ColoradoView Sustainable Grazing: Final Report

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Project Overview

We are conducting vegetation classifications on the BX ranch and the neighboring State Land Board. This ranch is part of a Sustainable Grazing pilot and we are determining baseline vegetation conditions on the ranch so that we can assess improvements in land condition due to management alterations. Using ArcGIS we mapped the land cover of the area, classifying areas of different vegetation health, using property boundaries provided from Teresa Chapman, USDA NAIP imagery downloaded from EarthExplorer, and a base map. We want to document differences in vegetation classifications and try to determine which patches have maintained health (greenness and cover) throughout the past decade of drought. Ideally we will be able to use these methods to map the entire Southeastern shortgrass prairie of Colorado.

Objectives

To assess the utility of using remote sensing to determine baseline conditions and to quantify changes in vegetation cover due to implementation of integrated ranch planning on grazing lands in Colorado.

Question

What is the baseline vegetation cover on the BX and neighboring SLB ranches?

What has been accomplished?

For this project, we determined the methods necessary to accurately classify NAIP images of the study areas. We utilized the Support Vector Machine (SVM) classifier to classify the images into areas of upland grey herbaceous (assumed to be dead or senesced plants), upland live herbaceous, bare ground, water, riparian herbaceous, and woody tall. Using this method, we aimed for an accuracy rate of over 80%, which was achieved for the 6 tiles covering the ranch.

These tiles are:

m_3810463_nw_13_1_20150829
m_3810462_nw_13_1_20150920
m_3810455_sw_13_1_20150829
m_3810454_se_13_1_20150829
m_3810462_ne_13_1_20150829
m_3810454_sw_13_1_2015082

Guidance

Teresa Chapman was extremely helpful throughout the project, travelling to Fort Collins on a near weekly basis in order to give us suggestions, data, and other tips that would prove to be vital to the success of the project. She has been consistently available by phone, email or in person, to discuss questions or concerns that we may have encountered.

Teresa suggested we test the accuracy of several classifying algorithms, including support vector machines, maximum likelihood, and ISO unsupervised. The Support Vector Machine (SVM) classifier was the most accurate in our accuracy tests and became the primary method of classification for the project.

Methodology and Flowcharts

- **Downloading NAIP imagery**
    - Go to this website: http://www.fsa.usda.gov/programs-and-services/aerial-photography/imagery-programs/naip-imagery/
    - Scroll down to How can NAIP be accessed, click on the link: http://datagateway.nrcs.usda.gov/ or just click on this link: https://gdg.sc.egov.usda.gov/
    - Click on the green button on the right titled GET DATA
    - Select Colorado from the drop down menu
    - Select interactive Map - Custom
    - Select the area of interest
    - Download the most recent Ortho NAIP images
    - Then click on the link in the email to download

- **Changing bands**
    - Changed bands so they would display in NIR
    - Right click layer properties
    - Click the symbology tab
    - Change the bands

- **Making Training Samples**
  - Help files
    - http://desktop.arcgis.com/en/arcmap/10.3/guide-books/extensions/spatial-analyst/image-classification/creating-training-samples.htm
    - http://desktop.arcgis.com/en/arcmap/10.3/guide-books/extensions/spatial-analyst/image-classification/evaluating-training-samples.htm
    - http://desktop.arcgis.com/en/arcmap/10.3/guide-books/extensions/spatial-analyst/image-classification/managing-training-samples.htm

  - Make sure to turn on effects and image classification toolbar

  - **Process**

    - In classification toolbar click on

    - Once open click in classification toolbar
    - Draw a training sample, double click to finish
    - Name training sample

      - Can merge different polygons with

      - Can unmerge and reassign polygons with

    - To confirm classification use the slider in the effects toolbar to compare images

  - **Different classes**
    - 1. Bare ground
    - 2. Herbaceous dead
    - 3. Herbaceous Live (live grass)
    - 4. Woody tall (tree that you may encounter)
    - 5. Herbaceous Riparian (very green areas near watering holes and ditches)
    - 6. Water
    - To access histogram

    - To access scatterplot

    - To access statistics

   - To reset value column

- **Creating an image classification**
  - Click on classification in the classification toolbar
  - Click interactive supervised classification
  - Automatically will update and add to map

