OBJECT BASED IMAGE CLASSIFICATION IN CALIFORNIA OAK WOODLAND ECOSYSTEMS

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Introduction

River Ridge Ranch is a unique combination of working cattle ranch and ecological reserve set in the foothills of the southern Sierra Nevada Mountains in Tulare County, California. It is part of 2-million acres of intact blue oak woodland ecosystems that run from the Tehachapi Mountains up to Fresno (*Figure 1*).

Figure 1. Study Area

These ecosystems are of vital importance to many stakeholders that rely on these systems for their survival, human and wildlife alike (*Figure 2*).

The ranch is managed by the River Ridge Institute, headed by Dr. Gary Adest, who has made it his priority to practice and demonstrate regenerative and sustainable land management.

Through this partnership with CSULB, the ranch has become the subject of student research in vegetation mapping, UAVs, remote sensing, and LiDAR systems.

This study focuses on (1) using UAV obtained imagery to derive a vegetation classification map using object-based segmentation, (2) determine tree canopy coverage of various oaks, and (3) field check the results of the segmentation and classification.

Figure 2. Blue Oak Woodland

Data Sources

Imagery used in the analysis was obtained from UAV flights.

Date: March 30th, 2018
Sensor: senseFly/Parrot Sequoia 4-band multispectral camera
Aircraft: senseFly eBee+ fixed-wing UAV
Pilots: Scott Winslow and Duncan MacIntosh

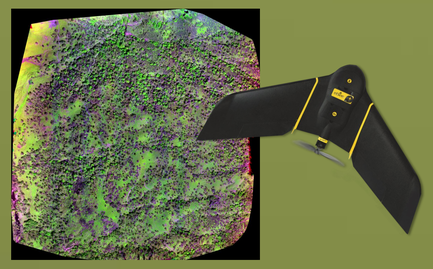

Figure 3. UAV Image and eBee+

Methodology

Three processing softwares were used throughout the analysis: Pix4D, ArcMap, and Avenza (*Figure 4*).

Data Pre-Processing:

(1) Mosaic of UAV captured tiles into single image (credit: Duncan MacIntosh), (2) layer stack of all 4 bands, (3) 'Clip' the raster extent to the study area (Block C), and (4) 'Split Raster' into 4 smaller subsets.

Analysis:

(1) The segmentation, classification, raster conversion, and area calculation process can be found in the spatial model (*Figure 5*). The segmentation, training sample selection, and classification process warranted many iterations until satisfactory results were found. After that, (2) 'Select by Attributes' was used to isolate the class of interest and (3) the 'Summarize' tab within the attribute table was accessed on the area field to find the total tree canopy coverage.

Field Sampling:

(1) Random samples of different species were collected in the field using the Avenza phone application and (2) points were compared to the classification map to help inform class identifications and accuracy.

Figure 4. Software Used; Pix4D, ArcMap, Avenza

Methodology (continued)

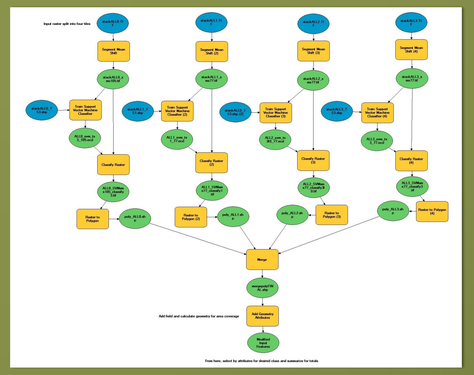

Figure 5. Spatial Model of Methodology

Results

Initially, class names were based on simple descriptions until after the field sampling.

Once checked in the field, California buckeye (*Aesculus californica*) filled a single prominent class. What was originally labelled 'transition veg' encompassed two found species of oak, blue oak (*Quercus douglasii*) and interior live oak (*Quercus wislizeni*). Non-Vegetated included any dead, leafless, or burned vegetation, as well as lichen covered rock (*Figure 6*).

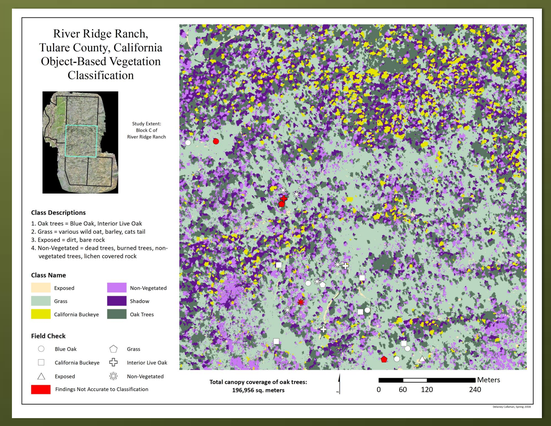

Figure 6. Final Map Composition

Total canopy coverage of oak trees in Block C of River Ridge Ranch equalled 196,956 square meters.

Out of 24 field sample locations, there were 5 statistical map classifications were inaccurate compared to ground surveys. Two incorrect classifications of grasses, one of non-vegetated cover, and one of blue oak.

Discussion

Overall, I was pleased with this segmentation and classification methodology within ArcMap. While not 100% accurate in all sections of the raster, the majority was classified correctly. The greatest overlap within classes occurred between grasses and oak trees, where distinctions in reflection was more nuanced given the time of year the imagery was taken. Regardless, I am confident in the results of this analysis.

Perhaps the most excited aspect of the project was the ability to isolate a single species. Ideally, the methodology would be refined further to extract more species level distinctions. This would include separating the oak trees class into each specific species of oak. I believe, with additional imagery dates in which to analyse, this would be possible. Interior live oak is an evergreen species which retains leafy greens year round, while blue oaks are deciduous and shed their leaves seasonally. This defining phenological difference holds the key to a time-series classification of species.

The main limitations included time, both in the lab and in the field. In the lab, selecting training samples that then translated into an accurate classification was the most time consuming aspect of this project. Figuring out the optimal number of training samples, sizes of samples, and distinct enough statistical signatures was challenging. In the field, more time would have produced a greater number of sample locations in which to check the classification. More sample locations would have created more significant findings in accuracy.

For the Future

Improvements:

- Additional and randomized field sample collections

Continued Developments:

- Unsupervised methodology
- Classification using stacked images across time
- Different statistical segmentation and classification options are available to use in endless combinations across multiple platforms

Sources and Acknowledgements

Sources: riverridgeinstitute.org

For additional information please contact:

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