Using Drones in the Pastures

Jaymelynn Farney, PhD
Beef Systems Specialist

Outline

- History
- Measuring biomass
- Tracking woody encroachment
- Counting cattle

- Other things on the horizon

History

History

- Gold-standard for biomass estimation is destructive sampling
  - Issues: labor intensive, local/spot specific, impassable areas of some pastures
- Simple grazing stick
  - Calibrate height of forage to biomass
- Use of tools such as rising plate meter or falling plate meters have been found to estimate some monoculture pastures
  - $R^2 > 0.80$
  - Rising plate meter generally a purchased product
  - Falling plate meter you can make at home

(https://ext.vt.edu/content/dam/ext_vt_edu/topics/agriculture/graze-300/Falling-Plate-Meter-For-Estimating-Pasture-Forage-Mass.pdf)

Plate Meters

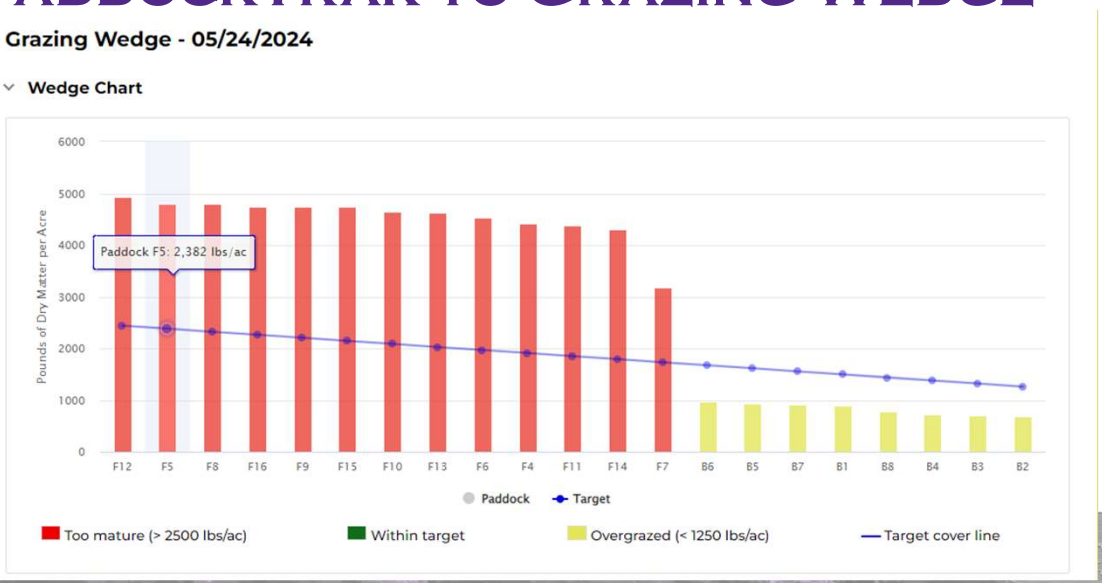
Falling Plate Meter

Rising Plate Meter

A C-Dax Pasture Meter

Video Session

PaddockTrak to Grazing Wedge



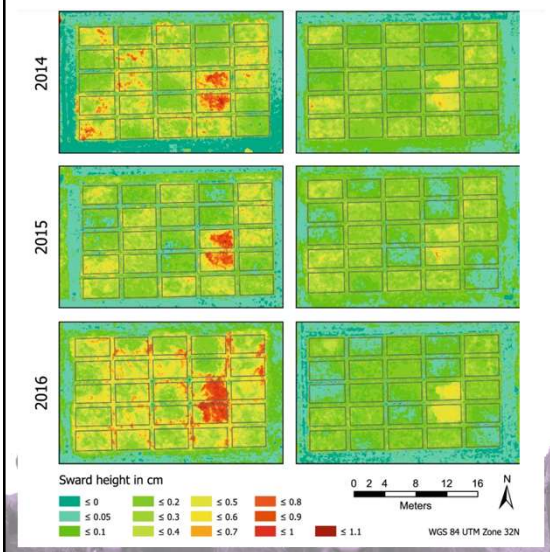
We have these other technologies

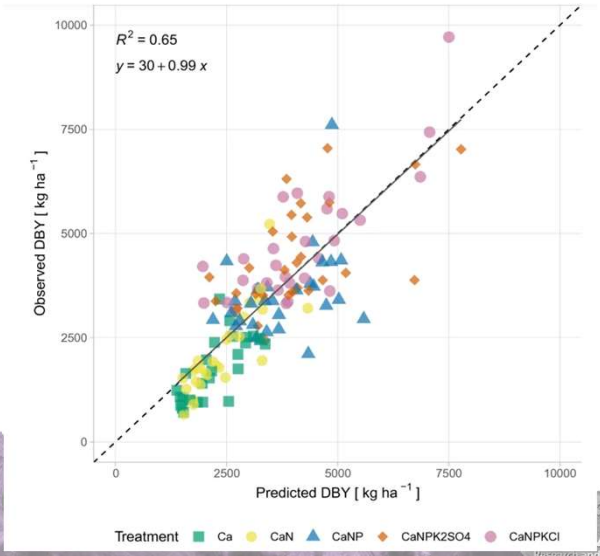
Why should I be interested in using UAV?

Using Drone to Measure Biomass

- 1st question – does it work?
