Applying Remote Sensing and Definiens eCognition Developer 8 to Estimate Tree, Shrub, and Intercanopy Vegetation Cover of Pinyon-Juniper Woodlands in the Great Basin.

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Joint Fire Science Program

Sagebrush Steppe SageSTEP Treatment Evaluation Project

Research

Research is needed to determine relationships between remotely sensed (RS) imagery, geographic information systems (GIS) and ground-reference vegetation data to support management of the sagebrush biome.

Objectives

1. Develop image-processing approaches that best estimate vegetation attributes in pinyon and juniper communities.
2. Assess the relationship between RS and GIS technologies with field- based measurements collected from SageSTEP to estimate vegetation attributes using high resolution (0.06 m pixel resolution) color imagery captured in 2009.

Methods

Study Location:

Stansbury is a SageSTEP Utah juniper-pinyon woodland located in Tooele Co., UT. Site represents all woodland phases (I, II, and III) and ranges in elevation from 1700 m to 1830 m (5600-6000 ft). Common vegetation includes: Utah juniper, mountain big sagebrush, bluebunch wheatgrass and Sandberg bluegrass. Subplots are 30 m^2 with five subplots per woodland phase.

Acquisition of imagery:

High-resolution color imagery was captured in 2009 using a turbocharged Cessna 206 aircraft equipped with a Vexcel UltracamX digital camera with forward motion compensation, airborne GPS capabilities and an ApplAnix inertial measurement unit (IMU).

Ground Sampling:

All tree species > 0.5 m in height that were rooted within the subplot were measured using the crown-diameter method (Mueller-Dombois & Ellenberg 1974). Line intercept and point methods were used on 5, 30 m vegetation transects to estimate shrub canopy cover and herbaceous species cover.

Image Processing and Analysis:

Was conducted at the Brigham Young University Geospatial Habitat Analysis Lab using Definiens eCognition Developer 8 software. We used a multiresolution segmentation algorithm embedded in eCognition which is based on three parameters: scale, spectral information, and shape (Fig. 1, Table 1). Once segmentation was complete, classification was performed using the segmented objects. To classify vegetation, we used hue, saturation and intensity which converted RGB colors into HSI values which range from 0 to 1 (Fig. 2).

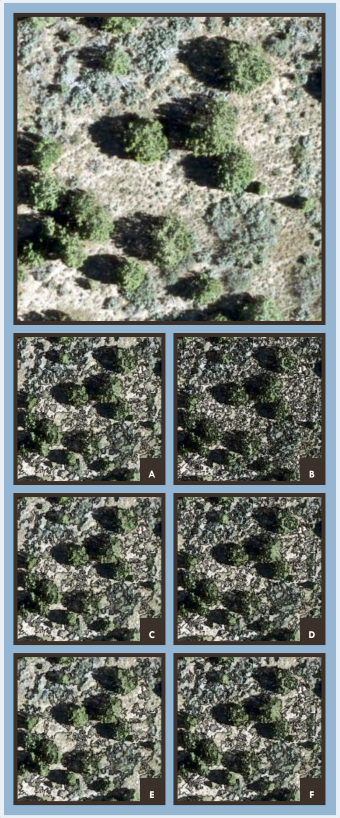

Fig. 1. Example of image segmentation. Dark lines represent image object boundaries for each of the segmentation parameters.

Table 1. Segmentation Parameters:

Level	Scale	Shape	Compactness
A	400	0.9	0.5
B	400	0.5	0.5
C	600	0.9	0.5
D	600	0.5	0.5
E	800	0.9	0.5
F	800	0.5	0.5

