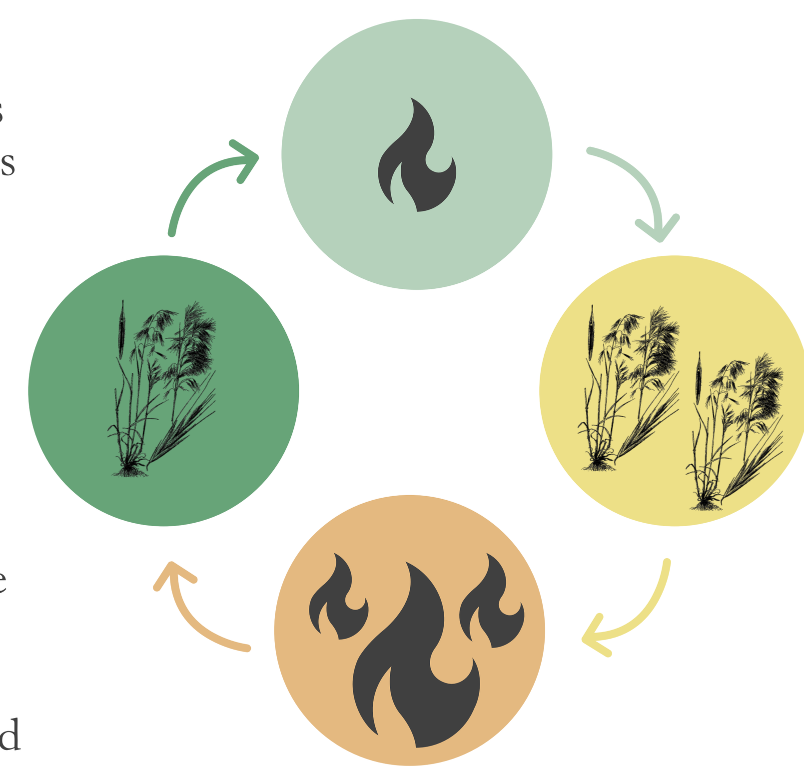
Southern Wyoming Ecological Conservation II

Improving Invasive Species Detection Mapping with Novel Phenology Approaches

Project Synopsis

Cheatgrass in an invasive annual species that thrives in disturbed burned environments due to high levels of nitrogen. The species' ability to rapidly uptake nitrogen allows it to germinate faster than native species. Unfortunately, cheatgrass has a relatively short life cycle, leaving large swathes of fine scale dried biomass across landscapes. This buildup of fine fuels increases the chances of wildfires, which then creates a positive feedback loop, favoring the growth of cheatgrass and ultimately reducing native biodiversity. This project aimed to map cheatgrass coverage in the 2020 Mullen Fire scar in Wyoming and Colorado by using differences in the normalized difference vegetation index (NDVI) values derived from unique phenological characteristics. Providing land managers with accurate mapping tools can assist them with their monitoring and treatment goals.



Hitchcock (1950)

Methodology

Data

- Harmonized and individual Landsat 8 and Sentinel-2 imagery
- USGS cheatgrass phenology date maps
- Field data for cheatgrass cover

Processing

- Calculate NDVI on collected imagery by date
- Determine most common date pairings for greenness and senescence
- Difference NDVI between peak greenness and senescence date