- **Segment Mean Shift Function**
- Process:
  - **Step 1**
    - Segment Mean Shift
      - Input Raster: NAIP 2015 Image
      - Output Raster Dataset: Image File (SMS_Image Name)
      - Spectral Detail: High (20)
      - Spatial Detail: (20)
      - Minimum Segment Size: (1)
      - Band Indexes: 4 1 2
  - **Step 2**
    - Create Training Samples using the Segment Mean Shift Image
      - Refer to February 16, 2016 Step 3
      - Order
        - Bare Ground
        - Herbaceous Dead
        - Herbaceous Live
        - Water
        - Herbaceous Riparian
        - Woody Tall
    - Train support Vector Machine Classifier
      - Input Raster: SMS_Raster
      - Input Training Sample File: Training Samples created above
      - Output Classifier Definition File: Image File (SVM_Image Name)
      - Additional Input Raster: NDVI image from the NAIP
      - Max Number of Samples Per Class: 0
      - Segment Attributes
        - Checked
          - Color
          - Mean
          - STD
          - Count
  - **Step 3**
    - Classify Raster
      - Input Raster: SMS_Raster
      - Input Classifier Definition File: .ecd created from Step 2
      - Output Classified Raster: Image File (SVM_Image Name)

- Additional Input Raster: NDVI image from the NAIP

- **Accuracy Assessment**
  - Random Point Creation
    - Search create random points
    - Click tool
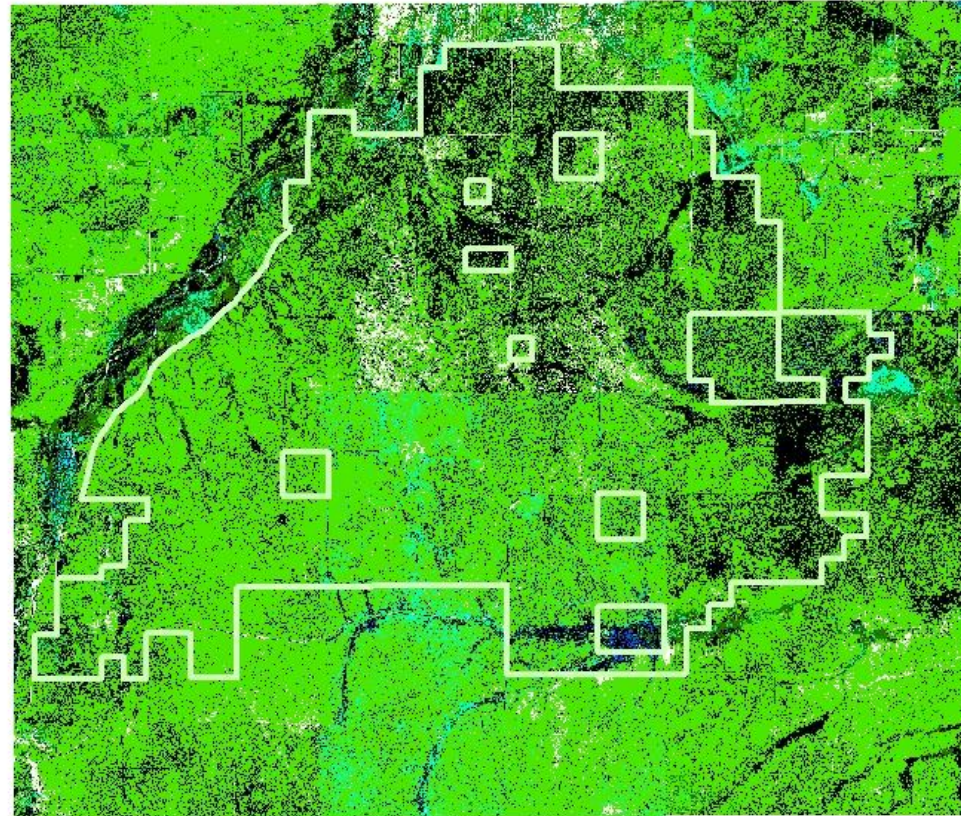   - Name the output feature class

- Constraint feature class is the layer of interest
- Minimum Allow Distance = 100 yds

- Classifying Points
  - Turn classification off, leave ortho image on
  - Open Attribute Table for points
    - Create a field titled observed
  - Open editor toolbar
  - Check points and label by value classification number in attribute table
    - If points are unclear move to a near known location
    - Once done spatial join points and classification

- Determine which of the three sampling methods are better by accuracy testing

  - IsoCluster, Maximum Likelihood, and **Support Vector Machine** (this is the method we utilized)

