


Using Drones to Assess Feral Swine Damage on a Florida Rangeland

Raoul K. Boughton, Bethany R. Wight, and Wesley M. Anderson
Department of Wildlife Ecology and Conservation
Range Cattle Research and Education Center
University of Florida

UF IFAS UNIVERSITY of FLORIDA

Drones or UAVs

Photo credit: Reuters

- Drone/UAV (unmanned aerial vehicle)
  an aircraft piloted by remote control
  and/or onboard computers
- Drone technology has expanded rapidly in the last several years
- Drones are a problem and a solution

Types of UAVs

Rotary wing or Copters

Pros	Cons
Vertical takeoff and landing	More mechanical and electronic complexity
Ability to hover, more maneuverability	Some decrease in payload and flight time
Lightweight, portable	Slower (not by much)

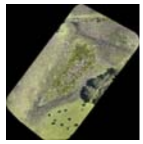
Fixed Wing

Pros	Cons
Simpler structure	Requires runway or launcher for takeoff and landing
Longer flight time and greater payload	Cannot hover
Faster (not much)	Typically more expensive

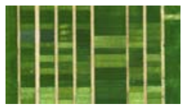



Applications in Landscape Mapping

- High resolution mapping (2D and 3D)
- Vegetation or Habitat Monitoring

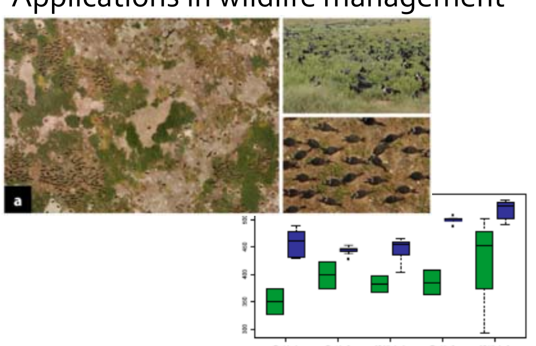


- Multispectral imaging of vegetation
- Damage assessments
  - invasive species, nutrient limitation, destruction



Applications in wildlife management

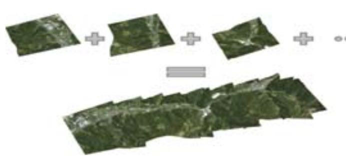
Applications in wildlife management



Florida Applications?

Our Overall Objective

1. Use a drone to conduct autonomous flights to collect aerial imagery
2. Mosaic georeferenced imagery for large area
3. Repeat to understand change overtime
4. Extract landscape features for analyses



Research Applications for Feral Swine

- Monitor size and repeat visitation of rooting impacts in wetlands and pastures
- Quarterly flights - 36 wetlands and24 pastures
- Quantify size of wetland and pasture areas impacted
- Assess temporal periods of rooting damage

Our Development (1st try)

DIY Open Source 3DR X8 Quadcopter (2014)

- Steep learning curve
- Complex electronics
- Designed for GoPro camera (fisheye lens)
- Installed a new gimbal with Canon SX260 PowerShot
- Used CHDK (Canon Hack Development Kit) scripts to trigger camera in flight
- Heavy short flight time (4-5 minutes)
- Unreliable image quality

....growth of drone technology rapid....

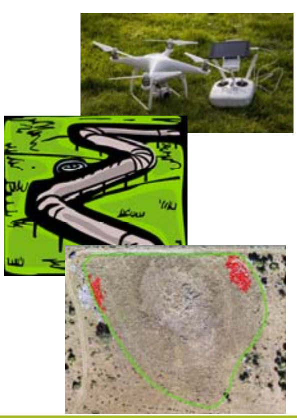
Our Development (2nd try)

Commercially Ready DJI Phantom 4 (2015)

- Easy to fly (manual and autonomous)
- Simple design and improved electronics
- Equipped with 3-axis gimbal and 12 MP camera
- i-Pad apps for manual flight and mission planning
- Built in FPV (first person view)
- Light long fly time up to 20 minutes
- Ability to land and swap batteries

!Data Pipeline!