Analysis

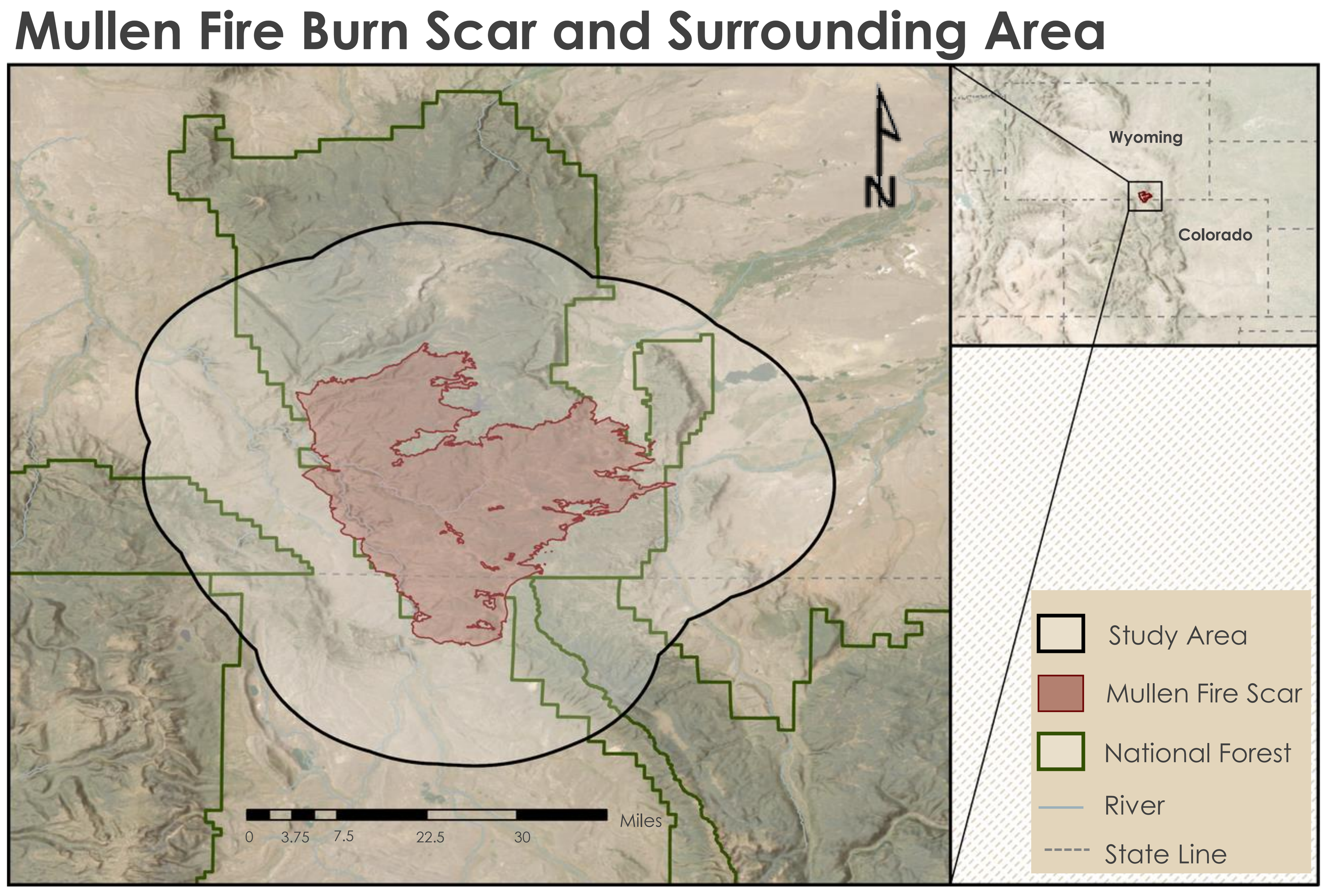
- Analyze distribution of cheatgrass presence in a scene-by-scene and pixel-by-pixel maps
- Compare results with cheatgrass field data and other available maps

Output

- Phenologically based cheatgrass cover map of the study area surrounding the Mullen fire scar

Study Area

Mullen Fire Burn Scar and Surrounding Area



Basemap Credit: ESRI, NAA, NGA, USGS, Earthstar Geographics, USGS, USFS, NOAA, USCB

The study area includes the Mullen Fire scar and a 10-mile buffer of surrounding area covering 907,383 acres. The project time period spans the May-October growing seasons of 2021 and 2022.

