NASA DEVELOP National Program
Fall 2015 Project Proposal
USGS at Colorado State University, Fort Collins, CO

Wyoming Ecological Forecasting
Using Landsat 8 and Aqua and Terra MODIS to Target Cheatgrass Mitigation in a Post-Wildfire Landscape in Wyoming's Medicine Bow National Forest

Objective:
To use multi-temporal and multi-spectral indices and species distribution modeling to map cheatgrass in a post-burn areas to identify variations in the annual lifecycle of cheatgrass and characterize using the Aqua/Terra MODIS phenology data product to support federal partners planning and implementation of aerial spraying and eradication efforts.

Community Concern:
Cheatgrass is known throughout the Western US as a problematic invasive species that alters nitrogen cycles, competes with native grass and forb species, and alters fire regimes. In recent years, land managers in Wyoming have observed increasing cheatgrass abundance in post-wildfire landscapes. To prepare for targeted management, highly accurate maps of cheatgrass cover are needed for the 40,000 ha burn area of the 2012 Arapaho Wildfire in Medicine Bow National Forest. Land managers also need to understand the regional phenology of cheatgrass to plan timing of herbicide application.

Partner Organizations:
Wyoming Game and Fish Department (End-User and Collaborator, POC: Lee Knox, Senior
      Wildlife Biologist)
US Forest Service, (End-User and Collaborator, POC: Jacquilyn Roaque, Rangeland
      Management Specialist)
Natural Resource Ecology Laboratory at Colorado State University (Collaborator and Boundary
      Organization, POC: Amanda West, Research Associate)

The Fort Collins DEVELOP node has a working relationship with all of the project partners. Wyoming Game and Fish are interested in understanding how critical mule deer and elk habitat are being affected by cheatgrass invasion. The USFS will use the maps to plan targeted cheatgrass management and mitigation. The phenological characterization will aid end-users to decide the optimal timing of mitigation treatments.

Decision Making Process:
Currently, field surveys are the only tools being used to assess cheatgrass distribution in these post-burn areas. Much of the area is inaccessible due to lack of roads and trails, making remote sensing a suitable alternative to these methods.

Earth Observations:

Platform	Sensor	Geophysical Parameter
Landsat 8	Operational Land Imager (OLI)	Surface Reflectance, Greenness, Moisture
Landsat 8	Thermal Infrared Sensor (TIRS)	Brightness Temperature
Aqua/Terra	Moderate Resolution Imaging Spectroradiometer (MODIS)	Vegetation Phenology

NASA Earth Observations to be Highlighted:
Landsat 8 provides the ideal temporal and spatial resolution for mapping cheatgrass cover. Its revisit time of 16 days provides two images per month, and multi-season variables have been shown to be key variables for modeling cheatgrass with SDMs.

The MODIS land product, distributed by the MODIS Land Product Subsets project, provides the temporal resolution and consistent data record to characterize cheatgrass phenology in Arapaho.

Ancillary Datasets:
Administrative Boundaries – provided by USFS
Arapaho Wildfire Boundary – provided by USFS
Field data – provided by Natural Resource Ecology Laboratory

Models:
MaxEnt species distribution model (POC: Catherine Jarnevich: USGS)

<u>**Decision Support Tools & Analyses:**</u>

Proposed End Products	Decision to be Impacted	Current Partner Tool/Method
Cheatgrass Cover Map	Locations for targeting management and mitigation	Field surveys
Cheatgrass Phenological Characterization	Timing of herbicide application	Estimation from local Knowledge

Cheatgrass Cover Map – This map will show the post-fire spatial distribution of cheatgrass within the Arapaho Wildfire burn area. Landsat 8 OLI and TIRS spectral indices from 2014 to 2015 will be combined with field data to develop the MaxEnt cheatgrass distribution model.

Cheatgrass Phenological Characterization – This will consist of maps and charts showing cheatgrass green-up and senescence in the Arapaho Wildfire burn area. This will be accomplished through a time-series analysis of MODIS, plotting NDVI and EVI values against time (2012-2015) in known cheatgrass populations.