  - Several different forages show it has high correlation to destructive methods
  - Tallgrass native range, tall fescue, Brachiaria pastures, ryegrass
- Is it producer friendly?
- What are other specifics I need to know??

Data from 10 years ago





https://link.springer.com/article/10.1007/s41064-020-00117-w?fromPaywallRec=true

Drone to Measure Biomass

Fig. 1. Clipping of aboveground biomass within a 1 m^2 area outlined with white PVC piping. Two upturned buckets at opposite corners of the clipped area served as ground-level references and two parallel white vinyl strips served as location identifiers.

Fig. 2. Visible light image captured during UA flight. White circles are upturned buckets of identical height with rims touching the soil surface. A PVC metre square frame outlines the vegetation sample. Vinyl panels are arranged to identify the sample location. A virtual transect crossing the frame between buckets is used to determine average vegetation height of the sample during analysis.

www.publish.csiro.au/journals/ijwf

Drone Measure Biomass

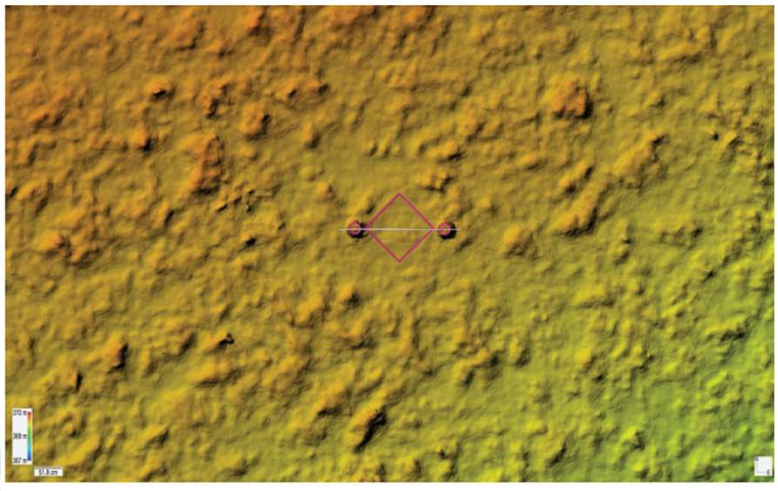
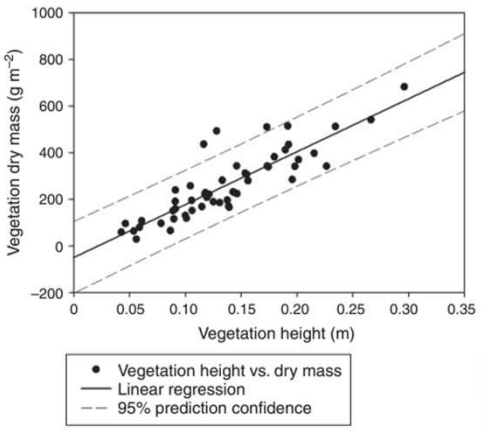


