DEVELOPING A GPS BASED TREE INVENTORY METHODOLOGY FOR ASSESSING VEGETATION CHANGE: A CASE STUDY OF THE RIVER RIDGE INSTITUTE

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Introduction

Geospatial technologies like GPS, GIS software, and remote sensing can be very effective tools for researchers wanting to understand land change and land cover. Non-profits in many cases have difficulty utilizing geospatial technology because of lack of resources and funding. This project focus on measuring tree parameters and historical imagery of a study site to understand ecological changes using GPS and GIS technology. The case study for this project was the River Ridge Institute, located in the Sierra Nevada Foothills in Springville, California.

The goal of this project was to gather new data that would benefit the Institute which was interested in learning more about the heights and widths of the oak trees that they manage. Using a Trimble Geo7x GPS unit, a Laser Tech TruPulse 360 laser rangefinder, a measuring tape, and a Suunto clinometer it was possible to record accurate and precise tree measurements in the field.

Photo 1. Pasture 1 showing Blue Oaks

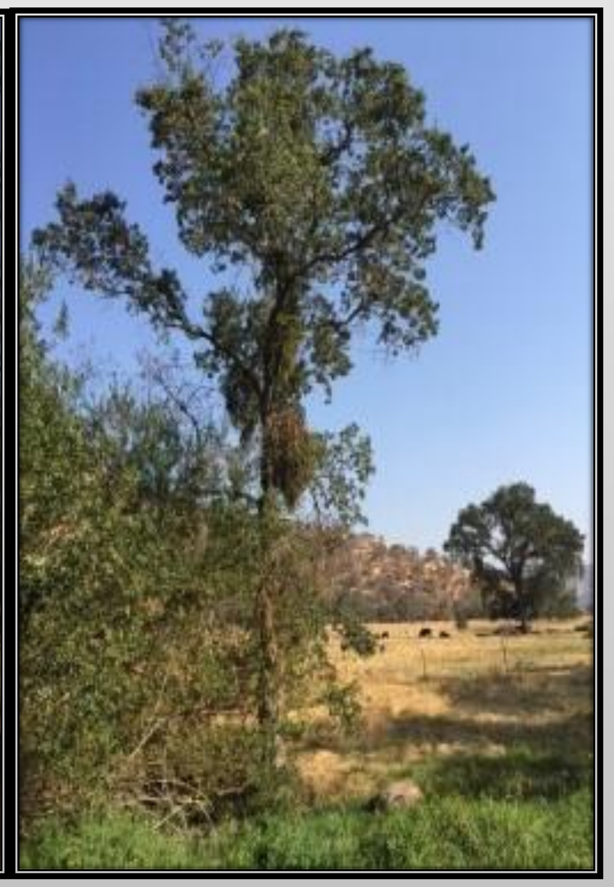

Photo 2. Pasture 2 showing Valley and Interior Live Oaks

Visual Model

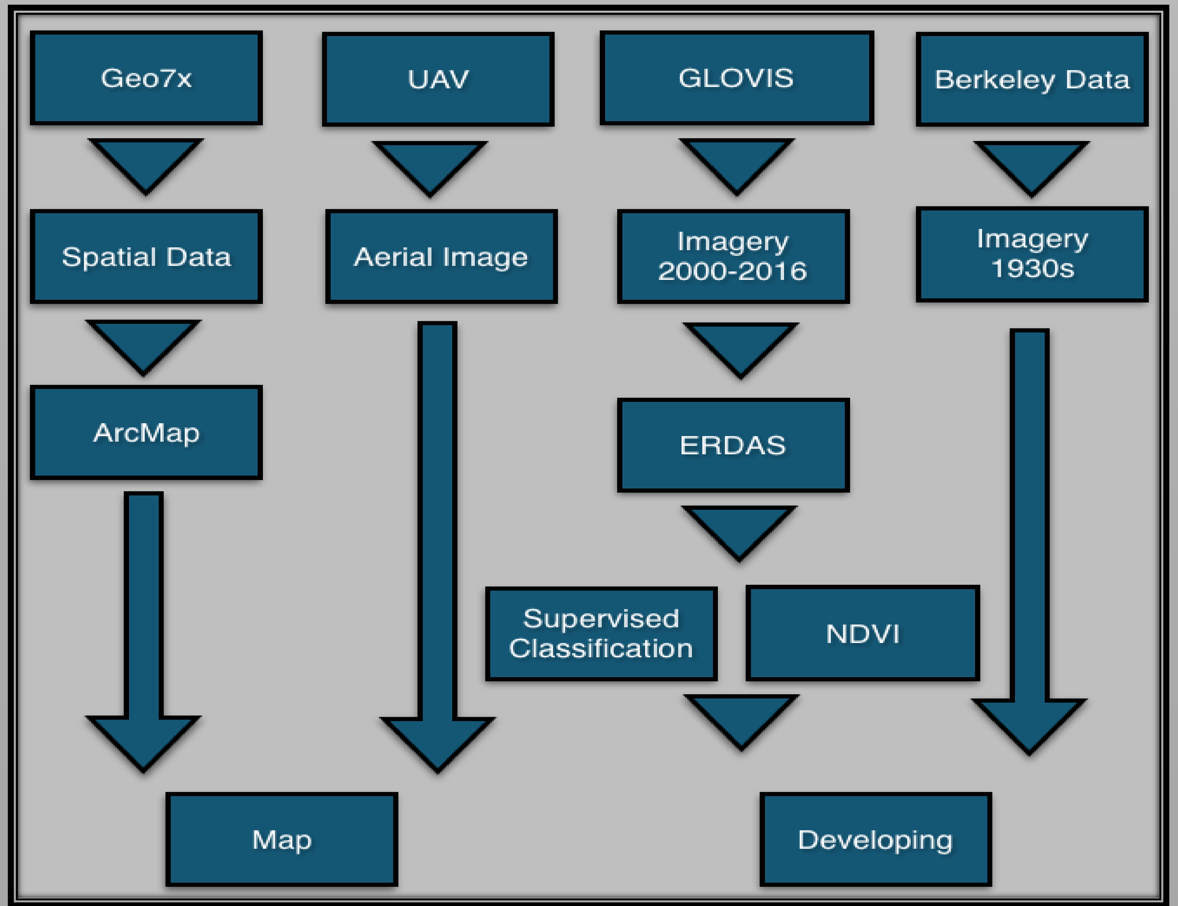

Figure 1. *Methodology for the Institute*

Methodology

The Suunto clinometer was used to collect tree height. My colleague would hold the measuring tape at the base of the tree and I would walk about 25 to 40 feet depending on the size of tree. I would take the clinometer and with both eyes open I would record the base of tree in degrees and percent, the final step was to take measurement of tree canopy at its highest peak. This was repeated for few more trees. Bias may have been introduced since I wear glasses and my hands shook a lot.

A Laser Tech TruPulse 360 laser rangefinder was more effective in gathering tree height measurements. It recorded distance, bottom and top of tree. Once this information was recorded on the top right corner of the visual it provided the height of tree to record on paper. This method was quicker than Suunto clinometer, especially for the number of trees that needed to be surveyed.

The Trimble Geo7x had the highest level of accuracy and precision. Not only was I able to record distance, bottom and top of tree, but also tree width. The level of accuracy depended on the user. There were 1-shot, 2-shot and 3-shot commands for recording tree height and 2-shot and 3-shot for recording width. Using the 3 shot command for height and width provided better data collecting than I would have gotten from Suunto clinometer or Laser Tech TruPulse 360 laser rangefinder.