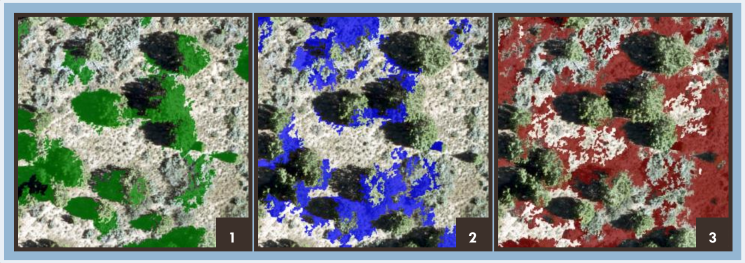

Fig. 2. Example of classification based on hue, saturation and intensity.
1. Juniper cover (C*) 2. Shrub cover (A*) 3. Herbaceous cover (D*).
*Segmentation Parameter

Results/Conclusions

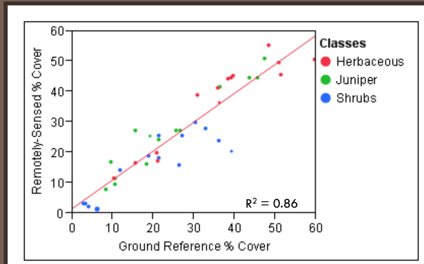

Fig. 3. Level B classification for all classes.

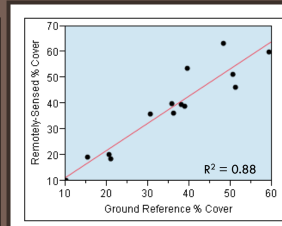

Fig. 4. Level A classification for herbaceous vegetation.

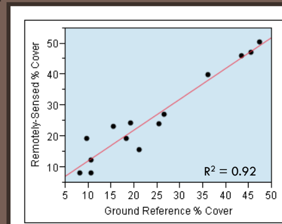

Fig. 5. Level D classification for juniper.

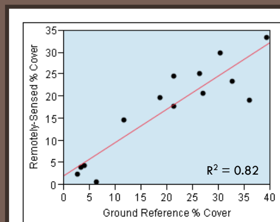

Fig. 6. Level F classification for shrubs.

The multiresolution segmentation parameter that best estimated, or distinguished the greatest spectral differences between all vegetation classes using HSI values was segmentation level B (Fig. 3). Level B was set at 400 (compared to 600 and 800) which produced the smallest sized objects. When evaluating vegetation class into individual groups, we see mixed results that can be contributed to shape criteria differences as well as scale (Fig. 4, 5, and 6). A lower shape value (0.5) results in objects more optimized for spectral heterogeneity. Therefore, with a high shape value (0.9), we have reduced the quality of the spectral segmentation (Definiens, 2009).

Further segmentation and classification techniques need to be developed to better estimate vegetation cover. Hue, saturation, and intensity layers were good initial indicators for distinguishing between vegetation but texture, patterns, and neighbor relation variables should be further evaluated to distinguish shadows, bare ground, and overlapping vegetation. Although the accuracy of the different levels varied, it provided valuable insight for further refinement of the classification process using eCognition 8.

More segmentation and classification variables need to be evaluated to determine which variables will be most appropriate for future classification of pinyon-juniper woodlands in the Great Basin.

Future Research

Utilize high-resolution color, color-infrared, multispectral, and hyperspectral imagery with ground-reference field data to increase our understanding of how remotely-sensed imagery can be used to better determine the highest scale and most rapid methods to accurately assess fuel loads and vegetation responses for the purposes of fuel management planning and evaluation on pinyon-juniper woodlands across the Great Basin. Fuel reduction treatments to be further investigated include Bullhog ®, mechanical cut, and prescribed burn (Fig. 7).

Fig. 7. Fuel reduction treatments. High resolution RGB imagery (0.06 m spatial resolution) for Bullhog ® (A), mechanical cut (B), prescribed burn (C), and example of color-infrared (D).

Literature Cited

Definiens, 2009. eCognition Developer 8 Reference Book, Version 1.2.0, User Guide, Definiens AG, München, Germany, 34-38 p.

Mueller-Dombois, D., and H. Ellenberg. 1974. Aims and Methods of Vegetation Ecology. New York, NY, USA: John Wiley and Sons. 81-92 p.

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