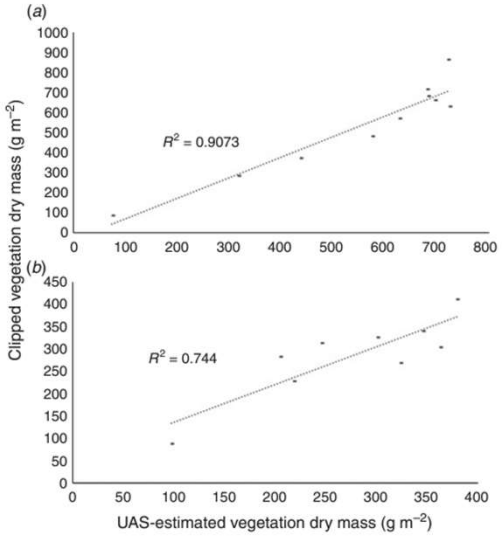
Fig. 3. Colourised digital surface model of the area depicted in Fig. 2. The square is the sampled area. The two circles at opposite corners are the rims of buckets used for ground height references.

www.publish.csiro.au/journals/ijwf

Fig. 2. Visible light image captured during UA flight. White circles are upturned buckets of identical height with rims touching the soil surface. A PVC metre square frame outlines the vegetation sample. Vinyl panels are arranged to identify the sample location. A virtual transect crossing the frame between buckets is used to determine average vegetation height of the sample during analysis.

Drone Measure Biomass





www.publish.csiro.au/journals/ijwf

Equipment Needs

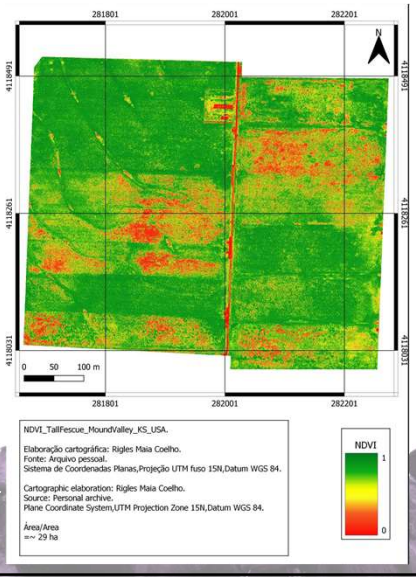
- Drone
  - Specific shutter speeds, frame size, tremble, might need color shields
- Buckets
- Subscription to data and image processing systems
- Insurance
- License

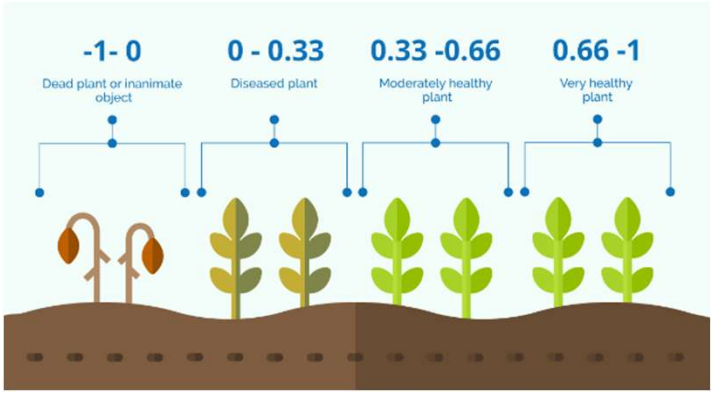
Remotely Piloted Aircraft Systems (RPAS)

- Study conducted at SEREC on fescue pastures (n = 15)
- Drone equipped with Mapir Survey 3W sensors (12 mp 6.20 x 4.65 mm, and f/2.3) with RGNIR (red: 550, green: 660, near infra-red [NIR]: 850 nm) and Red Edge (RE; 725 nm) filter transmission settings
- Pix4DFields software