Photo 3. Suunto Clinometer, TruPulse Rangefinder and Trimble Geo7x

Timeline

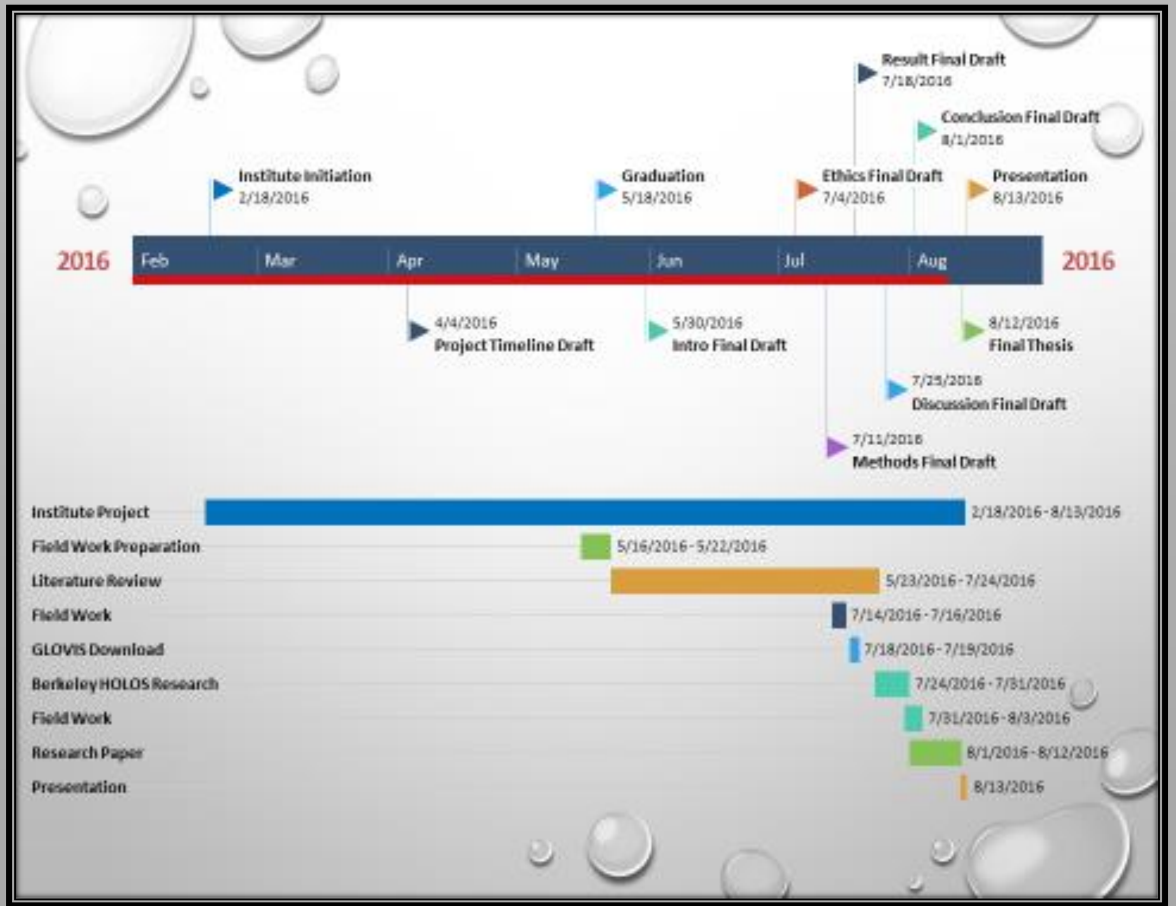

Figure 2. *Timeline for Institute Project*

Results

Using TerraSync software in the Trimble Geo7x I was able to georeference the 89 trees surveyed. After transferring this data into Pathfinder Office and differently correcting the points I was ready to use this information in ArcMap. Using the Institute's vector shapefiles I was able to create a thematic map accurately showing, trees, fences, property boundary, trails, rivers and creeks (Figure 3).

The field work data gathered was transferred to excel spreadsheet to create two bar graphs displaying tree height and width for all 89 trees. Figure 4 shows a 3-D clustered column for tree height. The average tree height at the three study sites was 16.7 meters. Pasture III, which has the most trees, holds the most diversity and highest trees, that is, until Pasture IV becomes managed by the Institute. Figure 5 used the same methodology to graph tree width. The average tree width at the three study sites was 16.1 meters.

Historical data is also important when studying oak woodlands. The University of California Berkeley and Davis have been working on restoring Wieslander Vegetation Type Maps created in the1930s. Digitizing and storing information in a geographic information geodatabase will help researchers understand past, present and future vegetation changes in California. Figure 6 shows blue oak woodlands in quadrangle 112, where the Institute is located.