1. Obtain UAV-derived imagery
2. Mosaic imagery
3. Geo-reference imagery to ground control points
4. Perform spatial analyses to quantify extent of rooted areas



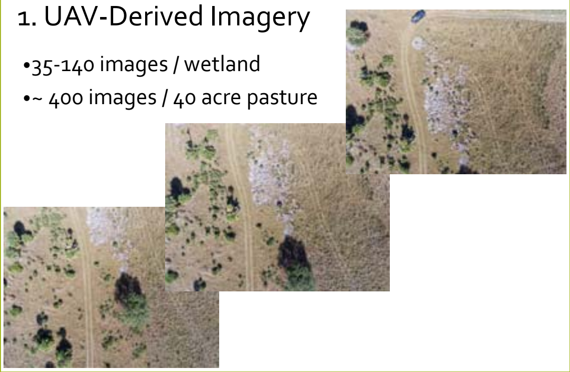
1. UAV-Derived Imagery

Map Pilot for DJI App

- Open app in the field (predefined cached layer of location to be flown)
- Zoom in on cached map and create flight polygon
- Set altitude (50m) , overlap % (75%), max speed (5m/s)
  2-2.5 cm pixel resolution
- Adjust flight path direction
- Save mission, upload flight, and press "Start"
- Repeat mission anytime

1. UAV-Derived Imagery

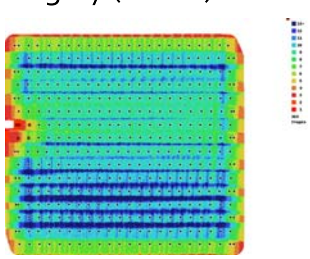
- 35-140 images / wetland
- ~ 400 images / 40 acre pasture



2. Mosaicking Imagery (online)

Maps Made Easy ®

- Online map processing site
- Raw images to jpegs (*Adobe PhotoShop*)
- Upload images, GPS EXIF tags help georeference
- Download mosaicked georeferenced image
- Provides an overlap report



2. Mosaicking Imagery

Wetland WL42 – 135 Images

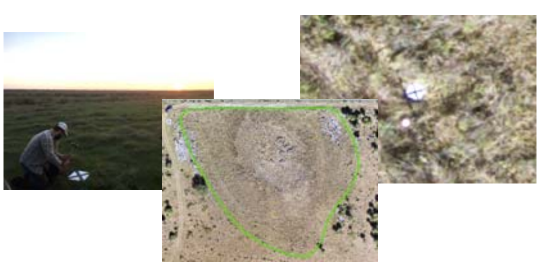
Pasture NG10 – 430 Images

Pasture NG01 – 421 Images

Wetland WL42

3. ArcGIS – Ground Control Points

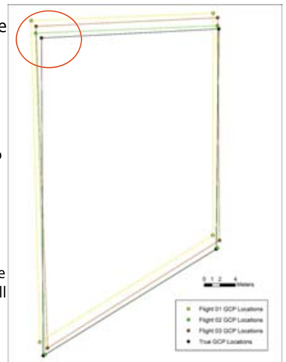
- Onboard GPS only so good, GCP reduce the error between flights



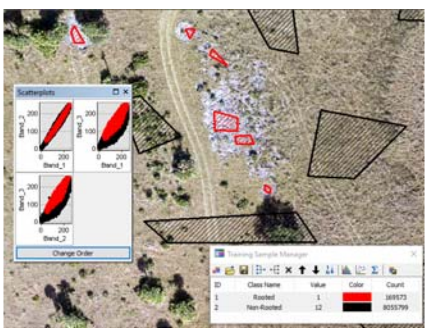
Ground Control Points

Repeated same flight to compare flight mosaic overlay and error.

- Trimble GCP locations
- Flight GCP locations digitized
- Average distance from flight GCP to Trimble GCP = 1.28±0.74 m
- Average percent error for GCP Polygons = 2.9%
- After geo-referenced to true Trimble locations flight mosaics overlaid well with <10 cm error



4. ArcGIS – Image Classification



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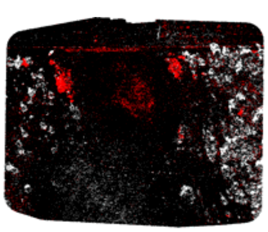
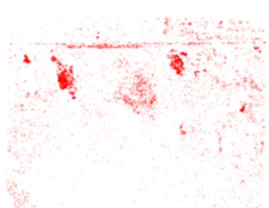
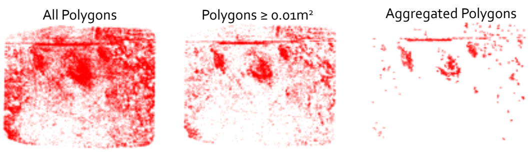