<u>**Project Details:**</u>
National Application Area Addressed: Ecological Forecasting
Source of Project Idea: This project idea was conceived during a recent meeting with the project partners.

Study Location: Arapaho Wildfire burn area, Medicine Bow National Forest, Wyoming
Period being Studied: 2012 - 2015

Advisor: Paul Evangelista (Natural Resource Ecology Lab, Colorado State University)
Participants Requested: 4-5

Project Timeline: 1 Term: 2015 Fall
Previous Related DEVELOP Work:
Fall 2014 and Spring 2015, Arizona Ecological Forecasting I and II, Fort Collins: Comparing WorldView-2 with Landsat 8 Imagery: Refining and Evaluating Invasive Tamarisk Mapping in Havasu National Wildlife Refuge

Summer 2014 (Fort Collins) Alaska Ecological Forecasting- Modeling Current and Future Invasion Vulnerability for Critical Habitat in Interior Alaska: Applying Novel Modeling Techniques for Invasive Species Risk Assessment in the Yukon Flats National Wildlife Refuge

Spring 2014 (Fort Collins) Ethiopia Ecological Forecasting- Mapping Distribution and Forecasting Invasion of Mesquite (*Prosopis juliflora*) in Ethiopia's Afar Region

Fall 2014 (Ames Research Center) Great Basin Climate- A Geospatial Assessment of Fire Events in the Great Basin Ecoregion and Its Relation to Cheatgrass Spread Under Changing Climate Conditions

Software & Scripting Utilized:
- ENVI – Landsat imagery calibration and pre-processing
- ArcGIS – Landsat imagery processing (study area designation, clipping, etc.), derivation of indices, map creation
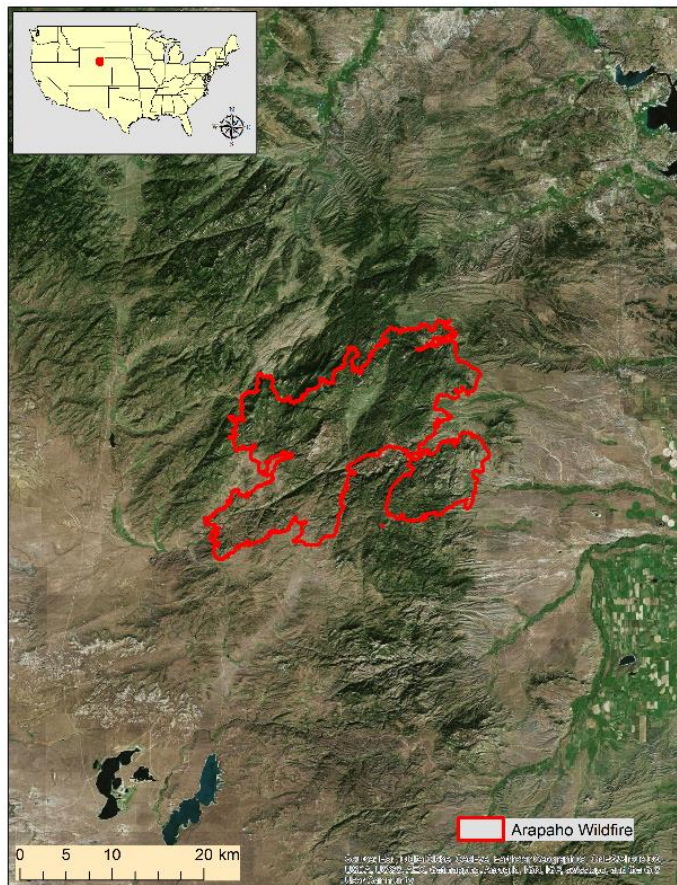- MaxEnt Program– maximum entropy species distribution modeling

Notes:

Figure 1. Map of the Arapaho post-burn area