Figure 3. *Institute Thematic Map*

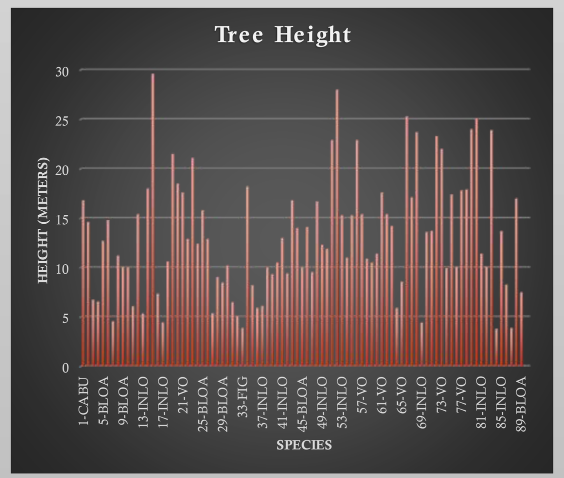

Figure 4. *Oak height in meters*

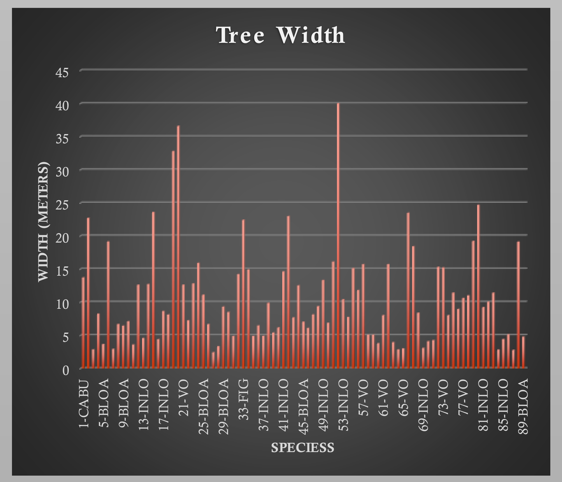

Figure 5. *Oak width in meters*

Figure 6. *Wieslander Vegetation Type Map (VTM) in Tulare County*

Discussion

In this project I used various tools for recording tree parameters in the field. High-end equipment like the Trimble Geo7x is ideal for managing vegetation data. The problem is that this equipment is not always available so it is important to look at alternatives like a Laser Tech TruPulse 360 laser rangefinder that provides the same features at a lower cost. The Suunto clinometer is an effective tool that many researchers carry with them to get an estimation of trees in the surrounding landscape, but for a tree inventory analysis at the Institute, accuracy and precision equipment is ideal.

There is still more work that needs to be done for the Institute. I will be using ERDAS to measure NDVI from Landsat Imagery gathered from USGS GLOVIS. I will also be using supervised classification scheme to map out the southern Sierra Nevada Foothills in California. Last, I will continue working on the historical component of this project by gathering information on oak woodlands from the digitized work conducted by U.C. Berkeley and Davis.

While conducting field work it was important to minimize disturbances. Cattle are part of the Institute and are rotated daily to diminish long term degradation from traditional intense cattle practices. Cattle are not allowed near the Tule river so it was important to remember to leave gates as you found them. When leaving the premises after field work I would double check I did not leave any gates open. Also during field work I would have to hop around from pasture to pasture since cattle would be laying next to the oak trees. I would definitely not go into a pasture if a bull was near the oak trees. Researchers need to keep in mind that were are guest in these environments and respect and care for these species is our responsibility.

Conclusion

Future work on this project will be creating an interactive web page. The Institute already has team of experts helping create a geodatabase in the following disciplines: geomorphology, hydrology, geology, environmental science, and ecology. This data will facilitate the creation on an interactive web page that will help bring awareness of the Institute and their mission of creating an ecological system that benefits everyone. Using ArcMap Pro I can display geographic information to tell the story of the Institute. Showing different web layers the Institute can educate their visitors and expose them to GIS, which is a great tool for scientist to use for research.

Acknowledgements

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