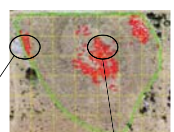
4. ArcGIS – Polygon Refinement

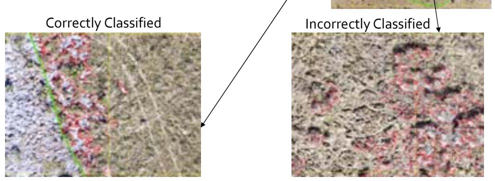
- Remove polygons < 0.01 m²
- Aggregate Polygons
  - Aggregation Distance = 30 cm
  - Minimum Area = 1 m²
  - Minimum hole size = 400 cm²



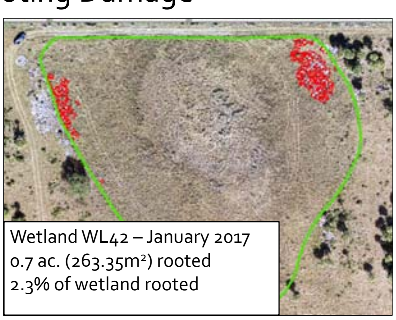
4. ArcGIS – Delete incorrectly-classified polygons

- Create fishnet (20m x 20m) to form grid
- View each grid cell at 1:150 map scale, verify if polygons are rooting





4. ArcGIS – Calculate Extent of Rooting Damage



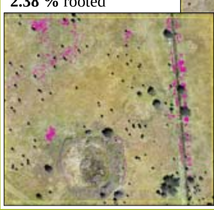
Wetland 42
2.83 ac / 1.15 ha

November 2016
3154 ft^2 / 293 m^2 rooted
2.56 % rooted

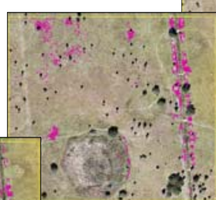
January 2017
3332 ft^2 / 310 m^2 rooted
2.70 % rooted

March 2017
3139 ft^2 / 292 m^2 rooted
2.55 % rooted

Pasture NG04
40 ac / 16.19 ha



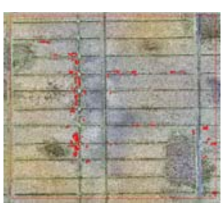
October 2016
41457 ft^2
3851 m^2
2.38 % rooted

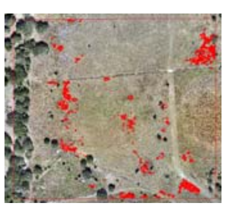


January 2017
56287 ft^2
5229 m^2
3.23 % rooted

March 2017
59830 ft^2
5558 m^2
3.43 % rooted

Economic Impacts





1. Rooting causes a 44% forage loss in area rooted at a minimum.
2. If 2% of an acre is rooted equates to $3.12 loss in possible calf production.
3. On a 5,000 acre ranch that is a $15,600 loss per year from 2% rooting.

Costs

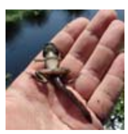
Equipment
- DJI Phantom 4 w/ 12MP camera - **$1,200**
- iPad for flight mission control - **$499**
- Adobe PhotoShop - **$9.99/month**
- ArcGIS for Desktop Advanced (non-commercial use) - **$100/year**

Storage and Processing
- 3 flights of our study design **1.3terrabytes** of space needed - **$200tb**
- Fast computer helps – Xeon processor- **$3,000**

Data
- Maps Made Easy Cost Breakdown
  - **For 40 acre pasture average $15**
  - Below 3.25 ac. (1.31 ha) area free

Major use of our datasets

1. Extent of rooting in wetlands and impacts on amphibian communities
2. Temporal periods of rooting damage across pastures and the cost to ranchers through loss of forage
3. Identification of repeated rooting locations
4. What is the reduction in rooting after feral swine control and what is the cost-benefit analyses of removal.



WHAT ARE HOGS EATING WHEN PERFORMING ALL OF THIS ROOTING THE GENETICS OF FECES!

Raoul K. Boughton, Bethany R. Wight, Wesley M. Anderson, Samantha Wisely, Mary L Morris Merrill, Elizabeth Boughton, Michael Robeson and Antoinette Piaggio
A collaborative study between University of Florida USDA APHIS NWRC, and Buck Island Ranch

Feral Swine Diet Objectives

- What do they eat?
- Collect fecal material over a full year
- Extract DNA
- Use sequencing and barcoding genes to determine species composition of each stool
- Using "Local Experts" define what the likely species actually is, as many species still missing from DNA databases
- How does diet change over season?