- Spectral value **low R^2 = 0.44** but forage height estimates **R^2 = 0.75 were OK**

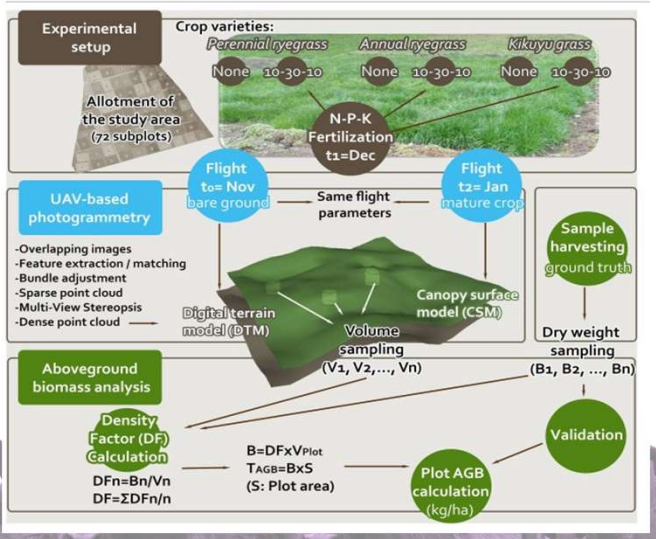
SEREC Fescue Study

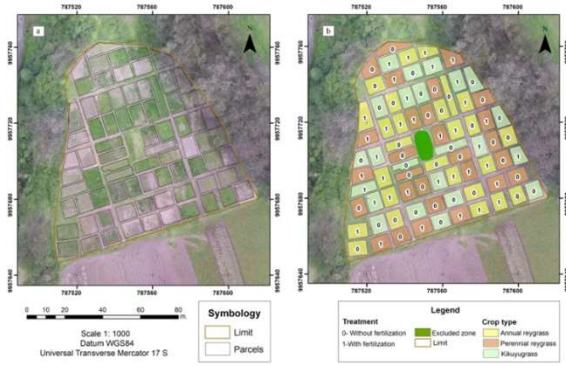




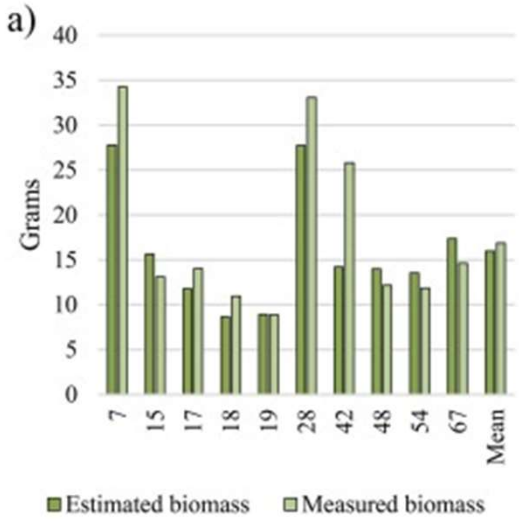
https://www.auravant.com/en/articles/precision-agriculture/vegetation-indices-and-their-interpretation-ndvi-gndvi-msavi2-ndre-and-ndwi/

