Evaluation of remote sensing approaches for population analysis of an endangered Texas shrub oak

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INTRODUCTION

- The Shinnery Oak is an endangered short rhizomatous shrub of 2m native to the southern Great Plains of North America. It plays a keystone role in its community, yet over one million acres of the oak have been eradicated.
- The lack of research on the species has left many unanswered questions; questions that our study hopes to answer.
- **Aim:** Utilize UAV imagery to monitor the long-term growth and phenology of the Shinnery Oak and optimize the best way to conduct routine aerial surveys, assess the accuracy of these photos, and establish a workflow to carry out the analyses.
- This is a new research technique for this type of research, so it is exploratory without established methods for this particular purpose.

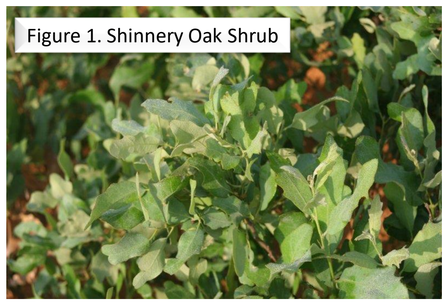

Figure 1. Shinnery Oak Shrub

Figure 2. Study Site in Texas

MATERIALS

- Agisoft Metashape, Litchi for DJI drones, DJI Phantom 4 drone, and camera model FC330.
- The study site was in Western Texas (276m x 184m). Images were taken in June 2021 and January 2022. Two mottes of varying size were analyzed.

METHODS

Flight Settings

- June 2021: 0.694 m/s speed, a side overlap of 26.7 m (69%), shutter speed of 1/320.
- January 2022: 4 m/s speed, image front overlap of 16 meters (75%), and a shutter speed of 1/314.564 - 1/899.281.

Flight Angle Comparison

- Visually compared 4 separate image angles to determine which would be most optimal: Nadir, Oblique angle 8°, Oblique angle 15°, and all 3 angles combined (Figure to left)

Filtering Parameters

- We then experimented with less aggressive filtering for our data from January 2022, from both nadir and oblique angles combined to obtain more accurate orthomosaics

RESULTS

Figure 3. Orthomosaic from June 2021 is visibly better with higher point density, more color, and better exposure.

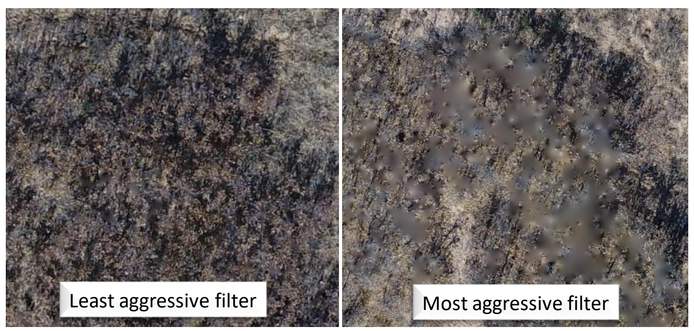

Figure 4. Least aggressive filtering orthomosaic has visibly less blurriness.

	Combined	Nadir	Oblique 8°	Oblique 15°
Error deg	0.560-17.637	1.606-15.903	2.208-18.190	0.826-8.151
Resolution (pixel/cm)	11090x12524, 1.71 cm/px	25390x18064, 1.47 cm/px	21384x15224, 1.86 cm	25229x19442, 1.48cm
# images	824	274	270	280
Error Pix	0.171-0.255	0.167-0.218	0.202-0.269	0.160-0.235

CONCLUSIONS

Seasonal differences: When factors such as foliage, foliage color, and natural lighting are of best quality, the image sets produce better orthomosaics. Denser vegetation areas require more images in blurry areas.
Filtering parameters: Less aggressive workflow parameters created the best visible quality.
Flight settings: Slower flight speed and higher front overlap contributed to superior imagery.
Angle comparison: Combined nadir and oblique camera angles provided the most accurate orthomosaic.

These factors create better quality images because they create greater amounts of image tie points. However, this would increase flight time and cost, and deplete battery life.

FUTURE WORK

- Take more images in April 2022, when the shrub is fully grown and has greater foliage
- Use R package tools to create a digital Terrain Model from UAV generated point clouds, find potential tree positions using a canopy height model, and compare RGB indices to compare color between image sets.

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