Project Partners

USGS science for a changing world — Fort Collins Science Center

Forest Service U.S. Department of Agriculture — Laramie Ranger District

Acknowledgements

We would like to thank our previous contributors from the Southern Wyoming Ecological Conservation DEVELOP team: Dahlia Shahin, Emily Snyder, Sanju Khatri, Kyle Paulekas, Michael Segala. We would also like to thank our DEVELOP Fellow, Sarah Hettema; Science Advisors: Nicholas Young, Peder Engelstad, Dr. Paul Evangelista; and our partners Janet Prevey and Jacquilyn Roaque.

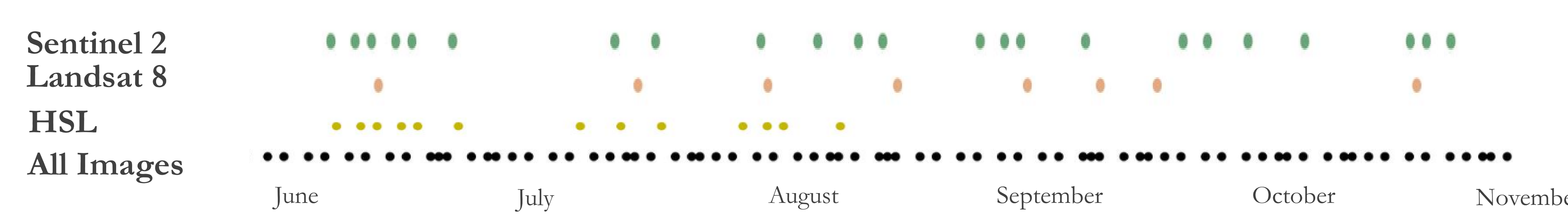
25TH DEVELOP ANNIVERSARY

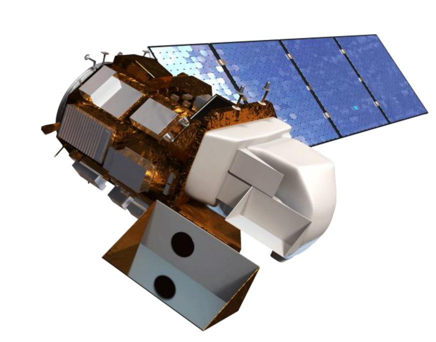
Objectives

- **Compare** NDVI values between images from peak greenness to peak senescence
- **Compare** satellite imagery between Landsat 8, Sentinel-2, and Harmonized Landsat 8/Sentinel-2 (HSL) for accessing greenness and senescence dates
- **Map** cheatgrass coverage based on NDVI differences across a topographically diverse landscape

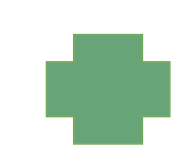
Earth Observations & Imagery Products

The rapid lifecycle of cheatgrass makes image availability a key component to building an accurate distribution model. We analyzed differences in accuracy using three different imaging products: Landsat-8 , Sentinel-2, and a Harmonized Landsat 8/Sentinel-2 (HSL) dataset that normalizes spatial extents and bands for true cross satellite comparison. The chart below shows image availability per satellite after cloud masking and ocular sampling.