Disbursed Sampling Method

- 5 sectors defined
- 5 fresh fecal samples collected every 2 months
- Conduct sampling for at least 1 year
- Allows for seasonal diet preferences to be captured
- Minimum of 150 samples
- 204 actually collected

Next Generation Sequencing (fast)

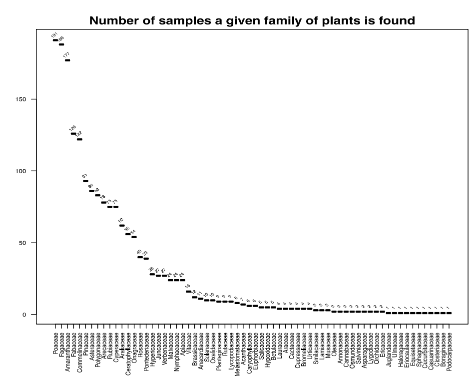
- DNA barcodes aim to provide rapid, accurate and automatable species identifications by using a standardized DNA region (usually part of a specific gene) as an identity tag.
  - By default a good barcode will vary across the species of interest (This is not always the case!)
- We used three barcoding genes to define species
  - Trnl - plants
  - CO1 – animals
  - 12S – better for amphibians
- Identification based on percent similarity of our sequenced DNA to a database (BLAST is the largest)

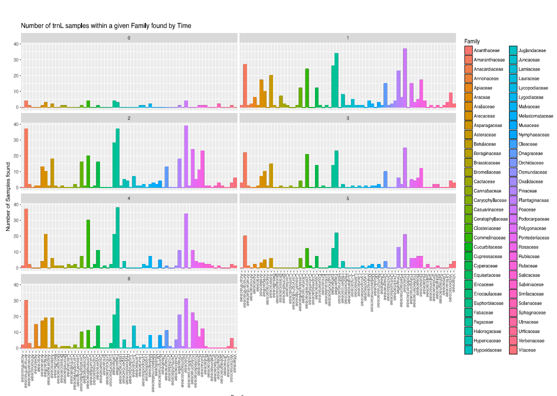
Percent Similarity Example

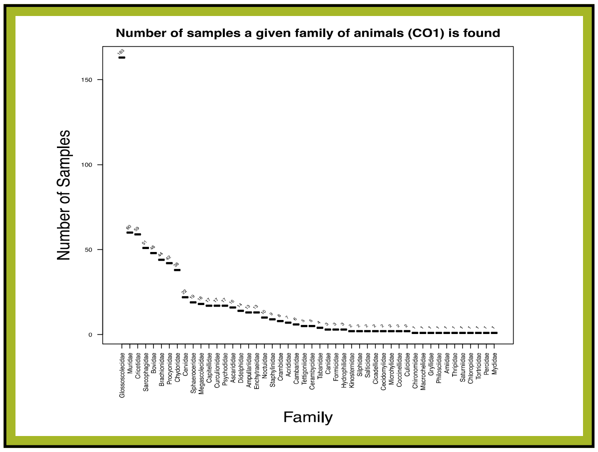
AA**T**CC**GC**TAG – our sequence
AA**A**CC**CT**TAG – BLAST database

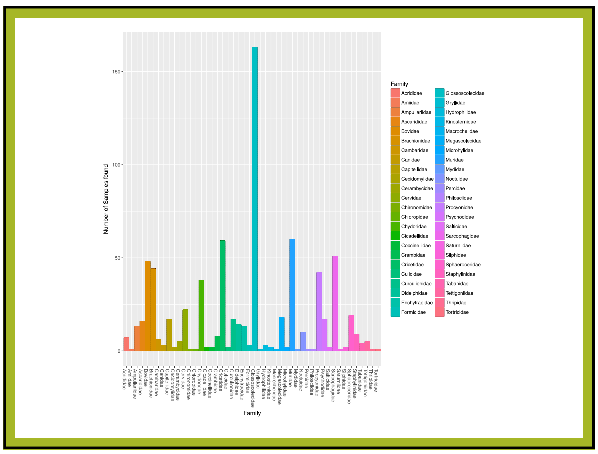
Of these 10 bases between the two sequence how similar are they?

7/10 70%






Number of samples a given family of animals (CO1) is found
Number of Samples
150
100
50
0
Family


150
100
50
0
Number of Samples found
Family


Questions?
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