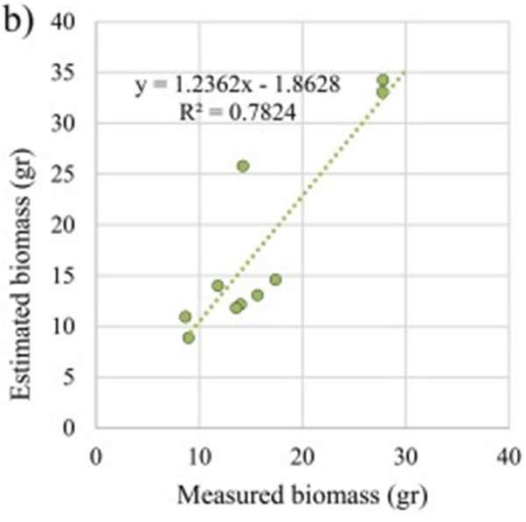
Ryegrass Measurements of Biomass





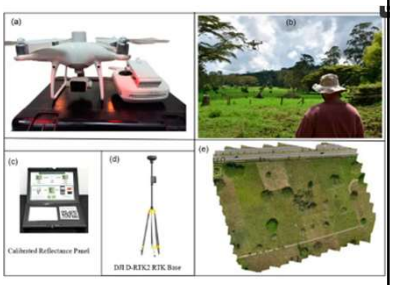
Ryegrass Study



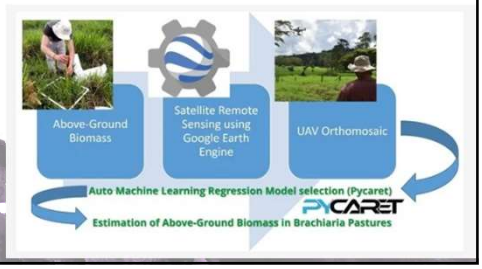


Is it Producer Friendly??

- Several steps right now to convert photo to data
- Companies are working on online tools
- Machine Learning has been actively investigated



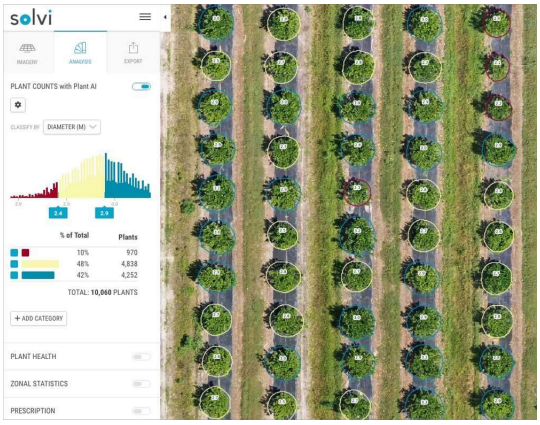
https://www.mdpi.com/2072-4292/14/22/5870



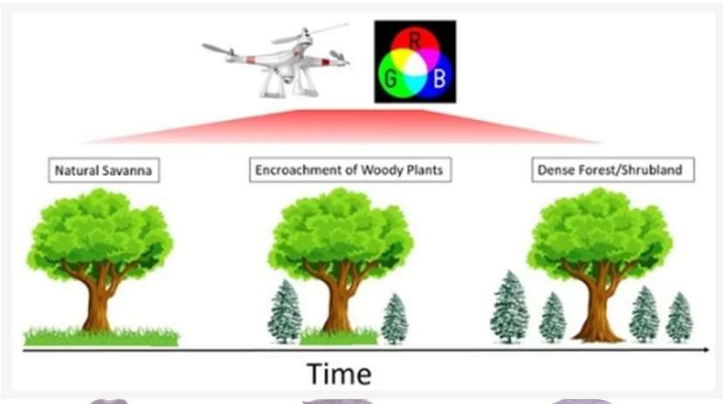
What other Specifics Do I need to Know???

- Safety and protect your rear-end
- Use things like AMA to get some certification and liability insurance for low cost
- Make sure you research the drone before you buy
  - Specifics about flying height, do you need filters, will your pastures work to keep LINE of SIGHT?

Tracking Woody Encroachment



Drones for Woody Encroachment



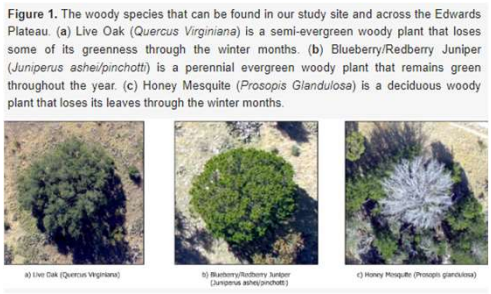


Figure 1. The woody species that can be found in our study site and across the Edwards Plateau. (**a**) Live Oak (*Quercus Virginiana*) is a semi-evergreen woody plant that loses some of its greenness through the winter months. (**b**) Blueberry/Redberry Juniper (*Juniperus ashei/pinchotti*) is a perennial evergreen woody plant that remains green throughout the year. (**c**) Honey Mesquite (*Prosopis Glandulosa*) is a deciduous woody plant that loses its leaves through the winter months.