- **Process to Accuracy Assess Points**
  - Create Observed column with what the observed value
  - Once all points are created
    - Search extract values by points
      - Input point feature: Random Points
      - Input Raster: SVM raster
      - Output: in image folder
  - Selection by Attributes
    - Select Layer: Accuracy Assessment Points
    - Equation: Observed_2=RasterValu
  - This will give you your accuracy assessment of how close you are to being right
  - Our goal was at least **80% accuracy**
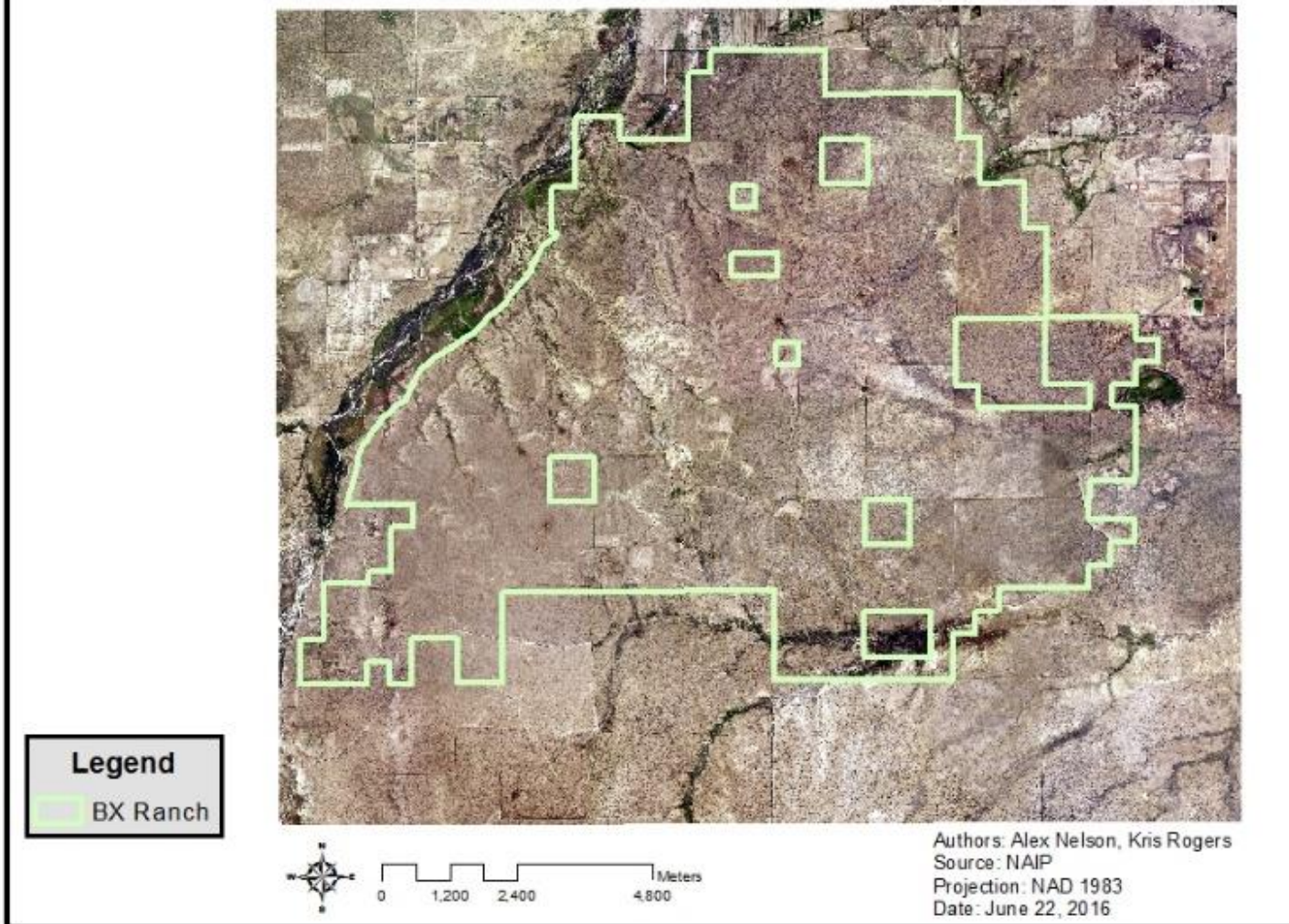
View of BX Ranch using NAIP 2015 imagery.
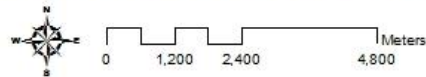
View of BX Ranch following the classification of land cover in 2015 NAIP imagery

Final Reflection

This project will prove to be extremely helpful in the field of conservation as an example of how researchers can map the cover and condition of grasslands. Specifically, this project could potentially be replicated throughout a much larger range in order to determine the scale of grassland health and monitor conversion of grasslands to bare ground. There were a few challenges that arose that slowed the progress of the project periodically. One challenge revolved around the classification of similar categories that the program struggled to differentiate between. For example, classifying woody tall and herbaceous riparian vegetation often overlapped to the extent that the generated classifications were inaccurate. Another challenge we faced was determining which classifier was the most efficient for this project. After trying IsoCluster, Maximum Likelihood, and Support Vector Machine, we found that the Support Vector Machine (SVM) classifier worked best with our images and groups. This project can potentially be replicated for use in tracking the decline of vegetation cover and increase in healthy grasslands.