| Fire Severity Map | Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI & TIRS | Classification of previous fire strengths to discern the relationship between aspen regeneration and fire severity |
| Fire Return Intervals | Landsat 5 TM, Landsat 7 ETM+, Landsat 8 OLI & TIRS | Calculation of fire return interval to learn about aspen regeneration and assist in the timing of prescribed fires.  |

**Project Imagery**

Coming Soon!

**Software Release Requirements**

Category I