a) Live Oak (Quercus Virginiana)
b) Blueberry/Redberry Juniper (Juniperus ashei/pinchotti)
c) Honey Mesquite (Prosopis glandulosa)

https://www.mdpi.com/2072-4292/14/7/1665#:~:text=Overall%2C%20our%20findings%20show%20that,sensors%20in%20more%20diverse%20landscapes.

Figure 3. The 3 data layers created to improve the traditional and classical machine learning classifications. (**a**) The 10 cm orthomosaic. (**b**) The Green-Red Difference layer only discerns junipers (displayed as dark brown). (**c**) The Green Leaf Index layer is able to discern the mesquites (displayed as dark green) and the juniper (displayed as brown). (**d**) The Canopy Height Model layer discerns the tops of individual woody plants with lighter green/brown and the edges of tree canopies as darker green.

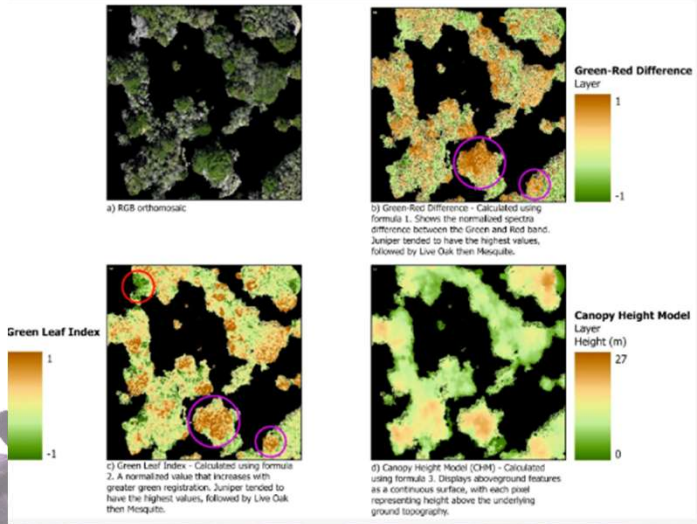


Figure 6. Labeled training images used to run the VGG-19 CNN. Images were carefully selected to accurately represent the class features in our study area. (**a**) A labeled image containing juniper and live oak, as well as some open area. (**b**) A labeled image containing a heavily forested scene with all three woody plant species. (**c**) A labeled image containing an open area, juniper, live oak, and large shadows.

