Remotely Sensed Vegetation Cover and Species Information for Detecting Vegetative States on Ecological Sites – Preliminary Results

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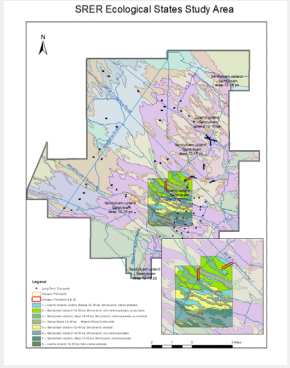
Introduction

- Land management is a critical component of the Multi Species Conservation Plan (MSCP), which is part of the Pima County Sonoran Desert Conservation Plan. The goal of the Sonoran Desert Conservation Plan is to ensure the long-term survival of the full spectrum of plants and animals that are native to Pima County.
- One tool developed to aid land managers deciding where to focus management actions is the State and Transition Model (STM).
- State and Transition Models are conceptualizations of how plant communities change over time for an Ecological Site.
- We need to be able to identify specific ecosystems/landscapes that are on the brink of crossing a threshold (due to management actions, climate, precipitation)
- Geographical Information Systems (GIS) and Remote Sensing have provided Natural Resource Managers with new ways to visualize the environment and model change.
- The increasing use of UAV Imagery and regular flights collecting hyperspectral imagery provide an opportunity to gather species level data.

Objective

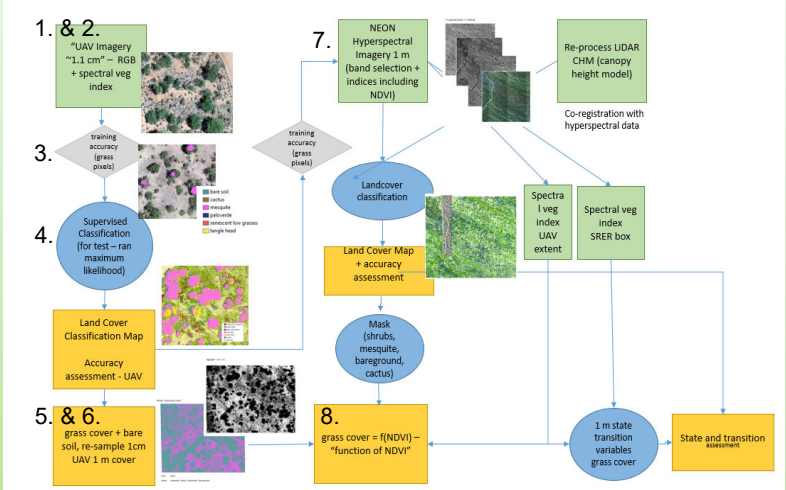
- Determine the percent cover of shrub, mesquite, native grasses, invasive grasses, succulents and bare ground to examine how well we can determine vegetative states for ecological sites by analyzing a combination of 2017 NEON (National Ecological Observatory Network) hyperspectral remotely sensed imagery, LiDAR and Unmanned Aerial Vehicle (UAV) based digital color imagery.

Study Area In SRER



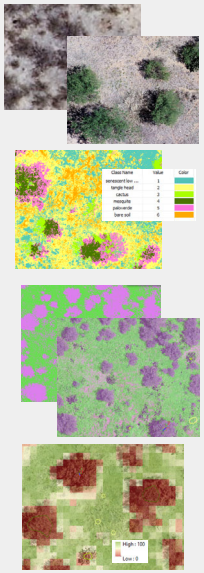
In April 2016, the Natural Resource Conservation Service (NRCS Tucson) worked in the field (watersheds 3,4 and 5,6,7 and 8 on the Santa Rita Experimental Range) for five days in May and February of 2016 to inventory 2 – 4 x 4.5 mile areas in order to map vegetative states on ecological sites using field based observation techniques.

Flowchart of Methods to Determine Vegetation Cover Percentage



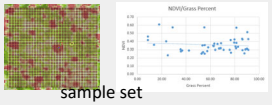
Methods

1. Gather data for site:
   - UAV Imagery ~ 1 cm
   - NEON Hyperspectral
   - NEON LiDAR
2. Create Orthomosaics from UAV Imagery
3. Identify Species in UAV Imagery
   - Train UAV imagery
     - grass, mesquite, cactus, bare ground
4. Supervised Classification Support Vector Machine
5. Reclass LandCover Raster
   grass -> 1
   everything else -> 0
6. Aggregate to 1 m and sum all grass pixels
   - create a grass percent raster



Difference between 1m and ~ 1cm data: UAV Drone 1 cm data used for reference data / training

7. Extract hyperspectral bands in NEON imagery and examine spectral signatures
8. Clip NDVI Raster to UAV extent
   - Raster to Point (capture grass percentage in point feature)
   - Extract Values to Points (associate NDVI values from clipped Raster to grass raster points)
   - mask out any category that is not grass

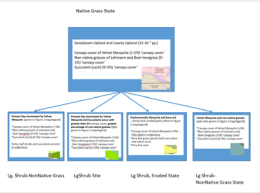


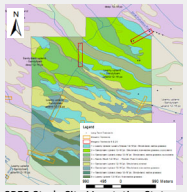
sample set

Ecological Site/Vegetative State/State and Transition

- Ecological Sites describe the plant communities potentially observed in an area based on soil and climate.
- They provide a consistent framework for classifying and describing rangeland and forestland soils and vegetation: thereby delineating land units that share similar capabilities to respond to management activities or disturbance.
- State and Transition Models (STMs) coupled to ecological sites specify indicators of ecological resilience and thresholds.
- Each ecological site features a distinctive STM that can contain several alternative plant community.

SRER Focus Area Natural State and Vegetative Transitions

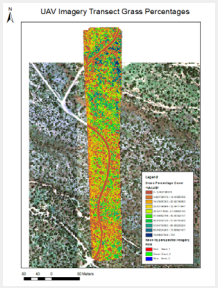


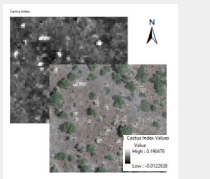


SRER Study Site Vegetative States

Preliminary Results and Discussion

- Percent grass cover analysis and training of NEON data is being developed. Percent grass detection with UAV data along with Hyperspectral image analysis should yield grass, mesquite, cactus, bare ground percent cover values.
- The data sets must be properly georeferenced in the creation of training samples
- The current analysis was completed with UAV imagery that was flown in the late spring compared to NEON data which was collected in August two years ago. UAV grass is senescent and NEON data was flown during the monsoon season.
- When correlating grass percentages to NDVI values it is important to properly mask the areas of non grass cover.
- Shadow effects, can skew the analysis.





NEON: Cactus Index $NDCI = (\rho_{RT2} - \rho_{RT1}) / (\rho_{RT2} + \rho_{RT1})$

References and Acknowledgements

1. Conley, C. & van Leeuwen, W. (2018, Oct). Woody Cover Species Mapping on Santa Rita Experimental Range Using Hyperspectral, LiDAR, and High Resolution SUAV Imagery. Poster session presented at the RISE conference, University of Arizona, AZ.
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3. Dan Robinett – Robinett Rangeland Resources LLC, 5-26-16