Landsat 8 OLI/TIRS

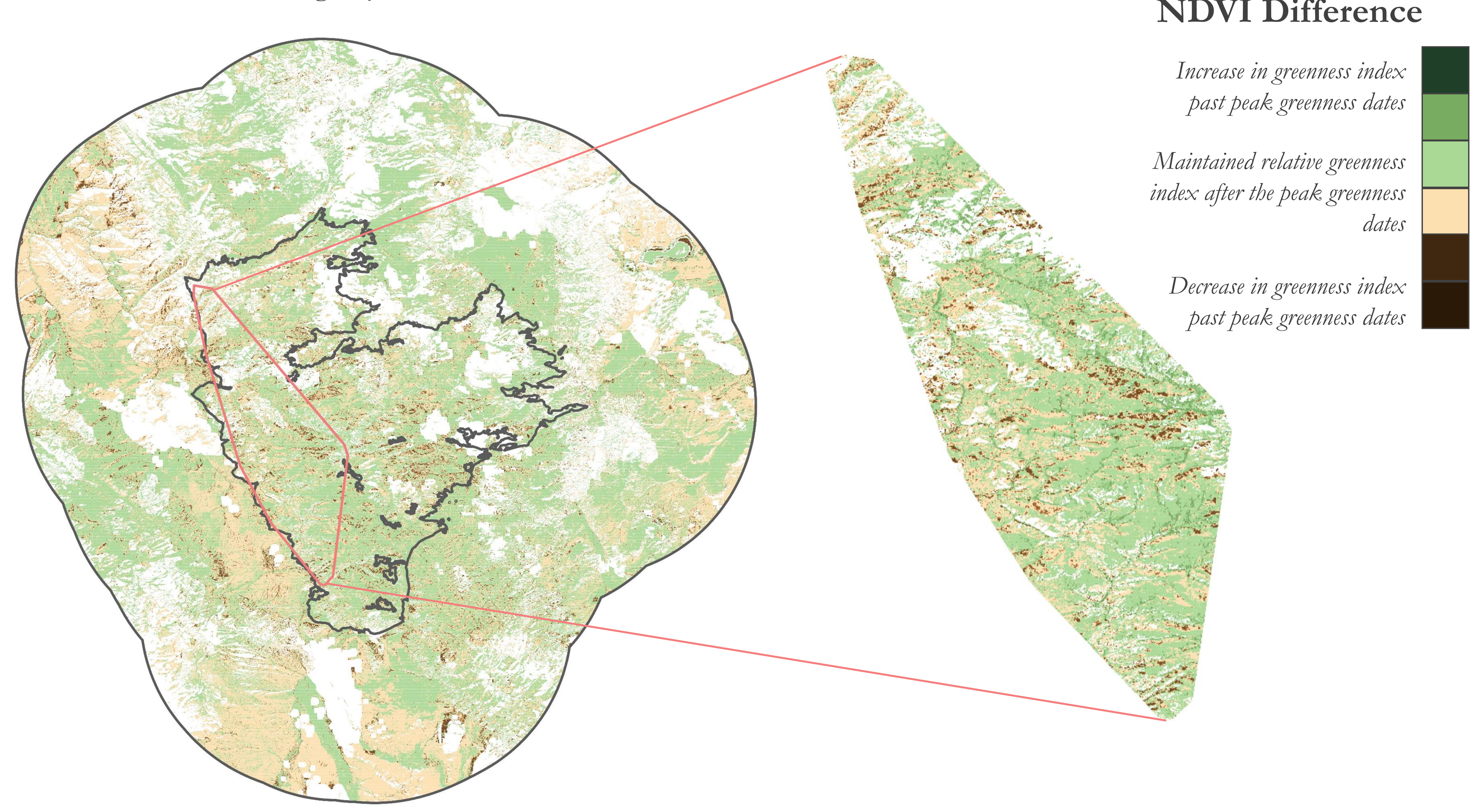


HSL

Sentinel-2 MSI

Results

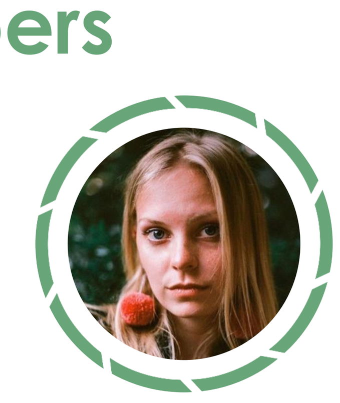
A pixel-by-pixel based map shows NDVI differences between the green-up and senescence date NDVI values for each pixel in the study area. We hypothesize that cheatgrass is present in areas with high NDVI difference values (dark green) and is not present in areas with low NDVI values (black). Shown below is a pixel-by-pixel NDVI difference map (2021) with field validation polygons extracted to magnify differences.



Conclusions

- The best imagery may exist across multiple satellites; therefore, it is best practice to harmonize sets of imagery to allow for the largest range of imagery.
- Using pixel-by-pixel NDVI difference maps help provide a more accurate assessment in determining suitable cheatgrass locations.
- Year to year monitoring can be a challenge due to image availability being highly variable between years.

Team Members



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