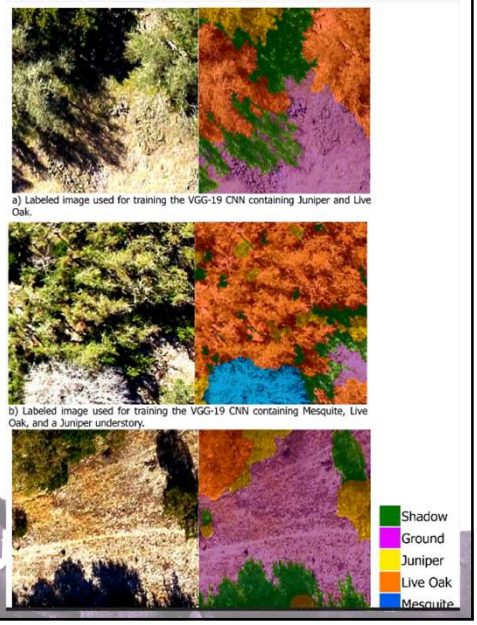
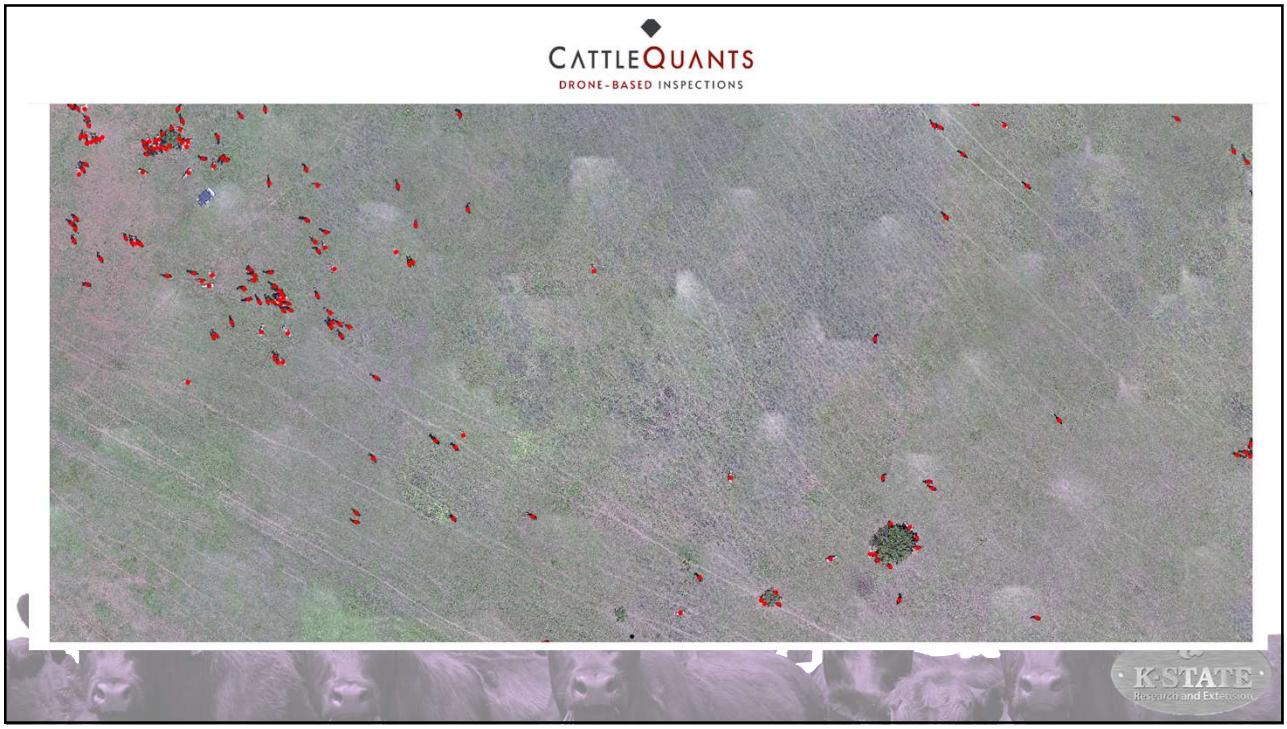


Figure 7. A comparison of the 3 traditional and classical machine learning algorithms used to classify the woody plant species in our study area. (**a**) The 10 cm orthomosaic. (**b**) ML tended to overestimate mesquite cover, as well as total tree cover with what was generally shadow. (**c**) RF was similar to ML, overestimating tree cover with shadow. (**d**) Overall, SVM was more robust in parsing between shadow and canopy cover for the three tree species.

Counting Cattle with Drones



CATTLEQUANTS
DRONE-BASED INSPECTIONS

Research and Extension

How It Works

1. Collect Images

Collect aerial images via drone...

2. Process Images

...run them through our AI-powered counting software...

3. Provide Report

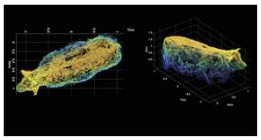
...and give you a detailed inventory report.

K-STATE Research and Extension

What Else is Being Investigated

On the Horizon

- Drone are ready for implementation – hold up is data processing and understanding



- Body weight algorithms from drone photos in pasture
- Animal Identification
  - Facial and body shape and color patterns
- Health assessment
- Calving identification

Questions

Jaymelynn Farney
jkj@ksu.edu
620-820-6125